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Adoption Of Green Building Practices And Rating System In Kenya: Potentials And Barriers

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Adoption of Green Building Practices and Rating System in Kenya:

Potentials and Barriers

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Biographical Sketch

Peter Khaemba obtained a Master of Science degree in construction management from Southern Polytechnic State University – Georgia in 2007; a Bachelors of Applied Science and Technology degree from Thomas Edison State College – New Jersey in 2006; and a Diploma in Building and Civil Engineering from Mombasa Polytechnic (renamed “Mombasa Polytechnic University College”) – Kenya in 1990.

Peter is a grants manager at the U.S. Agency for International Development (USAID) in Washington DC. Previously, he worked as a general engineer at the U.S. Department of Housing & Urban Development (HUD) in the State of Virginia (August to September 2011); program officer at the U.S. Department of Energy’s (DOE) energy efficiency and renewable energy/building technologies program in Washington DC (December 2009 to August 2011); federal career intern at the U.S. Environmental Protection Agency (EPA)’s office of air quality and planning standards in North Carolina (August 2008 to July 2009); and active duty military in the U.S, Navy (January 2003 to January 2008).

Peter also worked in Kenya as a property/facilities management officer at Kenya Revenue Authority (March 2000 to September 2002); building/civil engineering technician at Kenya Power & Lighting Company (June 1998 to March 2000); building/construction works superintendent at Kenya Posts & Telecommunications Corporation (March 1992 to June 1998); and architectural assistant at Ministry of Water Development (January 1991 to March 1992).

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List of Abbreviations

AAK	Architectural Association of Kenya
ACEEE	American Council for an Energy-Efficient Economy
ANOVA	Analysis of Variance
AREHF	African Real Estate and Housing Finance
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Measurement
BAS	Building automated system
BMS	Building Management System
BOD	Basis of Design
BORAQS	Board of Registration of Architects & Quantity Surveyors of Kenya
BREEAM	British Research Establishment Environmental Assessment Methodology
CASBEE	Comprehensive Assessment System for Building Environmental Efficiency
CBECS	Commercial Buildings Energy Consumption Survey
CFC	Chlorofluorocarbons
CFR	Code of Federal Regulations
CGP	Construction General Permit
CIBSE	Chartered Institution of Building Services Engineers
CoC	Chain of Custody
CRS	Center for Resource Solutions
CSI	Constructions Specifications Institute
DOE	United States Department of Energy

EA	Energy and Atmosphere
EAC	East African Community
EO	Executive Order
EPA	United States Environmental Protection Agency
EPAct	Energy Policy Act
EQ	Indoor Environmental Quality
ETS	Environmental Tobacco Smoke
FEMA	United States Federal Emergency Management Agency
FSC	Forest Stewardship Council
FTE	Full-Time Equivalent
GSA	United States General Services Administration
HCFC	Hydro-chlorofluorocarbon
HK-BEAM	Hong Kong Building Environmental Assessment Method
HVAC	Heating, Ventilation and Air Conditioning
IESNA	Illuminating Engineering Society of North America
IGBC	Indian Green Building Council
IPMVP	International Performance Measurement and Verification Protocol
IQSK	Institute of Quantity Surveyors of Kenya
ISO	International Standards Organization
LED	Light-emitting diode
LEED	Leadership in Energy and Environmental Design
MERV	Minimum efficiency reporting value
MOPW	Ministry of Public Works (Kenya)

MR	Materials and Resources
OPR	Owner’s Project Requirement
SCAQMD	South Coast Air Quality Management District
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SPSS	Statistical Package for the Social Sciences
SRI	Solar Reflectance Index
SS	Sustainable Sites
USDA	United States Department of Agriculture
USGBC	United States Green Building Council
VOC	Volatile organic compound
WE	Water Efficiency
ZEV	Zero-emission vehicle

Abstract

This research study was undertaken to identify (a) green building rating attributes that could be adopted for Kenya, and (b) barriers to initial adoption of green building practices and a green building rating system in Kenya. The study was primarily built on the premise of select rating and adoption attributes in existing green building standards, especially Leadership in Energy and Environmental Design (LEED). A pilot phase of the study was conducted using a combination of focus groups and personal interviews. The pilot findings became the basis of a questionnaire that was utilized to survey a sample of 608 registered building professionals in Kenya with a view of understanding their perspectives and awareness towards green building adoption. End-line data was interpreted using a combination of descriptive statistics, content analysis, and analysis of variance. Among other findings, this study revealed that 'energy and atmosphere' green building attributes have the highest potential, or likelihood, for adoption in Kenya. These were followed by 'water efficiency,' 'indoor environmental quality,' 'materials and resources,' and 'sustainable sites,' in that order. Further, the study revealed that lack of institutional support was the greatest barrier to adoption of green building in Kenya; followed by lack of regulatory and policy tools, socio-economic factors, and inadequate technical and awareness interventions, in that order. Statistically significant differences were noted in the mean responses for the demographic categories of (a) primary occupation, (b) sector of occupation, and (c) years of experience. This mixed method study was timely in providing a preliminary platform for developing green building guidelines and best practices that would be meaningful to the Kenyan building industry. Also, the findings would inform stakeholders about barriers that need to be overcome in order to accelerate green building adoption in Kenya.

CHAPTER 1

Introduction

The increasing adoption of green building practices is primarily driven by global efforts to build resilience to the negative impacts of the built environment on economic, environmental and social systems. Liu (2011) proclaims that the built environment has huge impact on the natural and social environment, resource consumption, indoor environmental quality, human health associated with it, and land use. According to Kibert (2005), building constructions are responsible for many health related issues such as sick building syndrome, building-related illness, and multiple chemical sensitivity which conventional constructions do not pay much attention to.

Since the detrimental effects of the construction practices on the natural environment were highlighted, the performance of the buildings has become a major concern for occupants and built environment professionals (Cooper, 1999; Crawley & Aho, 1999; Kohler, 1999; Ding, 2008). However, Horvath (1999) argues that the construction industry has not done enough to reduce its environmental footprint. Nevertheless, the industry has to support a world of continuing population and economic development while at the same time paying heed to the widespread social interest in environmental preservation (Horvath, 1999).

The U.S. Environmental Protection Agency (EPA) defines green building as "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. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort" (USEPA, 2010).

The green building movement offers an unprecedented opportunity to respond to the most important challenge of our time, including global climate change, dependence on non-sustainable and expensive sources of energy, and threats to human health (LEED, 2009). Kibert (2008) asserts that “the green building movement is the response of the construction industry to the environmental and resource impacts of the built environment.” Kozlowski (2003) defines a green building as one “that uses a careful integrated design strategy that minimizes energy use, maximizes daylight, has a high degree of indoor air quality and thermal comfort, conserves water, reuses materials and uses materials with recycled content, minimizes site disruptions, and generally provides a high degree of occupant comfort.” Kwong (2004) argues that the advantages of green building technologies include lower maintenance costs, lower utility cost, increased productivity associated with better air quality and quality of life factors, and increased prestige. Previous studies have also shown that the building sector has the largest potential for greenhouse gas emissions reduction worldwide (Granada et al., 2009; UNEP, 2007).

In the U.S. alone, the value of green construction starts grew by 50% between 2008 and 2010, and represented more than 25% of the market for new construction at the beginning of 2012 (McGraw-Hill, 2012). It was further reported that non-residential green building activity in the U.S. is expected to triple in five years when it will represent 40% to 48% of new construction, and $14 to $18 billion in major retrofit and renovation projects. The market is expected to more than double to $6.4 billion between 2011 and 2017 (McGraw-Hill, 2012). These strides are attributable to the significant research that has been conducted to determine the financial benefit of adopting green building technologies (Eichholtz, Kok, & Quigley, 2009; Fuerst, 2009; Miller, Spivey, & Florence, 2008; Wiley, Benefield, & Johnson, 2010). A study conducted by Kats (2003) found that the financial benefits of green buildings are ten times their initial cost premium.

1.1 Green Building Rating Systems

In response to the concern of reducing environmental impact of the design and operation of buildings, many researchers have developed methods for measuring environmental performance of buildings with the intention of creating a sustainable built environment (Crawley & Aho, 1999; Blom, 2004). Green building rating tools are also referred to (but not limited to) as green building rating systems (Yudelson, 2007), building environmental assessment systems (Cole, 1998; Gomes, 2007), and environmental assessment tools (Blom, 2004). Fowler & Rauch (2006) describe a green building rating system as a tool that is useful for evaluating buildings to determine how ‘green’ they are.

The Florida Green Building Coalition proclaims that “green rating systems offer methods of certifying and scoring the environmental stewardship of a project” (FGBC, 2012). These tools enhance the environmental awareness of building practices and provide fundamental direction for the building industry to move toward environmental protection and the achievement of sustainability (Ding, 2008). They also provide a way of showing that a building has been successful in meeting an expected level of performance in various declared criteria (Cole, 2005). Their adoption and promotion has had a major contribution to creating a market demand for green buildings and has significantly shifted the public’s awareness and perceptions of what building quality is (Cole, 2005).

According to Reeder (2010), using a green building rating system provides designers, constructors, and owners with a metric to verify the sustainability of their projects. Reed, Bilos, Wilkinson, and Schulte (2009) assert that many countries have created organizations that are responsible for developing standards for constructing a sustainable built environment and also to rate their buildings' effectiveness in obtaining this goal. This is confirmed by the increasing number of people demanding information on environmental aspects of buildings, such as whether or not a building is good for their health or it fits into a sustainable society (Carlson & Lundgren, 2002).

Several other studies have stressed the importance of developing guidelines or tools that will provide a systematic approach to achieving sustainability in the built environment (Bebbington & Gray, 2001; Hemphill, McGreal, & Berry, 2002; Nobe & Dunbar, 2004; Wyatt, Sobotka, & Rogalska, 2000). Regardless of how these guidelines are designed, they all define sustainability as a component of three primary parts: environmental, economic and social (Rodriguez, Roman, Sturhahn, & Terry, 2002). In this context, Kaatz, Barker, Hill, and Bowen (2002) reiterate that rating tools created for developing countries, which have more pressing social and economic concerns, need to reflect such concerns.

A typical rating system is made of various credit categories such as ecology, energy and water use, waste management, indoor environment, external pollution, transport impacts, innovation, methods of design, construction and operations. A building that achieves the necessary points in each category is awarded a certification level based on the requirements of the rating system. Such a building is then considered to be "green," "sustainable" or "high performance."

According to the U.S. EPA, a green building is also known as a sustainable or high performance building (USEPA, 2010). McGraw-Hill (2007) states that high performance green buildings are "green" or "sustainable" buildings which exhibit maximum energy efficiency of envelope, mechanical and lighting systems coupled with improved indoor environmental quality to enhance occupants' well-being. Yudelson (2008) defines a green building as "a high performance property that considers and reduces its impact on the environment and human health." For the purpose of this study, the terms, 'green building,' 'sustainable building,' and 'high performance building' are used interchangeably. Also used interchangeably are the terms, 'building' and 'construction.'

1.2 Leadership in Energy and Environmental Design (LEED) Rating System

The Leadership in Energy and Environmental Design (LEED) rating system is a pioneering green building standard that was established by United States Green Building Council (USGBC) in 1998 and introduced into the market in 2000. Since then, it has been gradually adopted for use in the U.S. and in various other countries. A press release from USGBC on January 19, 2012 indicated that LEED is the internationally recognized mark of building excellence, with more than 44,000 commercial projects participating, comprising over 8 billion square feet of construction space in all 50 states of U.S. and 120 countries. In addition, more than 16,000 homes have been certified under the LEED for Homes rating system, with more than 67,000 more homes registered (USGBC Press, 2012). Also, LEED provides reference for development of a base of expertise to design, apply and operate high performance buildings.

More than 170,000 people now have received LEED credentials and opportunities continue to grow for people who want to learn to apply green technologies and improve energy efficiency (HPB, 2012). As of February 2012, there were over 35,000 LEED-registered projects out of which more than 10,500 projects were certified at different levels (USGBC, 2012). This is a huge increase compared to 2006 data when there were only 623 LEED-certified buildings (Howe & Gerrard, 2010). According to Kibert (2005), these numbers are rising exponentially.

Various federal, state and local governments in the U.S. have adopted the LEED rating system as the baseline tool in their pursuit and development of green building programs and initiatives (Policy and Government, 2012). LEED initiatives including legislation, executive orders, resolutions, ordinances, policies, and incentives are found in 442 localities (384 cities/towns and 58 counties and across 45 states), in 34 state governments (including the Commonwealth of Puerto Rico), in 14 federal agencies or departments, and numerous public school jurisdictions and institutions of higher education across the United States (Policy and Government, 2012).

As of May 2012, government owned or occupied LEED buildings made up 27 of all LEED projects by count. The federal government had 826 certified projects and another 3,942 pursuing certification. State governments had 911 certified projects and 1,845 pursuing certification. Local governments had 1,449 certified projects and 3,026 pursuing certification. Tribal governments had 5 certified projects and 23 pursuing certification (Policy and Government 2012).

As a way of ensuring that their buildings embody the U.S. commitment to global environmental stewardship, the U.S Department of State has adopted LEED guidelines for its facilities within the U.S. and outside the continent. The Bureau of Overseas Building Operations (OBO) at the U.S. Department of State describes LEED as "an internationally recognized certification system that measures how well a building or community performs across all the metrics that matter most: energy savings, water efficiency, carbon dioxide (CO_2) emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts" (OBO, 2012).

As of June 2012, ten U.S. embassies overseas had earned LEED certification. These were: Antananarivo (Madagascar), Brazzaville (Republic of Congo), Dubai (United Arab Emirates), Johannesburg (South Africa), Lusaka (Zambia), Monrovia (Liberia), Ouagadougou (Burkina Faso), Panama City (Republic of Panama), Sofia (Bulgaria), and Tijuana (Mexico) (OBO, 2012). As LEED certification has become a coveted symbol of environmental responsibility, the Bureau has required all U.S. embassies to earn this certification (OBO, 2012). Obviously, this requirement also applies to the U.S. Embassy in Nairobi, Kenya, which falls within the scope of this research.

An interview with J. Kwan (personal communication, December 6, 2010) of USGBC revealed that Canada, China, Italy, and India used LEED as a baseline to frame green building guidelines for their respective country contexts. For instance, USGBC entered into a licensing agreement with the Indian Green Building Council (IGBC) in 2004 to develop LEED guidelines for India (IGBC, 2010).

The increasing acceptance of the LEED rating system nationally and internationally attests that although it was developed in the U.S. and for the context of the U.S., the system is a potential sustainability benchmark upon which other countries, including Kenya, can frame green building guidelines according to the their respective building design and construction contexts. USGBC (2011) proclaims that “LEED was designed to encourage and accelerate global adoption of sustainable green building and development practices through the creation and implementation of universally understood and accepted standards, tools, and performance criteria.”

Other major green building rating systems that have national and international adoption include: British Research Establishment Environmental Assessment Method (BREEAM) in the

United Kingdom; Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) in Japan; Green Star in Australia; Hong Kong Building Environmental Assessment Method (HK-BBEAM) in Hong Kong; SBTool in Canada; and Green Globes in Canada and the U.S. (Reeder, 2010).

1.3 Rationale for the Study

As green building rating systems continue to permeate the building industry globally, the pilot phase of this study revealed that there was no green building rating system for Kenya as of that time. However, based on the information garnered from the pilot study, there was an apparent interest in green building practices in the country. One pointer of this interest was the proceedings of the "Conference on promoting green building rating in Africa" that was convened at the UN-Habitat in Nairobi on May 4-6, 2010. The conference participants ranged from designers, builders and planners to educators, lawyers and leaders from non-governmental organizations (UN-Habitat, 2010). In this conference, experts, practitioners and decision makers from twenty African countries, including Kenya, were enlightened on the need to promote and foster green building practice in Africa (UN-Habitat, 2010). The objectives of the conference were to: 1) make commitments, and develop the elements of strategies and roadmaps, for promoting green building and green building rating in participants' countries or sub-regions in Africa, 2) develop the outline for a proposed Africa-wide Network, in order to facilitate ongoing communications and exchanges between champions of green building in different parts of Africa, and 3) provide recommendations to UN-Habitat and its partners and counterparts regarding future support for green building efforts in Africa (UN-Habitat, 2010).

In addition to the UN-Habitat conference, the pilot study identified isolated cases of projects that virtually indicated that the Kenyan building sector was tending towards embracing green practices. Pointers to this included the initiatives that had been taken, or were being taken, to incorporate green features into buildings; especially within Nairobi – the capital city of Kenya. Case study examples of these “green initiatives” are presented later in this report and include: (a) The UN Complex at Gigiri – an office building facility which houses the headquarters of both the United Nations Environmental Programme (UNEP) and the United Nations Human Settlements Program (UN-Habitat; UN Nairobi, 2011); (b) The Green House –an upcoming commercial complex located along Ngong Road next to Adams Arcade (Greenhouse, 2012); (c) School of Business Studies – Strathmore University, Nairobi (Strathmore Business School, 2012); and (d) Fedha Plaza – a modern commercial building in Westlands (Fedha Plaza, 2012). These green initiatives in Kenya seemed to have gained recognition both at national and international levels. For instance, the UN Complex was opened on March 31st 2011 by UN Secretary-General Ban Ki-Moon and Kenyan President Mwai Kibaki (UN Nairobi, 2011). However, these initiatives were not based on any green building rating standard.

Despite the apparent positive trend toward embracing green building in Kenya, lack of a structured approach and/or formalized method for defining a green building in the context of the local building practices remains a deterrent factor to the sector’s transition from conventional to sustainable building practices. This study therefore plays a crucial role in attempting to bridge this gap.

1.4 Objectives of the Study

This study sought to identify (a) green building rating attributes that could be adopted for Kenya, and (b) barriers to initial adoption of green building practices and a green building rating system in Kenya. These objectives form the core theme of the study, which was primarily built on the premise of select rating and adoption attributes of existing green building standards – especially the Leadership in Energy and Environmental Design (LEED).

1.5 Research Questions

According to Creswell (2003), research can be framed into research objectives and questions. The objectives of this study were therefore achieved by pursuing the following primary research questions:

Research Question 1: What green building rating attributes are applicable to Kenyan building industry, as identified and validated in this research?

Research Question 2: What is the likelihood of adopting certain green building rating attributes and what is their level of importance, as perceived by Kenyan building professionals?

Research Question 3: Are there any statistically significant differences in perceived importance of certain green building rating attributes among Kenyan building professionals with differing primary occupations, sectors of occupation, and years of experience?

Research Question 4: What are the barriers to adoption of green building practices in Kenya and what is their level of importance, as perceived by Kenyan building professionals?

Research Question 5: Are there any statistically significant differences in perceived importance/severity of barriers to adoption of green building practices and rating system among Kenyan building professionals with differing primary occupations, sectors of occupation, and years of experience?

Additionally, the study pursued one secondary research question, ‘What sources of information are potentially useful for promoting awareness of green building in Kenya?’

1.6 Limitations

The scope of this study was constrained by the following limitations:

1. The target population consisted of 1,238 building professionals who were listed as members of the Board of Registration of Architects & Quantity Surveyors of Kenya (BORAQS) as of August 31, 2012. The sample size was, however, limited to only 608 professionals that had an email address on their registration profiles.
2. Only 347 survey responses that were received by the data collection deadline of December 31, 2012, and usable, were analyzed for the purpose of the study.
3. Due to the geographic dispersion of the study participants and desire to be as environmentally friendly as possible, data for the main phase of the study was only collected by means of an electronic survey.
4. The LEED reference was only based on the 2009 New Construction and Major Renovation guideline. Other LEED reference guidelines were not considered for the purpose of the study.
5. Questions in the research instrument were based on a paradigm of a typical commercial building in an urban location of Kenya, such as municipality or city.

1.7 Assumptions

The following underlying assumptions were made with respect to this study:

1. The ultimate results would be generalized across all commercial buildings in urban areas of Kenya.
2. The survey instrument adequately addressed all the prescribed research questions.
3. Data collected from research subjects was a true representation of the survey respondents' awareness and perspectives.
4. When completing the survey, respondents were not biased by any desired outcome of the study.

1.8 Significance of the Study

First, this study focused on identifying salient green building attributes that could be adopted as a platform for developing a meaningful green building rating system for the context of Kenya without necessarily reinventing the wheel of other green building rating systems. Essentially, the identified green building attributes are the low-hanging fruits that would be adopted to frame green building guidelines for Kenya. Secondly, the study unveiled barriers that must be overcome in order to pave way for initial adoption of green building practices and a green building rating system in Kenya. In sum, these findings are invaluable for Kenyan building industry stakeholders in developing a roadmap to enhance adoption and uptake of green building practices by means of a scalable green building rating system. Beyond Kenya's boundaries, this study provided a template that could be used to create green building standards and best practices in countries where economic, environmental and social geographies are similar to those in Kenya.

This study is also expected to guide future research efforts dedicated to inquiry on similar subjects. In arguing that the construction industry has not done enough to reduce its environmental footprint, Horvath (1999) asserts that concerted national and international research and educational efforts are therefore needed to change the situation.

1.9 Definition of Terms and Acronyms

The following terms and acronyms, used throughout this study, are interpreted using the following definitions:

<u>Commercial building:</u> Buildings which include, but are not limited to, offices, retail and service establishments, institutional (libraries, schools, museums, churches, etc.), hotels and residential buildings of four or more habitable stories (LEED, 2007).

Environmentally responsible: Products or services that have a lesser or reduced effect on human health and the environment when compared with competing products or services that serve that same purpose. This comparison may consider raw materials acquisition, product, manufacturing, packaging, distribution, reuse, operation, maintenance, or disposal of the product or service (EO 13423, 2011).

Green building: The Office of Federal Environmental Executive (OFEE) defines Green Building as a method of increasing the effectiveness with which “buildings and their sites use energy, water, and materials, and reducing building impacts on human health and the environment, through better siting, design, construction, operation, maintenance , and removal to the complete building life cycle (OFEE, 2009).

Green building rating system: Metrics for assessing the environmental performance of new and existing buildings (Reeder, 2010).

High-performance building: A building that integrates and optimizes on a life-cycle basis all major high performance attributes including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations (EISA, 2007).

Kenya: Officially the Republic of Kenya is a country in East Africa. Lying along the Indian Ocean to its southeast and at the equator, it is bordered by Somalia to the northeast, Ethiopia to the north, Sudan to the northwest, Uganda to the west and Tanzania to the south. The country lies between latitudes 5^{o}N – 5^{o}S, and longitudes 34^{o}E – 41^{o}E. Lake Victoria is situated to the southwest, and is shared with Uganda and Tanzania (Kenya, 2010).The map of Kenya is shown in Appendix A.

LEED: Leadership in Energy and Environmental Design (LEED) is a voluntary, consensus-based, market-driven building rating system developed by the United States Green Building Council. The goal of LEED is to evaluate environmental performance from the whole building perspective over the building's lifecycle, providing definitive standard for what constitutes a green building" (USGBC, 2010).

Sustainable: To create and maintain conditions, under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and other requirements of present and future generations (EO 13514, 2009).

Sustainable construction: An integration of environmentally and energy efficient design, construction, operation, and demolition. Additionally, sustainable structures are built to limit energy use, create a healthy indoor environment, conserve resources and material, and improve the building's long term durability (Mead, 2001).

USGBC: The U.S. Green Building Council (USGBC) is a non-governmental agency which is self-described, committee-based, member-driven, and consensus-focused. The USGBC has developed and promotes the LEED green building rating system as a means of transforming the market so that green buildings become accepted as commonplace.

1.10 Organization of the Study

Chapter 1 presents an introductory background about green building; green building rating systems; and Leadership in Energy and Environmental Design (LEED) rating system. It further discusses the rationale for the study; objectives; research questions; limitations; assumptions; significance; and definitions of terms and acronyms.

Chapter 2 discusses the results of an extensive review of literature related to the theme of research. After the introduction, the chapter provides an overview of what sustainable building means. This is followed by discussions on roles of key players in the Kenyan building industry; summary examples of green initiatives in Kenyan building industry; and adoption and rating attributes of LEED green building system. This chapter further looks at 'benchmarking LEED rating system criteria versus typical Kenyan building practices'; 'adoption of the LEED green building guidelines outside of the U.S. – case study of LEED-India'; and 'other major international green building rating systems including the World Green Building Council.' The chapter concludes with a summary of lessons learnt from the review of literature.

Chapter 3 outlines the research methodologies that were employed for data collection. This includes genesis of research agenda; rationale for research design; rationale for research strategy; rationale for focus group research technique; and triangulation process. This chapter further discusses the variety of processes that were employed including instrument development; instrument validation; population and sample selection; instrument pilot-testing; reliability of measures; data collection procedures; data analysis procedures; and summary of methodology.

Chapter 4 presents a detailed analysis of data collected and results. This includes demographic profile of survey respondents, analysis of research questions, and summary.

Chapter 5 concludes the study by presenting the summary; restatement of research questions and findings; implications and further discussions; and limitations and recommendations for future research directions.

References are provided at the end of this research report followed by appendices.

CHAPTER 2

Literature Review

2.1 Introduction

This chapter presents a review of literature that provided a theoretical basis for the study. For ease of reference, the chapter is organized into eight sections. The first section defines sustainable building in regard to three pillars of sustainability: economic, environmental, and social. The second section provides an overview of key players in the Kenyan building industry, including the roles of the Ministry of Public Works of Kenya (MOPW) and the Board of Registration of Architects and Quantity Surveyors of Kenya (BORAQS). Case summaries of green initiatives in Kenyan building industry are presented in the third section.

Leadership in Energy and Environmental Design (LEED) green building rating system, and its adoption and rating attributes are discussed in the fourth section. The fifth section presents a detailed comparison of the LEED rating system criteria versus the typical context of building practices in Kenya. This is followed by a discussion on adoption of LEED green building rating system in other countries, using LEED-India as a case study. The seventh section looks at other major international green building rating systems including an overview of the World Green Building Council. A summary of literature covered in this chapter is presented in the eighth section.

2.2 Defining Sustainable Building

Sustainability can be defined in many ways depending on one's perspective. "Definitions of and approaches to sustainability vary depending on the view and interest of the definer, but each emphasizes that activities are ecologically sound, socially just, economically viable and humane, and that they will continue to be so for future generations" (Clugston & Calder, 1992).

According to section 19(l) of the U.S. Executive Order 13514 dated October 5, 2009, "sustainability" and "sustainable" mean "to create and maintain conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and other requirements of present and future generations" (EO 13514, 2009).

From the development perspective, a report of the World Commission on Environment and Development (1987) defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). The Development Assistance Committee (DAC) of the Organization for Economic Co-operation and Development (OECD), stated that "sustainable development means integrating the economic, social and environmental objectives of society, in order to maximize human well-being in the present without compromising the ability of future generations to meet their needs" (OECD, 2001).

Tietenberg (2003) defines sustainability criterion as "a criterion that judges the fairness of allocations of resources among generations, and generally requires that resource use by any generation, or time period, should not exceed a level that would prevent future generations from achieving a level of well-being at least as great." In regard to the built environment, this pertains to resources such as occupant comfort, health, productivity, etc. that impact the society's well-being either directly or indirectly due to the existence of a building or buildings.

Elkington (1997) developed the triple bottom line (TBL) approach in the 1980s as a platform to report and measure organizational performance with respect to the three dimensions of sustainability – economic, environmental and social. According to Schultz (2010), a sustainable solution must be economically viable, environmentally bearable, and socially equitable. This TBL concept is illustrated in Figure 2.1 and it implies that a sustainable building is required to be economically and environmentally viable; environmentally and socially bearable; and socially and economically equitable.

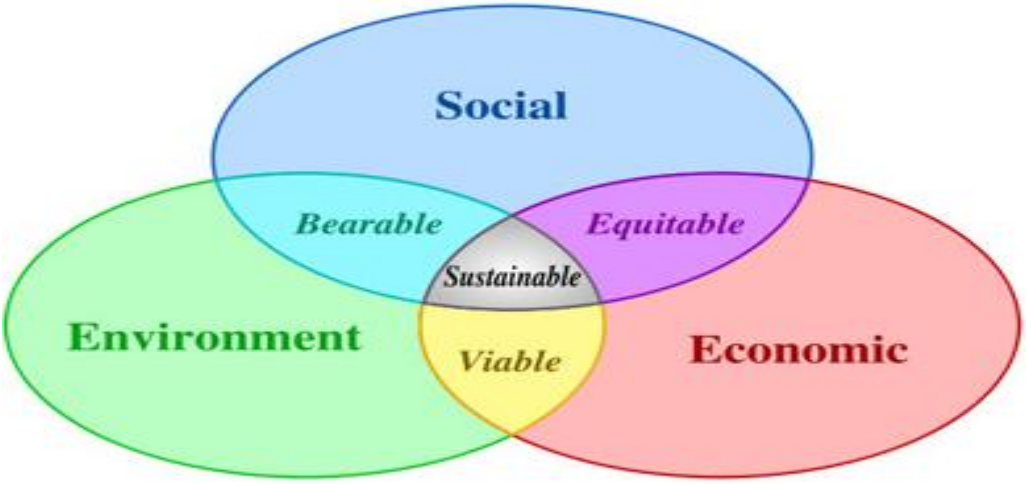

Figure 2.1. Triple bottom line of sustainability.

2.2.1 The need for sustainable building. Buildings across the world emit 40% of all global CO_2 emissions into the atmosphere, one of the main components for the phenomenon of global warming (Yudelson, 2007). The fact that most of the materials used in construction are procured from far off places adds to the carbon footprint of the building due to the transportation involved. Buildings are also responsible for over 10% of the world's freshwater withdrawals, 25% of its wood harvest, and 40% of material and energy flows (Kibert, 2005). Furthermore, the construction industry generates 8-20% of the total municipal solid waste (Augenbroe & Pearce, 1998; Fisk, 2000). This is in addition to wastes from construction that end up in landfills causing potential destruction to the environment surrounding the landfill area. Looking at the U.S. for instance, buildings account for 39% of its total energy use, 72% of electrical consumption, 38% of all CO_2 emissions, 40% of raw materials use, 30% of waste output, and 14% of potable water consumption (USGBC, 2008).

Sustainable or green building can help mitigate the growing list of problems associated with the footprint of conventional buildings. According to USGBC, green buildings can help to minimize this negative impact on the environment, and improve occupant health and productivity. For instance, green building advocates for making the building more energy efficient, thus reducing the energy consumption. It further advocates for use of clean renewable energy such as solar and wind instead of conventional sources of energy such as fossil fuels and coal. Benefits of this include reducing the building's dependence on the grid, and overall promotion of an eco-friendly built environment (LEED, 2007). In simple terms, sustainable or green building is a method of increasing the effectiveness with which "buildings and their sites use energy, water, and materials, and reducing building impacts on human health and the environment, through better siting, design, construction, operation, maintenance, and removal to the complete building life cycle" (OFEE, 2009).

Winchip (2005) defines sustainable design as "design that focuses on products and processes that protect the environment while conserving energy for future generations." A study conducted by Shelbourn et al. (2006) revealed that the ability to introduce sustainability into any design process encourages sustainability behavior of the clients, the contractor, and end-users, which is a demonstration of the day-to-day advantages inherent in a sustainable project. Augenbroe and Pierce (2000) argue that, based on sustainability demands from end users and a continuous awareness of its effects on the environment, the construction industry is increasingly challenged to demonstrate its commitment to the environment. Thus industry stakeholders across all nations must embrace sustainability.

Kibert (2005) asserts that sustainable built environment involves "creating and operating a healthy built environment based on resource efficiency and ecological design." Beyond reducing the negative environmental impact of human habitation on the planet, more radical efforts at sustainability strive to make human intervention a net benefit for the planet by creating buildings that are net producers of energy and that serve the environment by incorporating strategies such as minimizing demolition and waste by making buildings of parts that can be re-used in different configurations as needs change (McDonough & Braungart, 2002).

The U.S. EPA highlights the environmental, economic, and social benefits of green building as summarized in Table 2.1. These benefits need to be demonstrated across the entire life-cycle of the building: thus planning, design, construction, operation, deconstruction and demolition.

Table 2.1

Summary of Environmental, Economic, and Social Benefits of Green Building

Type	Benefits
Environmental Benefits	• Enhance and protect biodiversity and ecosystems • Improve air and water quality • Reduce waste streams • Conserve and restore natural resources
Economic Benefits	• Reduce operating costs • Create, expand, and shape markets for green product and services • Improve occupant productivity • Optimize life-cycle economic performance
Social Benefits	• Enhance occupant comfort and health • Heighten aesthetic qualities • Minimize strain on local infrastructure • Improve overall quality of life

Source: U.S.EPA, 2012)

2.3 Key Players in the Kenyan Building Industry

According to the Ministry of Public Works of Kenya (MOPW), the construction industry is the engine of infrastructure development in the country (MOPW, 2012). Furthermore, the industry has experienced substantial growth since the country's independence in 1963. For example in the period 1998 – 2008 whereas the Gross Domestic Product (GDP) grew by 135.1%

the construction output grew by 406.1% (MOPW, 2012). This effort is attributable to various key players, or actors, whose generic roles are highlighted in this section.

2.3.1 Architects. In the context of Kenya, an architect – in consultation with engineers – ensures that the buildings are structurally sound, properly energized through proper electrification systems, fully serviced with clean water and properly drained of foul and waste water. An architect also works in consultation with the Quantity Surveyor to control the building construction costs, through the choice of appropriate materials and construction method (AAK, 2012).

Duties of an architect largely include but are not limited to (AAK, 2012):

1. Receiving instructions from building developers and preparation of sketch proposals on the basis of which feasibility study can be carried out.
2. Preparing feasibility studies on building developments.
3. Carrying out schematic designs and submission of the drawings to local authorities for approval on behalf of developers.
4. Carrying out detailed designs of buildings and prepare drawing on the basis of which Bills of Quantities can be prepared for tender action.
5. Supervising building construction works during the construction period.
6. Coordinating the activities of all other consultants in any given building project.
7. Acting as an arbitrator between the developer and the building contractor in case of any disputes during or after the construction period.
8. Carrying out project management on behalf of clients.

2.3.2 Quantity surveyors. Quantity Surveyors, also synonymously referred to as "building economists," provide an invaluable role in the construction process. According to BORAQS (2012), a Quantity Surveyor's work in Kenya includes:

1. Preliminary cost advice and approximate estimating.
2. Cost planning including investment appraisal, life-cycle costing and value engineering.
3. Contractual procurement and tendering procedures.
4. Preparation of contract documents.
5. Evaluation of tenders.

2.3.3 Contractors. The MOPW maintains a log of registered contractors in Kenya (MOPW, 2011). There are contractors of all categories ranging from labor-based contractors for simple jobs to those with the most advanced equipment in the market today and a capital base of millions of US dollars. The National Construction Authority Act (2011) recognizes the following classes of contract works in Kenya:

1. Building works: General building contractor, carpentry/joinery, painting, masonry, reinforced masonry, and specialized building.
2. Civil engineering works: Roads, structural work, borehole, site investigation, and sewer.
3. Electrical engineering services: Electrical installation, electronic services, lift hoists, escalators, mechanical ramps, conveyor belts, generating plant systems, solar power systems, uninterrupted power supply systems (UPS), automatic voltage regulators (AVR), surge protectors, power transmission lines, and power distribution equipment.
4. Mechanical engineering services: Plumbing, drainage, sanitary fittings, laundry equipment, refrigeration, cold rooms, air conditioning and ventilation, boilers, incinerators, solar heating systems, water tanks, rainwater harvesting equipment,

compressed air and hydraulic systems, cranes and hoists, fire engineering services, swimming pools, hospital equipment, etc.

In Addition, international cooperative agreements such as the USA-Kenya Chamber of Commerce foster investment in Kenya by foreign contracting companies (Gitau, 2011).

2.3.4 Engineers. In Kenya, an engineer typically works with the architect to provide essential services such as structural, civil, mechanical, and electrical engineering designs (Gitau, 2011). With the increasing trend toward green building, environmental engineers are definitely another important group of professionals to mention.

The Kenya Engineers Registration Board is a statutory body established through an Act of Parliament in 1969 to regulate activities and conduct of practicing engineers in Kenya. A minor revision was done to the Act in 1992, to accommodate Technician Engineer grade. In 2011, the Act was amended to create the Engineers Board of Kenya as a measure of strengthening the roles of Kenyan engineers (EBK, 2012).

2.3.5 Environment experts. In the earlier days, projects in Kenya were constructed without much regard to the sustainability of the construction industry or care for the environment. However, with the increasing calls to embrace sustainability across all sectors, the role of environmental champions in the Kenyan building industry is becoming more evident and necessary. Construction projects require huge amounts of the Earth’s natural resources and it is, therefore, necessary to protect the environment form the vagaries of the industry. Environmental experts assess projects and draw environmental impact assessment with a view to minimizing the negative effects while enhancing the positive ones (Gitau, 2011).

2.3.6 Material suppliers. Material suppliers play an important role in Kenyan building industry. This group of stakeholders range from cement factories, stone quarries, transportation companies to material vendors – commonly known as “hardware.” Mostly run by Asian immigrants, “hardware” business is a booming investment in Kenya. In a typical “hardware,” one would find a variety of building materials – whether imported or locally manufactured. Materials such as paints, glass, cement, steel, plastic and ceramic wares are all manufactured locally in most parts of the country (Gitau, 2011).

2.3.7 Property Managers. Property managers play the role of custodian for the completed building or facility. They are responsible for operations, repair and maintenance of the building. Property managers conduct surveillance activities over post-occupancy projects performed by contractors and in-house building trades. Other assignments include review of project plans and specifications for workability, estimation of material and labor costs, participation in sourcing of materials and services, and development and implementation of building maintenance programs. Although the responsibilities of a Kenyan property manager are mostly similar to a “facility manager” or “facility operation specialist” in the U.S., the former can wear several other titles such as “building technician” or “building superintendent.” For instance, the researcher of this dissertation worked as a regional building superintendent for Kenya Posts and Telecommunications Corporation from March 1992 to June 1998; regional building technician for Kenya Power and Lighting Company from June 1998 to March 2000; and regional property manager for Kenya Revenue Authority from March 2000 to September 2002.

2.3.8 Financiers. Various financial institutions are available in Kenya where investors may obtain financing from banks, non-governmental organizations, public and private pension funds, financial and insurance companies, etc. Of particular interest to the building industry are mortgage companies which are created purposely for the building industry. World Bank, African

Development Bank, and bilateral aid agencies also finance projects through loans and grants to the government and non-governmental organizations (Gitau, 2011).

2.3.9 Local authorities. According to Gitau (2011), building standards and regulations in Kenya exist in five documents namely: the Building Codes (1968), the Public Health Act (1972), Local Government Act (1977), the Revised Building By-laws (1995), and Physical Planning Act (1996). The local authorities are responsible for enforcing these building standards and regulations (Gitau, 2011).

In the housing sector, the National Housing Corporation of Kenya (NHC) assists the society and local authorities in building decent affordable houses through the Corporation’s various schemes such as tenant purchases, outright sales, rural and peri-urban housing loans, and rental housing (NHC, 2012). NHC is a statutory body established by an Act of Parliament Cap. 117 in 1967, and is mandated with the principal role of implementation of government housing policies and programs (NHC, 2012).

2.3.10 Ministry of Public Works. The Ministry of Public Works in Kenya is charged with the responsibility of planning, designing, construction and maintenance of Government assets in the field of built environment and infrastructure development. Assets in built environment include hospitals, schools, colleges, technical institutes, prisons and courts. Assets in infrastructure development include footbridges, sea walls, breakwaters and jetties (MOPW, 2013). The Ministry’s portfolio includes (MOPW, 2013):

1. Formulation of public works policies.
2. Planning of public works.
3. Development and maintenance of public buildings.
4. Maintenance of inventory of Government property.

5. Provision of mechanical and electrical (building) services.
6. Coordination and procurement of common-user items by Government Ministries.
7. Overseeing of activities at the Kenya Building Research Centre.
8. Registration of contractors and material suppliers.
9. Registration of civil, building and electromechanical Contractors.
10. Registration of architects and quantity surveyors.

At the regional level, the Ministry has County and District Works Offices which are charged with the responsibility of ensuring that all the projects and programmes are implemented on time and also bringing the Ministry's services closer to the people at the grassroots (MOPW, 2013).

2.3.11 Board of Registration of Architects and Quantity Surveyors of Kenya. The Board of Registration of Architects and Quantity Surveyors (BORAQS) was established in 1934 under Section 4 of the Architects and Quantity Surveyors Act "Cap 525 of the Laws of Kenya with the primary purpose of regulating the practice of architects and quantity surveyors in Kenya through professional training and registration. The Registrar of the Board is appointed by the Minister of Public Works and is charged with the duty of running the Secretariat. The Board's Vision Statement is "to promote world class professionals in the fields of architecture and quantity surveying towards a sustainable built and natural environment." Also, the Board's Mission Statement is "to regulate the profession of architecture and quantity surveying through training, registration and enhancement of ethical practice" (BORAQS, 2012). The Board serves the building industry through various ways such as:

1. Registration and regulation of the practice of architects and quantity surveyors.
2. Conducting professional examinations to those seeking registration to practice.

3. Preparing practice notes to guide the day to day practice of architects and quantity surveyors.
4. Conducting continuous professional development programs for its members.
5. Enforcing discipline and conduct in the profession.

BORAQS partners with the University of Nairobi, Jomo Kenyatta University College of Agriculture and Technology, and other training institutions in the country that offer courses in architecture and quantity surveying. Additionally, BORAQS coordinates its activities with other professional regulatory organizations such as the Architectural Association of Kenya (AAK), and the Institute of Quantity Surveyors of Kenya (IQSK) (BORAQS, 2012).

2.4 Summary Examples of Green Initiatives in Kenyan Building Industry

The pilot phase of this study revealed that there was evolving effort to incorporate green features into building projects in Kenya. Four summary examples of these green building initiatives are presented in this section. However, it is important to point out that these green initiatives were not based on any rating standard since there was none.

2.4.1 UN Green Building Complex, Nairobi. This office building facility houses the headquarters of both the UNEP and the UN-HABITAT (UN Green Building, 2012). The building was designed and built with the following green features (UN Green Building, 2012):

1. The building faces north-south, achieving maximum daytime lighting with minimum heat intake.
2. The area around the building has been planted with indigenous trees.
3. Landscaped areas beneath the atrium in the center of each block are planted with vegetation to reduce the need for water, to encourage biodiversity, and to create cool and beautiful interior gardens.

4. Desktop computers have been replaced with notebook computers as a way of minimizing electricity consumption.
5. Glazed roof lights are set into the building's flat roof, and toughened glass set at floor level beneath them on each floor, enabling natural light to penetrate right through to the ground floor.
6. Use of low energy fluorescent lighting, and a daylight sensing and presence detection system, significantly reduces energy consumption while still ensuring adequate light.
7. A central atrium runs the length of the building, allowing natural light to flood into offices, while encouraging airflow and comfortable internal temperatures by drawing warm air up and out of the building.
8. Windows can be opened and closed for temperature regulation, while high quality solar glass insulates the building against heat and cold.
9. Open plan offices help air circulation and temperature control, and also encourage a more cooperative working environment.
10. The carpet has a very high recycled content and is 100 per cent recyclable, and all paints are environmentally friendly.
11. Solar panels cover the roof space and plans are a source of solar energy for the building.
12. Water for coffee station kitchens is solar heated.
13. Data centers use air and cool water to maintain server temperatures thereby reducing the need for costly air conditioning.
14. Water fixtures at the entrance to each of the four blocks are fed by rainwater harvested from the roof.

15. Rainwater is collected from the roof and used to irrigate the landscaped areas around the building. No fresh water is needed to irrigate the planted areas.
16. Water saving taps and lavatories reduce water consumption. Wastewater is treated in a state-of-the- art on the site aeration facility and the clean water used to irrigate the landscaped compound.

2.4.2 School of Business Studies – Strathmore University, Nairobi. This building won the 'best green building development in Africa' by the African Real Estate and Housing Finance (AREHF) academy award on March 30, 2012 (Strathmore Business School, 2012). The building was designed and built with the following green features:

1. The building features an auditorium, chapel, dining area, a lounge, a balcony, and a library. All these spaces have indoor air quality fittings designed to meet LEED standard (Strathmore Business School, 2012).
2. Light-emitting diode (LED) lighting connected directly to photovoltaic solar louvers act as sun shading devices on the east and west facades (Strathmore Business School, 2012).
3. The indoor air quality utilizes evaporative cooling units that use the rainwater harvested to control temperatures in all the classrooms with temperatures and humidity set at ideal learning conditions (Strathmore Business School, 2012).
4. The building covers an area of approximately 735 square meters with four floors and the main building mass is oriented in the North-South direction, presenting minimal direct solar radiation on to the building façade (Silva & Ssekulima, 2012).
5. The windows are made of aluminum frame and 6mm clear glass; they are also in set thus being shaded by the building design and roof overhang. There is maximum integration of

day-lighting into the building design as evidenced by the 12 mm clear glass curtain walling system that was employed (Silva & Ssekulima, 2012).

6. The western façade of the building is shaded by a neighboring building while the eastern side has roof over hangs and in set windows, permitting minimal solar radiation into the building. As a result, the students never suffer from glare at any time of the day (Silva & Ssekulima, 2012).
7. The building was designed to allow extensive use of natural ventilation in the building and the roof is a slab structure with a coating of poly-ethene and tar (Silva & Ssekulima, 2012).
8. The building has a building management system (BMS) integrated into it to control the resource utilization. The building utilizes 4ft-25W electronic ballast fluorescent tube lighting. Also, there is approximately 80% on lighting energy due to the integration of day light into the building design and use of electronic lighting controls such as motion detectors and power cards linked to the BMS (Silva & Ssekulima, 2012).
9. Rainwater from the building roof is harvested into underground water storage tanks and then treated before being pumped to the various water taps in the building. All water needs for the building are met by using the harvested rainwater (Silva & Ssekulima, 2012).
10. As a way of enhancing proper waste management, an incinerator is in place to burn the non-recyclable waste as well as provide heat energy when required (Silva & Ssekulima, 2012).

2.4.3 Fedha Plaza, Nairobi. This commercial building is in Westlands, Nairobi, and was completed in November 2011. The developers' vision was to deliver a unique set of design features and amenities that would minimize the impact on the environment, and therefore add value to the tenants through minimizing fit-out and running costs (Fedha Plaza, 2012). The building features the following green attributes (Fedha Plaza, 2012):

1. Glazing has been designed to be not only beautiful, but to also reduce up to 80% of the solar heat gain substantially in order to save on air-conditioning costs and also make the building more “green.”
2. By utilizing Belgian glass that is specially treated and double-glazed, tenants should expect to have very pleasant working environment and only use air conditioning in exceptional heat waves or for specific purposes (e.g., server rooms). There is the added benefit of reducing sound pollution in the working environment.
3. Digital smart meters per tenant incentivize each tenant to minimize wastage of electric power and turn off the lights when not needed.
4. Common area lighting is fitted with motion sensors to ensure lights automatically turn off when the areas are not being used.
5. Essential and non-essential bus bars were fitted to ensure that only essential equipment would be run by generators. Also, when there is low load, only one generator switches on; the second one kicks in only when there is a peak load. This saves on fuel and maintenance costs.
6. The building has a rainwater harvesting system, where rain water is collected and used for general building cleaning. Low flush toilets and push taps also ensure that water usage is minimized across the whole building.
7. The building was designed recognizing that the development process entails a huge amount carbon release to the environment and that while minimizing the carbon footprint

during the life of building was important, it was also equally important to minimize the carbon footprint for both the building and the occupants at the very beginning. The plans were refined with the Concepts of Design to Use, efficiency and elimination of duplication throughout the building. The Design to use and Efficiency concepts meant that the concrete and steel structure was designed for tolerances specific to office buildings thus ensuring that huge amount of carbon-intensive concrete and steel was eliminated. Indeed, the glass curtain wall added to this saving.

8. Usable space was maximized such that over 82% of a typical floor could be used for office space and design tweaks on column spacing and profiles ensured easy tenant office fit outs – further reducing the carbon footprint per tenant.
9. The Eliminating of Duplication concept meant the all occupants could benefit from common standardized systems such as access control, fire Alarm, CCTV cameras, Internal PABX, Telecom Termination point and CAT 6A ICT backbone and free Wi-Fi internet services.

2.4.4 The Green House, Nairobi. This is an upcoming one and a half acre commercial complex located along Ngong Road in Nairobi. It consists of offices and shops spaces for sale, distributed within the five floors of the building. The ground floor is designated for shops and high-end boutique shops while the upper four floors are reserved for offices. The objective behind the commercial center is to mix international expertise with local knowledge; consequently, the complex has been designed by both local and UK-based architects and interior designers (Greenhouse, 2012). The building consists of the following green features (Greenhouse, 2012):

1. The U-shaped master building will comprise three small structures in the middle of a lively green yard.
2. The Greenhouse complex is designed as an open space and is tailored according to the needs of clients, so that the internal walls are the last to be built.
3. To give it the greenhouse effect, green plants will surround the complex. The middle yard plaza will have huge trees with fountains and water features. Tables will be set outside to serve the restaurant diners.

2.5 Adoption and Rating Attributes of Leadership in Energy and Environmental Design (LEED) Green Building System

The United States Green Building Council (USGBC) was established in 1993 as non-profit, non-governmental organization composed of leaders from across the building industry working together to advance environmentally responsible, profitable, and healthy buildings in which to live and work established (USGBC, 2010). The USGBC developed the LEED rating system in order to promote and foster market acceptance of green building. The pilot program Version 1.0 for what is now the LEED for New Construction and Major Renovations (LEED-NC) was launched in 1998. This was followed by the inception of the LEED-NC in 2000. By the end of 2010, the LEED family of rating systems and pilot programs had expanded to include LEED Reference Guides for: 1) New Construction (NC); 2) Existing Buildings: Operations & Maintenance (EB:O&M); 3) Commercial Interiors (CI); 4) Core & Shell (CS); 5) Schools (SCH); 6) Retail; 7) Healthcare (HC); 8) Homes; and 9) Neighborhood Development (ND) (USGBC, 2010).

The LEED 2009 reference for new construction and major renovation version 3 guide shows that USGC’s greatest strength is the diversity of membership. USGBC is a balanced, consensus-based nonprofit with more than 18,000 member companies and organizations representing the entire building industry. Since its inception in 1993, USGBC has played a vital role in providing a leadership forum and a unique, integrating force for the building industry (LEED, 2009). The reference guide further highlights the following important attributes of USGBC membership:

1. It is member-driven. Membership is open and balanced and provides a comprehensive platform for carrying out important programs and activities. USGBC targets the issues identified by its members as the highest priority. USGBC conducts an annual review of achievements that allows it to set policy, revise strategies, and devise work plans based on members' needs (LEED, 2009).
2. It is committee-based. The heart of this effective coalition is in the committee structure, in which volunteer members design strategies that are implemented by staff and expert consultations. The committees provide a forum for members to resolve differences, build alliances, and forge cooperative solutions for influencing change in all sectors of the building industry (LEED, 2009).
3. It is consensus-focused. USGBC works with its members to promote green buildings, and in doing so, help foster greater economic vitality and environmental health at lower costs. They work to bridge ideological gaps between industry segments and develop balanced policies that benefit the entire industry (LEED, 2009).
4. It is voluntary-based. USGBC acknowledges that "The LEED Reference Guide for Green Building Design and Construction," 2009 edition, has been made possible only through the efforts of many dedicated volunteers, staff members, and others in the USGBC community (LEED, 2009). This confirms the assertion made by Cole (2009) that "a

majority of the existing green building rating tools are voluntary in their application." They can be used to assess the performance of existing buildings or the design of new buildings (Cole, 1998).

2.5.1 LEED rating criteria. The LEED rating criteria is credit based. The maximum points any project can achieve under the LEED 2009 reference for new construction and major renovation (LEED-NC version 3) is 110. Distribution of points in this reference guide is shown in Appendix B (LEED, 2009). Based on the number of credits (points) a project achieves, it is assigned ratings in four levels of LEED certification: certified, silver, gold, and platinum. Table 2.1 shows the distribution of points according to different levels of LEED 2009 rating scale (LEED, 2009).

Table 2.2

Distribution of Points Based on Levels of LEED 2009 Rating Scale

Level	Number of Points
Platinum	80 to 100
Gold	60 to 79
Silver	50 to 59
Certified	40 to 49
No rating	39 or less

2.5.2 LEED credit categories. The LEED rating system has established a strong environmental foundation within the construction and facilities industries and is the cornerstone of the USGBC (Augenbroe & Pearce, 1998; Crawley & Aho, 1999; Fedrizzi, 2004). As a tool to assess the environmental performance of new and existing buildings, LEED defines "green building" by employing minimum, mandatory requirements in at least seven areas, or categories: sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, innovation and design, and regional priority. A summary of LEED 2009 rating assessment categories is shown in Figure 2.2. Each of the seven performance areas of the LEED rating system has its particular goals, as described below.

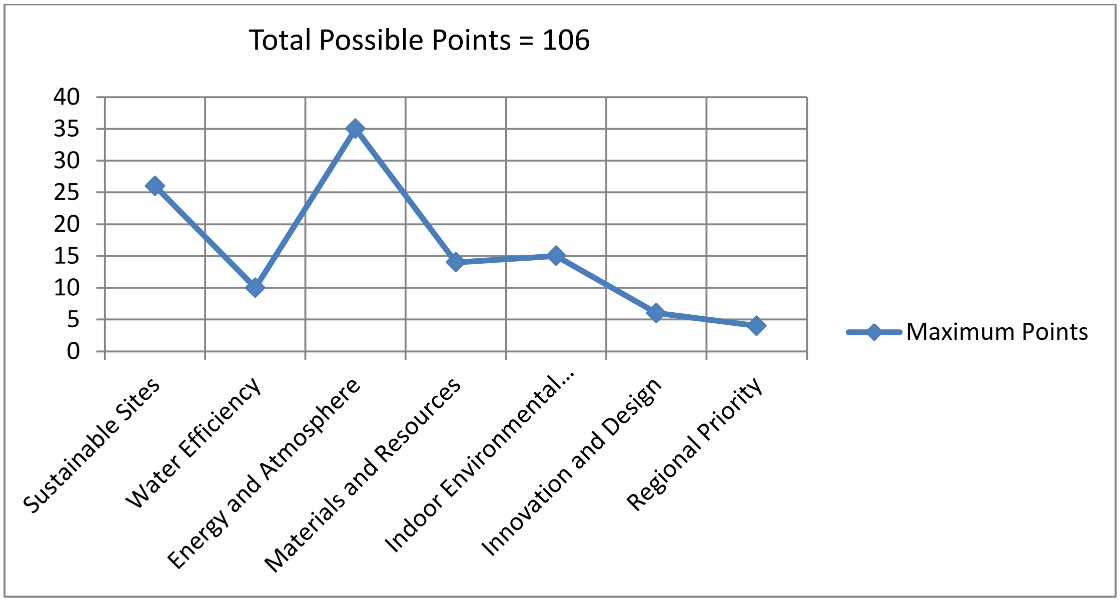

Figure 2.2. Summary of LEED rating assessment categories.

2.5.2.1 Sustainable sites (SS). These prerequisites and credits promote responsible, innovative, and practical site maintenance strategies that are sensitive to plants, wildlife, water, and air quality. These credits also mitigate some of the negative effects buildings have on the local and regional environment. Environmentally sensitive site maintenance practices reduce site operations and maintenance costs while creating and maintaining outdoor spaces that are attractive and healthy for both building occupants and local flora and fauna. A project can earn up to 26 points on LEED rating scale for sustainable sites category.

2.5.2.2 Water efficiency (WE). These prerequisites and credits encourage the use of strategies and technologies that reduce the amount of potable water consumed in facilities. Many water conservation strategies are no-cost; others provide rapid payback. Some, such as biological wastewater treatment systems and graywater plumbing systems, require more substantial investments and are cost-effective only under certain building and site conditions. This credit category provides an opportunity for a project to earn up to 10 possible points on the LEED rating scale.

In order to address the credits under Water Efficiency (WE) category, the LEED rating system employs different definitions for various types of water. Potable water is that which meets or exceeds the EPA's drinking water quality standards and is approved for human consumption by state or local authorities having jurisdiction; it may be supplied from wells or municipal plumbing systems. Process water is that which is used for industrial processes and building systems such as cooling towers, boilers, and chillers. Although there are various definitions for blackwater, they generally refer to wastewater from toilets and urinals. However, wastewater from kitchen sinks, showers, or bathtubs is considered blackwater under some state and local codes. Finally, the LEED rating system adopts the Uniform Plumbing Code's definition for gray water as "untreated household wastewater which has not come into contact with toilet waste." Gray water includes used water from bathtubs, showers, bathroom wash basins, and water from clothes-washer and laundry tubs. It must not include water from kitchen sinks and dish washers.

2.5.2.3 Energy and atmosphere (EA). These prerequisites and credits address the reduction of energy consumption through a performance-based approach that allows owners and managers to tailor energy reduction measures to their buildings. Improving the energy performance of facilities lowers operating costs, reduces pollution, and enhances occupant comfort.

The EA credit category provides an opportunity for a project to earn up to 35 possible points on the LEED rating scale and seeks to: (a) optimize energy efficiency and system performance; (b) encourage renewable and alternative energy sources; and (c) support ozone protection protocols.

According to USGBC, buildings in the U.S. consume approximately 37% of the energy and 68% of the electricity produced in the United States annually, according to the U.S. Department of Energy. Energy generated from fossil fuels – oil and coal – impact the environment in a myriad of adverse ways, beginning with their extraction, transportation, refining and distribution. Coal mining disrupts habitats and can devastate landscapes. Acidic mine drainage further degrades regional ecosystems. Coal is rinsed with water, which results in billions of gallons of sludge stored in ponds. Mining is a dangerous occupation in which accidents and the long-term effects of breathing coal dust result in shortened life spans of coal miners (LEED, 2007).

Conventional fossil-based generated of electricity releases carbon dioxide, which contributes to global climate change. Coal-fired electric utilities emit almost one-third of the country's anthropogenic nitrogen oxide, the key element in smog, and two-thirds the sulfur dioxide, a key element in acid rain. They also emit more fine particulate material than any other activity in United States. Because the human body is incapable of clearing these fine particles from the lungs, they are contributing factors in tens of thousands of cancer and respiratory illness-related deaths annually (LEED, 2007).

Natural gas, nuclear fission and hydro-electric generators all have adverse environmental impacts as well. Natural gas is a major source of nitrogen oxide and greenhouse gas emissions. Nuclear power increases the potential for catastrophic accidents and raises significant waste transportation and disposal issues. Hydroelectric generating plants disrupt natural water flows, resulting in disturbance of habitat and depletion of fish populations (LEED, 2007).

Green buildings address these issues by 1) reducing the amount of energy required, and 2) using more benign forms. The better the energy performance of a project, the lower the operations costs. As world competition for the availability supply of fuels heightens, the rate of return on energy-efficiency measures improves. Electrical generation using sources other than fossil fuels reduces environmental impacts (LEED, 2007).

Electricity in the U.S. is generally more easily available and affordable than in Kenya. For these reasons, this section of the rating system is critical to LEED since it deals with minimizing energy use in buildings (and harmful refrigerant use in air conditioning systems) and with verifying that building mechanical systems are performing as designed.

2.5.2.4 Materials and resources (MR). These prerequisites and credits set the foundation for developing, implementing, and documenting policies and practices that support effective waste management and responsible procurement. The MR credit category focuses on two main issues: the environmental impact of materials brought into the facility and the minimization of landfill and incinerator disposal for materials taken out of the facility.

The MR credit category provides an opportunity for a project to earn up to 14 possible points on the LEED rating scale and seeks to: reduce waste, to encourage sustainable means of waste disposal through recycling and re-use, to encourage sustainable means of production for materials and to minimize energy used in the transport of building materials.

This credit category is also helpful in creating awareness of the energy embodied in a given material through its extraction and production as well as through its transport. In addition to the embodied energy, it’s important to be aware of the environmental impacts of the process of extraction and production of a given building material. For example, bamboo is a highly renewable material, but if its production involves toxic chemicals being dumped untreated in streams and its use necessitates transport from the other side of the world, how sustainable is it in reality?

2.5.2.5 Indoor environmental quality (EQ). These prerequisites and credits address concerns relating to indoor air quality; occupant's health, safety, and comfort; air change effectiveness; and air contaminant management. The EQ credit category encourages improvements to ventilation, indoor CO_2 levels, daylighting and lighting quality, and thermal comfort – all of which have the potential to impact occupant health and performance.

This credit category provides an opportunity for a project to earn up to 15 possible points on the LEED rating scale and seeks to: (a) Establish good indoor environmental quality; (b) Eliminate, reduce and manage the sources of indoor pollutants; (c) Ensure thermal comfort and system controllability; and (d) Provide for occupant connection to the outdoor environment.

According to the USGBC's LEED reference guide, the U.S. EPA estimates that Americans spend on average 90% of their time indoors, where levels of pollutants may run two to five times – and occasionally more than 100 times – higher than outdoors (LEED, 2007). This underscores the importance of including EQ category in the LEED rating system.

Unlike the U.S. and other countries which experience extreme climates, the overall climatic conditions in Kenya enable people to spend more time outdoors than indoors. As a result of this, most buildings in Kenya do not have controls for climate. The differences that exist at various times of the year between desirable indoor temperatures and outdoor ambient temperature can very often be minimized through passive design measures such as building orientation, roof overhangs and location of openings, or mechanically through the installation of ceiling fans. Furthermore, the requirements for air changes per hour and air filtration as developed by the US-based professional society, the ASHRAE and referenced in the LEED criteria are only marginally relevant in Kenya since doors and windows are not built to be air-tight and are often left open. Some local building practices inherited from colonial times even have permanent through-the-wall ventilation openings at the level of the ceiling to ensure continuous natural ventilation.

2.5.2.6 Innovation and design (ID). These credits recognize projects for innovative and exemplary technologies, methods, project planning, and project execution. This credit category provides an opportunity for a project to earn up to 6 possible points on the LEED rating scale, thereby rewarding sustainability strategies not addressed elsewhere in the system. Credit is also earned for involvement in a given project of a professional knowledgeable in the LEED rating system.

One of the aspects of sustainability that LEED identifies and credits under this category is efforts at education concerning sustainability as exemplified by the building in question. This is a critical aspect of sustainability, and just as much so in the typical context of Kenya, since it is only through the raising of consciousness that sustainability will become the normal and expected way of living. The few sustainability programs that exist today are supported by non-governmental organizations (NGOs) and focus on the broad spectrums of general ecosystems. One example is the Green Belt Movement, an indigenous non-governmental organization with focus on environmental conservation, community development and capacity building (Green Belt Movement, 2011).

2.5.2.7 Regional priority (RP). RP credits address environmental concerns that are local priorities for each region of the country, as identified by USGBC’s regional councils, chapters, and affiliates. A project that earns a regional priority credit will earn one bonus point in addition to any points already awarded for that credit. This credit category therefore provides an opportunity for a project to earn up to 4 possible points on the LEED rating scale.

2.6 Benchmarking LEED Rating System Criteria Versus Typical Kenyan Building Practices

This section consists of an extensive cross walk analysis of the LEED rating system criteria against the typical context of building and construction practices in Kenya. This cross reference analysis is based on: (a) the researcher's expertise and knowledge of both the U.S. and Kenyan systems of building and construction; (b) preliminary findings from the pilot study (June 2010 to March 2012); and (c) findings of a similar analysis conducted by Ozolins (2010) for the context of Madagascar and Tanzania (see Appendix C for permission).

For the purpose of this study, only LEED-NC 2009 version was considered. As mentioned elsewhere in this report, LEED-NC, which includes both new constructions and major renovations, formed the basis upon which other USGBC standards were developed.

2.6.1 SS Prerequisite 1 – Construction activity pollution prevention. This LEED prerequisite seeks to reduce pollution by controlling soil erosion, waterway sedimentation and dust. The prerequisite is fulfilled by preventing soil loss from stormwater runoff and wind; preventing sedimentation of storm sewers and streams; and preventing polluting air with dust.

The prerequisite is based on the 2003 EPA Construction General Permit standards or local erosion & sedimentation controls, whichever is more stringent. In order to meet the requirement, the project civil engineer or landscape architect would typically identify erosion prone areas and outline soil stabilization measures. On the other hand, the contractor would need to adopt a construction pollution prevention plan and implement measures to respond to rain and site activities which may cause erosion. Recommended strategies for a strategic construction pollution prevention plan would include: (a) stabilization measures – using temporary or permanent seeding, and (b) structural measures – using silt fence, sediment trap or basin, or earth dyke (LEED, 2009).

While this green building rating prerequisite is meaningful to Kenya, the pilot survey revealed that no such codes or standards exist in the country. The Ministry of Environment and Natural Resources in Kenya, which is an equivalent of the U.S EPA, had not yet outlined such standards or codes as of the time of this study. Also, there was no Kenyan institution that was responsible for reviewing reports of inspections related to construction activity pollutions.

2.6.2 SS Credit 1 – Site selection. This credit seeks to avoid development of inappropriate sites and reduce environmental impact of the building. References for this criterion include: U.S. Department of Agriculture (USDA), Federal Emergency Management Agency (FEMA), Threatened or endangered species lists (as defined by the U.S. Fish and Wildlife Service), and U.S. Code of Federal Regulations (CFR) for defining Wetlands. The credit stipulates that there should be no development on:

- Prime farmland (as defined by USDA)
- Undeveloped land less than 5 feet above 100-year flood elevation (as defined by FEMA)
- Land with endangered species (plants or animals)
- Within 100ft of wetlands; follow local standard if stricter
- Undeveloped land within 50 feet of water body
- Public parkland (unless swapped for more valuable land) (LEED, 2009).

While this green building rating attribute is meaningful to Kenya, the pilot survey revealed that no such codes or standards existed in the country. In order to adopt a similar rating attribute, relevant government and institutions in Kenya would need to outline appropriate guidelines.

2.6.3 SS Credit 2 – Development density & community connectivity. This credit seeks to channel development to urban areas that already have infrastructure, protect greenfields, and preserve habitats and resources. Points for development density can be earned if the: 1) construction /renovation activity is on a previously developed site, and 2) surrounding community (within density radius) has an average of 60,000 square feet per acre density. Density radius is based on the project size, and is used to verify that the project is constructed in a community with a minimum average density of 60,000 square feet per acre (LEED, 2009).

On the other hand, points for community connectivity can be earned if the: 1) construction/renovation activity is on a previously developed site, and 2) is one-half mile from residential community with 10 units per acre, and 3) one-half mile distance from at least 10 basic services, and 4) pedestrian access between buildings and services. The businesses (name and service type) that must be in proximity of one-half mile distance includes bank, place of worship, grocery, day care, cleaner, hardware, beauty, laundry, dental, park, pharmacy, restaurant, fire station, medical/dental, senior care facility, post office, school, supermarket, and commercial offices. A maximum of 2 services can be under construction. The candidate project can count as 1 service to the requirement if the building is mixed-use (LEED, 2009).

Although this LEED rating attribute is meaningful to Kenya, an important difference would be the definition of community services. It is not common to find fitness centers, museums, and fire stations nearby in Kenya. However, it is common to find open-air markets, bicycle repair, tailors and auto mechanics. The requirement also stipulates only one of each of the listed community services can be counted with the exception of restaurants, of which two can be counted. One would have to look at the context for what would be appropriate. A lot of small shops sell similar items in towns in Kenya and are located next to each other. Since there is a variety of merchandise available in them, more than one or two should be allowed to count for the community services (Ozolins, 2010).

2.6.4 SS Credit 3 – Brownfield redevelopment. The intent of this credit is to rehabilitate damaged sites. Earning this point would require the project team to first identify a brownfield. This can be done through reference from American Society for Testing and Measurement (ASTM E-1903-97 Phase II Environmental Site Assessment; local voluntary cleanup program; and local, state, or federal agencies such as EPA (LEED, 2009).

In the absence of meaningful environmental regulations in Kenya, there are industrial and other sites that have been used and left in their polluted states. While brownfield remediation can be an expensive undertaking, it would be worthwhile to consider what it would take to reclaim, remediate and re-use industrial and other impacted sites, and thereby to encourage their reintegration into the healthy life of the community (Ozolins, 2010).

2.6.5 SS Credit 4 – Alternative transportation. The intent of this credit is to reduce pollution and land development impacts from automobile use, and requires the project to be either located within: 1) one-half mile of an existing (or planned/funded) rail or subway station, or 2) one-quarter mile for two public or campus bus lines (not necessarily bus stops). The public transit must be within walking distance, and the distance is measured from building main entrance (LEED, 2009).

The pilot survey for this study revealed that there was virtually no public transit in Kenya. The transportation of the population is undertaken by private companies that run fleets of small vans (commonly known as *"matatu"*) within cities and towns and buses between them. In order to suit the context of Kenya, this point would have to be restated to refer to proximity to existing van and bus routes (Ozolins, 2010).

2.6.6 SS Credit 4.2 – Alternative transportation: Bicycle storage & changing rooms. The intent of this credit is similar to that for SS credit 4.1: To reduce pollution and land development impacts from automobile use. In case of residential projects, this point can be earned by providing secure, covered bicycle racks for 15% of building occupants. In case of non-residential projects, these credits can be earned by providing bicycle racks for 5% of peak building occupancy; providing showers for 0.5% of Full-Time Equivalent (FTE) employees; and bicycle racks and showers within 200 yards of main entrance. The LEED reference guide defines FTE as a regular building occupant who spends 40 hours per week in the project building. Part-time or overtime occupants have FTE values based on their hours per week divided by 40. Multiple shifts are included or excluded depending on the intent and requirements of the credit (LEED, 2009).

Bicycles are important for personal and commercial transportation in Kenya. It is therefore important to accommodate their storage and security while their owners are in the given building. However, provision of changing rooms and showers would mean higher project budgets. The recommendation here would be that secure bicycle storage be provided, but not necessarily the lockers and showers (Ozolins, 2010).

2.6.7 SS Credit 4.3 – Alternative transportation: Low-emitting & fuel efficient vehicles. The intent of this credit is same as SS credit 4.1 and 4.2 which seek to reduce pollution and land development impacts from automobile use. The LEED reference guide classifies low-emitting vehicle as a zero-emission vehicle (ZEV) based on the standards of the California Air Resources Board. The reference guide, however, defines fuel-efficient vehicle as a vehicle that has achieved a minimum green score of 40 on the American Council for an Energy Efficient Economy (ACEEE) annual vehicle-rating guide. In order to earn points for this credit, the project must meet one of the following requirements:

- Preferred parking for low-emitting & fuel efficient vehicles for 5% of site's parking capacity, or
- Refueling capacity for 3% of parking capacity for low-emitting & fuel efficient vehicles on-site, or
- Low-emitting & fuel efficient vehicles provided for 3% of FTE workers and preferred parking for those vehicles, or
- One shared low-emitting & fuel efficient vehicle per 267 FTE (LEED, 2009).

This credit is meaningful to Kenya since fuel is relatively much more expensive and every effort should be made to encourage efficient vehicles. The reference standards should be reviewed for their applicability to Kenyan context. This credit could also be adapted to apply to lightweight high gas mileage vehicles (Ozolins, 2010).

2.6.8 SS Credit 4.4 – Alternative transportation: Parking capacity. This credit seeks to encourage reduction of pollution and land development impacts from single vehicle occupancy. In the case of a residential project, this credit requires that parking cannot exceed minimum zoning and provide infrastructure to support shared vehicle usage. A non-residential project is, however, required to meet the following requirements:

1. Parking cannot exceed minimum zoning and preferred carpool parking for 5% of total parking spots, or
2. For projects with parking for fewer than 5% of FTE occupants, provide preferred carpool parking for 5% of total parking spots.

It is also required that no new parking be provided for either residential or non-residential projects (LEED, 2009).

Although automobile use is on the increase, there are significantly fewer cars in use in Kenya. This credit could be modified for Kenya where cars do not have the same kind of impact as in the U.S. A threshold of per capita car use could be established over which this point comes into play or the point could be modified to address parking for scooters, bicycles and other low-impact means of conveyance (Ozolins, 2010).

2.6.9 SS Credit 5.1 – Site development: Protect or restore habitat. This credit seeks to conserve existing natural areas and restore damaged ones to provide habitat. On greenfield developments, this credit is meant to limit impact of construction by observing the following protection measures: a) 40 feet from building perimeter; b) 25 feet from permeable surfaces; c) 15 feet from primary roads; d) 10 feet from sidewalks (LEED, 2009).

On previously developed sites, the credit is meant to restore native habitat as much as possible. The restoration should either be 50% of the project site area excluding the building or 20% of the project site area including the building. Vegetated roof counts toward achieving this credit if the plants are native and if they qualify for SS Credit 2 – Development density and community connectivity (LEED, 2009).

This credit is an important environmental aspect in Kenya where development threatens the naturally occurring ecosystem. It is critical in Kenyan context to raise awareness of the importance and role of habitat and the fact that natural sites continue to be vulnerable to irreversible damage from uncontrolled development (Ozolins, 2010).

2.6.10 SS Credit 5.2 – Site development: Maximize open space. The intent of this credit is to provide high ratio of open space to development of footprint to promote biodiversity.

This credit is similar to SS Credit 5.1 that helps raise awareness of the importance of land in its natural state and rewards the strategy that maintains open land for nature and for the enjoyment of the building's users. There are three options for meeting the requirements for this credit:

- Option 1: 25% more space than required by zoning
- Option 2: For areas with no zoning, open space must be same size as the building footprint
- Option 3: For areas with zoning, but no minimum (zero), provide 20% of site area with vegetation.

Wetlands, ponds, and vegetated side slopes count as open space. Also, if the project is situated in a city (such as Nairobi, Mombasa, Kisumu or Nakuru), hardscape and garden roofs count as open space (LEED, 2009).

2.6.11 SS Credit 6.1 – Stormwater design: Quantity control; SS Credit 6.2 – Stormwater design: Quality control. The intent of the stormwater quantity control credit is to limit disruption of natural hydrology by: managing stormwater run-off, reducing impervious cover, and increasing infiltration. Strategies for earning this point depend on the location and climate zone but the most effective approach is to reduce the amount of impervious area through: smaller building footprint; pervious paving materials; stormwater harvesting for reuse; green roofs; bioswales/vegetated filter strips; retention ponds; bio retention/rain gardens; and clustering development to reduce roads/sidewalks (LEED, 2009).

Stormwater quality control credit strives to reduce water pollution by increasing infiltration, and removing contaminants and pollutants from stormwater. The requirements for earning this point are:1) capture and treat 90% of runoff from average annual rainfall, and 2) Use Best Management Practices to remove Total Suspended Solids. This should comply with either

Technology Acceptance Reciprocity Partnership (TARP) of Washington State; or State or local standards (LEED, 2009).

Stormwater quality control can be achieved by collecting/intercepting the water (for possible reuse) using stormwater harvesting and retention ponds. Alternatively, it can be achieved by reducing the impervious area using strategies such as pervious paving materials; open grid pavement; garden roofs; smaller building footprint; cluster buildings; and bioswales/vegetated filter strips (LEED, 2009).

Since domestic water in Kenya is often non-potable anyway, this stored stormwater could conceivably be re-used in the buildings in conjunction with a settling tank or other filtration system. Control of stormwater is critical in Kenya where, most often, no sewers of any kind exist and stormwater has devastating effects on communities. Non-existence of stormwater systems and/or roads of any kind – especially in sub-urban areas – is common in Kenya. There is haphazard subdivision and sale of land with right-of-ways reserved for future roads. In general, infrastructure systems are either lacking or are not well designed to align with building projects. Many buildings do not even have storm water retention facilities and rainwater is collected from the downspouts to an underground cistern. Once it is full, however, the surplus is simply directed outside of the lot to the right-of-way. Another option would be to build a stormwater retention facility of broken stone under the parking lot which is surfaced in concrete pavers. Such stored stormwater can be used for non-potable water use such as irrigation or flushing toilets (Ozolins, 2010).

2.6.12 SS Credit 7.1 – Heat island effect: Non-roof. According to the LEED reference guide, solar reflectance index (SRI) as a measure of a material's ability to reject solar heat, as shown by a small temperature rise. Standard black (reflectance 0.05, emittance 0.90) is 0 and a standard white (reflectance 0.80, emittance 0.90) is 100. These parameters are based on ASTM Standard E903. Higher SRI means reduced heat island effect (LEED, 2009).

This credit seeks to reduce heat islands (thermal gradient between developed and undeveloped land) and requires the project to meet one of the following requirements:

1. Provide 50% of site hardscape with a combination of: a) Shade (within 5 years of occupancy); b) Shade from solar panels; c) Paving materials with SRI of 29 or higher; d) Open grid paving system.
2. Place a minimum of 50% of parking under cover. Roof of cover must have SRI 29 or higher (LEED, 2009).

In Kenya, gravel (in form of a volcanic materials known as ‘murram’) is commonly available for use on roads, driveways and parking areas. This allows storm water to percolate through and does not absorb heat as asphalt does. Fabric tent structures on aluminum frames are increasingly used in parking lots of urban areas to shade cars and parking areas (Ozolins, 2010).

2.6.13 SS Credit 7.2 – Heat island effect: Roof. This goal of this credit is to reduce heat islands (thermal gradient between developed and undeveloped land) and requires the project to meet one of the following options:

1. High SRI for 75% of roof surface: a) Low slope ≤ 2:12 must have at least SRI 78; b) High slope > 2:12 must have at least SRI 29.

2. Vegetated roof for 50% of roof area.

3. Combination of vegetated and high SRI roof.

Skylights, solar panels, HVAC equipment, ducts, penetrations, etc. are excluded from calculated area. These parameters are based on ASTM Standard E903.

The credit seeks to reduce the increased ambient temperature that occurs in and around buildings with dark heat-absorbing roofs. The idea is to have either a highly reflective roof that would reflect solar energy or a vegetated one that will absorb and retain the sun's energy (LEED, 2009).

In Kenya, highly reflective roofs are desirable to reduce the absorbed solar energy that would otherwise be transferred to the interior. Galvanized cast iron roofs are very common as they are the least expensive and require the least maintenance. A light colored iron roof would be the most likely alternative for Kenya. A vegetated roof generally is dependent on relatively high levels of technical skill to install and to maintain. Its first cost and maintenance requirements make it not a very likely choice for Kenya (Ozolins, 2010).

2.6.14 SS Credit 8 – Light pollution reduction. The intent of this credit is to minimize: light trespass from the building and site; night sky glow; and development impact on nocturnal environments. It is based on Illuminating Engineering Society of North America (IESNA) and ASHRAE 90.1-2007 reference standards. For indoor lights, the credit can be achieved by either positioning lights to minimize light shining out windows, or providing automatic shutoff controls with manual override. For outdoor lights, the credit can be achieved by limiting: (a) the amount of light pointed into the sky, (b) power density (i.e., brightness) of exterior fixtures, and (c) limiting light trespass past property boundary (LEED, 2009).

The credit's goal which, essentially, is to reduce excess light that spills over from the project site onto the neighboring site and up into the sky is hard to justify in the context of Kenya, where electricity is not always available and is relatively very expensive to the consumer. The existence of such light spillover has a relation to security which has to do with the lack of a consistent and equitable police presence in the community. There's really no government entity to call in case of emergency. One has to rely on one's neighbors and the fact that most people know one another in a given community. In sum, security and survival concerns would result in the neighbors' gratitude for free nighttime illumination that increases their security level with respect to theft. Therefore, this criterion would not have much applicability to Kenyan context (Ozolins, 2010).

2.6.15 WE Prerequisite 1 – Water use reduction, 20% reduction; WE Credit 3 – Water use reduction. The intent of this prerequisite and credit is to maximize efficiency to reduce burden on supply and wastewater systems. The LEED rating system baseline for water consumption is established upon EPAct of 1992. This policy stipulates water reduction strategies requirements for water fixtures such as water closets, urinals, lavatory faucets, showers, kitchen/janitorial sinks, and pre-rinse spray valves. In addition to 20% potable water reduction mandatory requirement of LEED new buildings, the following strategies will enable a project to earn points for water efficiency:

- Selecting fixtures with flush and flow rates more efficient than EPAct 1992 standards
- Selecting water sense fixtures
- Use of non-potable water for toilets
- Use of water conserving fixtures (LEED, 2009)

This green building attribute focuses on a critical aspect of sustainable design and construction in the Kenyan context where water is such a precious commodity and municipal water supply systems are over-extended and inadequately maintained. If municipal water is available in towns in Kenya, it typically might be available only for certain times during the day. Stormwater collection, rainwater collection from roof surfaces and graywater collection and filtering for re-use are all strategies that make a lot of sense in the Kenyan context and should be emphasized and rewarded (Ozolins, 2010).

Water is a critical issue in Kenya, especially the availability of clean potable water. Water use in Kenya is a fraction of that of the U.S. Therefore, standards such as those referenced in the LEED criteria, such as those developed by the American Society of Mechanical Engineers (ASME) and others are of marginal relevance. In place of the referenced standards for water use, water use criteria could mandate low-flow fixtures and self-closing taps. Motion-activated taps would satisfy such a criterion but batteries are not likely to be replaced. More useful would be the kind of water faucets that work by means of a spring or other mechanical delayed shut-off mechanism. This type of tap helps in areas of public access where people risk not being good stewards of water (Ozolins, 2010).

In addition to the importance of minimizing water use would be the provision of potable and non-potable water to the surrounding communities. A building could be planned so that its water system was sized to offer also water to the surrounding community through an accessible water source such as community tap (Ozolins, 2010).

2.6.16 WE Credit 1 – Water efficient landscaping. The intent of this credit is to limit or eliminate the use of potable water (or other natural surface or subsurface resources) for landscape irrigation. Instead of potable water, the criterion encourages use of non-potable water from sources such as: non-toilet household wastewater; captured rainwater; and non-potable water treated by a public agency. Also, gray water can be used for landscape irrigation and for toilets/urinals (LEED, 2009).

The acceptance of this LEED criterion is, however, subject to varying regional graywater regulations in the U.S. For instance, the Colorado State water rights previously banned rainwater capture. Similarly, Las Vegas prohibits use of rainwater for indoor plumbing use. Additional strategies to achieve these include use of irrigation efficiency such as spray, rain sensors, and drip irrigation), and xeriscaping (a landscape designed so that irrigation is not necessary after the establishment period) (LEED, 2009).

This LEED rating attribute has relevance for commercial office buildings in suburban areas with their vast expanses of green grass. The issue is not really relevant to Kenyan context because the alternative to water efficient landscaping does not really exist. In concurrence with Ozolins (2010), even where water is more abundant in developing countries, lawns are not typically planted.

2.6.17 WE Credit 2 – Innovative wastewater technologies. The intent of this credit is to reduce wastewater and potable water demand. The credit is based on EPAct 1992 reference, and strives toward reducing demand for wastewater and potable water by using water-saving strategies such as replacement of potable water with non-potable water, and use of low-flush toilets and urinals. Minimum requirements for achieving points for this criterion are by either: 1) reducing potable water used for sewage conveyance by 50% through conservation or non-potable water usage, or 2) treating 50% of wastewater on site to tertiary standards (LEED, 2009).

This is an important aspect of every building in Kenyan context. Water is often in short supply. Sanitation is mostly handled on site. Recapturing the maximum amount of graywater and holding it/treating it for re-use makes eminent sense. A number of filtering systems are available for treating graywater and some of them are practical in the developing country context, such as a sand filter (Ozolins, 2010).

2.6.18 EA Prerequisite 1 – Fundamental commissioning of the building energy systems; EA Credit 3 – Enhanced commissioning. The prerequisite for Fundamental

Commissioning of the Building Energy System verifies that building's energy related systems are installed and working according to Owner's Project Requirements (OPR), basis of design (BOD), and construction documents. The credit for Enhanced Commissioning is, however, meant to encourage early beginning of commissioning process and execution of additional activities to verify performance. The systems to be commissioned are HVAC, lighting, hot water, and renewable energy. The purpose of building commissioning is to ensure that the systems, particularly mechanical systems such as HVAC, are functioning as designed. Achieving this prerequisite and credit requires the following measures:

1. Prior to construction documents phase designate an independent commissioning authority to oversee "all commissioning activities."
2. Designate-commissioning Authority to perform review of OPR, BOD and design documents prior to mid-construction documents phase and perform a back-check.
3. Designate-commissioning Authority to perform a post-occupancy review within 10 months.
4. Verify operator and occupant training.
5. Designate-commissioning Authority to review contractor submittals.
6. Develop a systems manual (LEED, 2009).

Mechanical systems can represent up to a third of initial building costs in the U.S. They also account for a large percentage of the energy used by a building and they play a critical role in 'sick building syndrome.' For these reasons, building commissioning has a crucial role to play in making for better and more efficient buildings in the U.S. However, it does not have much relevance to Kenyan context since there is very little to commission in buildings with virtually no mechanical systems. It is certainly good to check that the building is working as it should –

lights, plumbing, and locksets – so that the clients end up receiving what they paid for. Post-occupancy evaluations can serve a similar purpose in Kenyan context, verifying that everything works as intended and to verify that occupants are satisfied (Ozolins, 2010).

2.6.19 EA Prerequisite 2 – Minimum energy performance; EA Credit 1 – Optimize energy performance. This prerequisite and credit require that a computer simulation model be used in conformance with US-based standards to calculate the energy expected to be used in the building compared to a so-called baseline building and is required to comply with ASHRAE/IESNA Standard 90.1-2007 references. The intent of the prerequisite is to establish minimum level of energy efficiency while the intent of the credit is to achieve energy performance beyond prerequisite requirement. The LEED rating system further recommends basic measures of reducing energy consumption such as:

- Reduce demand by optimizing building form and orientation, reducing internal loads through shell and lighting improvements and shifting load to off-peak periods;
- Harvest free energy by using site resources such as daylight, ventilation cooling, solar heating and power, and wind energy to satisfy needs for space conditioning, service water heating and power generation (LEED, 2009).

While data does not exist for various building types in Kenya, it is clear that the energy use in that context is only a fraction of that in the more economically developed countries. Meager though the energy use of buildings in Kenya is, it is still important to minimize needed energy use because of the relatively high cost of energy. This attention to the reduction of energy use would need to be formalized in a credit that rewards maximization of daylighting to augment or replace artificial lighting, use of thermal solar systems for domestic hot water and other strategies, such as daylight sensors (Ozolins, 2010).

2.6.20 EA Prerequisite 3 – Fundamental refrigerant management; EA Credit 4 – Enhanced refrigerant management. The intent of the prerequisite is to reduce ozone depletion in accordance with the US EPA Clean Air Act. The intent of EA Credit 4, however, is to reduce both ozone depletion and global warming. Using the Montreal Protocol as reference, the prerequisite and credit both seek to prohibit the use of ozone-depleting refrigerants such as chlorofluorocarbons (CFCs), hydro chlorofluorocarbon (HCFCs) or halons. Enhanced refrigerant management further requires the project to be naturally ventilated (do not use refrigerants), and use of natural refrigerants such as water, CO_2 and ammonia. Only artificial refrigerants with low ozone depleting potential and low global warming potential may be used. Also, no CFC, HFC, or halon can be used for fire suppression (LEED, 2009).

Most buildings in the Kenyan context will comply because they have no cooling system other than a ceiling fan and windows. Where air conditioning is used, care should be taken to specify only non-ozone-depleting refrigerants. When air conditioning systems are used in Kenya, they are of the split-system type which consists of a wall- or ceiling-mounted air handling unit and a condenser located outside. There is no ductwork since the cool air is distributed directly from the air handling unit into the room in which it is located. The air being cooled is that which is already in the room. Fresh air is provided by leakage under and around doors and windows (Ozolins, 2010).

2.6.21 EA Credit 2 – On-site renewable energy. This credit seeks to encourage production of renewable energy (heat or electricity) on the building site in compliance to ASHRAE Standard 90.1-2007. Acceptable forms of energy include photovoltaic, solar thermal, wind, biofuel, geothermal heating/electric, low-impact hydro, wave/tidal, untreated wood waste (mill residue), agricultural/crop waste, animal waste, and landfill gas. This credit is however not earned for energy that is generated from combustion of municipal solid waste, forestry waste (other than mill residue), any type of treated wood, architectural features, passive solar strategies, daylighting strategies, geo-exchange (ground source heat pumps), and any off-site sources. In some areas of the U.S., the excess energy produced can be back fed to the electrical grid for credit or payment by the local power company.

The issue of energy independence is of critical importance in Kenyan context where the energy grid is a lot less developed, less reliable and energy is relatively more expensive. Being a net energy producer could have a benefit for the surrounding community if energy could be made available for sale to neighbors, thus increasing the project's sustainability. A strongly related issue to consider is that of the availability of the skilled labor to install and maintain such independent energy production systems and the cost, both initial and ongoing maintenance costs (Ozolins, 2010).

2.6.22 EA Credit 5 – Measurement and verification. This credit seeks to encourage ongoing accountability of building energy consumption. The credit is based on International Performance Measurement and Verification Protocol (IPMVP) and it is for the installation of meters to measure energy and water use and the implementation of plan to measure and take corrective measures should energy savings not be realized. This effort is meant to ensure accountability of building energy consumption (LEED, 2009).

The idea of measurement is a powerful one that would also have relevance to the context of Kenya as it would increase awareness of energy and water use and the efficacy of measures to reduce them. This raising of consciousness is very important and involves users as co-pilots of the building (Ozolins, 2010).

2.6.23 EA Credit 6 – Green power. This credit seeks to encourage development of grid-source (off-site) renewable energy by the local electrical supplier by giving preference to renewable sources over non-renewable ones. Key reference baselines are Center for Resource Solutions (CRS) and Green-e Product Certification. The green power can be obtained from one of the following sources:

1. Open market state (deregulated): Find a Green-e certified power provider and buy power;
2. Closed market state: Enroll in your power company's Green-e accredited program if they have one;
3. Closed market state and no Green-e program: Purchase Renewable Energy Certificates (same as Green-tags)

A minimum requirement for achieving the credit is to provide 35% of the building's electricity by engaging in a two-year renewable energy contract. The credit also requires third party certification by an auditor to document that green power purchased equals green power supplied, and verify other claims. Calculations are done using whole building energy models and are based on reference standards of the following DOE Commercial Buildings Energy Consumption Survey (CBECS) data. Table 2.2 shows the median electrical intensity for various types of commercial buildings (CBECS, 2012). Here is a sample calculation:

Default electrical consumption in kilowatt hours per year for a 100,000 square feet lodging: 100,000 sqft x 12.6kWh/sf-yr = 1,260,000 kWh/year required green power.
This credit has potential to be adopted in Kenya but requires sensitization and equipping of stakeholders with the relevant skills (LEED, 2009).

Table 2.3

Median Electrical Intensity for Various Types of Commercial Buildings

Building Type	Median Electrical Intensity (Kwh/sf-yr)
Education	6.6
Food Sales	58.9
Retail (other than mall)	8.0
Lodging	12.6
Office	11.7
Warehouse or Storage	3.0

2.6.24 MR Prerequisite 1 – Storage and collection of recyclables. This prerequisite encourages reduction of waste to landfills by requiring a separate room for the storage and sorting of recyclables. The room should be located inside or adjacent to the building and should be protected from the elements. Signage should be provided to discourage contamination. While space is at a premium due to its cost, it is a good idea to institutionalize the importance of recycling and build it into a building's program. Waste materials such as metal, glass, paper, plastic and cardboard can be commingled (LEED, 2009; Ozolins, 2010).

2.6.25 MR Credit 1.1 – Building reuse: Maintain existing walls, floors, and roof; MR Credit 1.2 – Building reuse: Maintain 50% of interior non-structural elements. The intent of these credits is to extend the life cycle of buildings, conserve resources, and cut down on waste, manufacturing and transport. The credits recognize that new building construction is an enormous consumer of energy. Reusing existing buildings also helps with continuity in a community and helps preserve existing open and arable land from development. The materials to be reused can be from the building structure (e.g., structural floor, interior structural walls, roof deck, and envelope). Interior non-structural elements (e.g., interior doors, flooring, ceiling, carpet, and casework) in at least 50% of the completed building (by area) can also be used (LEED, 2009).

These same issues are relevant to context of Kenya and probably more so. Though the cost of construction in Kenya is generally less than that of construction in the U.S., it represents a much larger capital investment proportion to people's personal income and to national income (Ozolins, 2010).

Furthermore, buildings in Kenya, other than those built of traditional materials, are generally built of much more durable materials, such as burnt brick, solid concrete blocks and cut stone, that can withstand the ravages of time better than a lot of the materials used in the U.S. In this regard, it makes even more sense to re-use buildings in Kenya. The challenge, however, in Kenya is the lack of documentation of existing buildings, many of which are built without plans or building permits. They are often built by rule of thumb and not by calculation and corners are often cut to minimize expensive materials such as cement and steel reinforcing bars. Non-invasive structural forensic testing such as X-ray or magnetic scanning is typically not available to ascertain the presence and size of concrete reinforcing (Ozolins, 2010).

2.6.26 MR Credit 2 – Construction waste management. The intent of this credit is to divert construction debris from landfills and incinerators, and encourage recycling. Typical recyclable materials include: acoustic ceiling tiles, asphalt, asphalt shingles, bricks, cardboard, carpet and pad, concrete, dirt, drywall, insulation, fluorescent lights and ballasts, metals, paint, porcelain, wood, plastic film from packaging, window glass, and field office waste such as paper, cans, glass and plastic bottles, and cardboard. The Construction Waste Management Guide provides samples and resources to view in developing a LEED project's Construction Waste Management Plan (LEED, 2009).

Calculations to identify amount of targeted materials is done by weight or volume. Only non-hazardous waste is considered; thus asbestos, lead, etc. is excluded. Also, excavated soil/land clearing debris do not count. Strategies for earning these points include: 1) recycle materials – sort onsite or comingle, 2) salvage – donate (e.g., to Habitat for Humanity) or reuse onsite, 3) crush and reuse concrete/masonry/asphalt onsite (LEED, 2009).

The higher rate of poverty in Kenya as compared to the U.S. makes people much more circumspect in the handling of any waste material. As regards this point in its particulars, formal landfills with weighing facilities such as one finds in the U.S. are not typically found in Kenya, so it would be impossible to meet the paperwork requirements necessary for this point. The requirements would need to be adapted to the existing local context to encourage separation of waste and identifying the best means of its recycling or re-use. Another challenge to this would be the care that is needed to prevent the theft of construction waste and its unnecessary production. Empty cement bags are very sought after for transport of charcoal or farm produce. Bent nails are usually straightened and re-sold by the piece. There is never a problem of construction debris cluttering up a site or the surrounding area (Ozolins, 2010).

2.6.27 MR Credit 3 – Materials reuse. The intent of this credit is to reuse existing or salvaged building materials to decrease demand of virgin materials and to reduce waste. This also minimizes energy expended in production of virgin materials and possibly in their transport as well.

The credit requires the following measures in use of salvaged/refurbished materials:

1. Exclude mechanical, electrical, plumbing and specialty items such as elevators.
2. Furniture is optional but must be included consistently across MR Credits 3, 4, 5, 6, and 7.

3. If salvaged from within 500 miles, the object can also count toward MR Credit 5 – Regional Content.
4. Calculations are based on percentage of total materials cost in the Constructions Specifications Institute (CSI) Divisions 3-10 & 31-32. Table 2.3 shows divisions of CSI (CSI, 2011).

Table 2.4

Divisions of Constructions Specifications Institute

Division #	Description
1	General requirements
2	Existing conditions
3	Concrete
4	Masonry
5	Metals
6	Wood and plastics
7	Thermal and moisture protection
8	Doors and windows
9	Finishes
10	Specialties
11-30	Furnishings, plumbing, HVAC, electrical, facility services, etc.
31	Earthwork
32	Exterior improvements
33-49	Utilities, process equipment, etc.

The issues here are similar to those of the minimization of construction waste since it is in the U.S. that buildings are demolished wholesale and thrown in the landfill. In typical Kenyan context, any material that can possibly be re-used will be, although in a degraded state. For example, galvanized roofing sheets get re-used in self-built housing or for storage buildings after they are taken off of a building. Other parts of buildings are more easily dismantled for re-use: doors, windows, plumbing and electrical fixtures. To maximize the reuse of building materials, a new construction project as well as a demolition project can be conceived with eventual re-use of building materials in mind (LEED, 2009; Ozolins, 2010).

2.6.28 MR Credit 4 – Recycled content. This credit is based on International Standards Organization (ISO) 14021-1999 and its intent is to increase demand for building products that incorporate recycled content. The credit encourages the use of materials that contain waste materials from the production stream or material that has already been used in a finished product (LEED, 2009).

Essentially, the intent of the credit is to increase demand for recycled and reduce demand for virgin materials. Post-industrial/pre-consumer contents that can be considered for this credit include waste that has never been owned by a consumer, such as fly ash, walnut shells, textile clippings, and sawdust. Post-consumer contents that can be considered for this credit include waste owned by a consumer, such as tuna cans, plastic bottles, and newspapers (LEED, 2009).

This kind of effort is already readily apparent in Kenya and a further step will be to find ways to incorporate such waste – such as the ubiquitous thin plastic bags or the plastic water bottles – into building materials such as building blocks or pavers. Entrepreneurial opportunities abound in this domain as long as the pricing is competitive with conventionally produced building materials (Ozolins, 2010).

2.6.29 MR Credit 5 – Regional materials. The intent of this credit is to increase demand for local goods, indigenous resources and reduce transport. The criterion promotes use of building materials that have been extracted (harvested or recovered) and materials that have been manufactured within 500 miles (805 kilometers) of the project site. This is meant to reduce the embodied energy in the form of transport costs and to promote the local (regional) economy. The point is achieved if at least 10% (by weight) of the building materials are from within a 500 mile (805 km) radius (measured in cost). Mechanical, electrical, and plumbing components are excluded from this credit. Also, furniture is optional but must be included consistently across MR Credits 3, 4, 5, 6, & 7 (LEED, 2009; Ozolins, 2010).

This parameter is based on the case of the U.S., a large country where centers of manufacturing and harvesting are distributed over the territory of the country, so that one can generally try to privilege the most local sources to minimize energy used in transportation. With a total area of 580,367 square kilometers or 224081 square miles, Kenya is approximately 83% the total area of Texas (CIA, 2010; Kenya, 2010). This shows how small Kenya is compared to the U.S. (Ozolins, 2010)

In Kenya, manufacturing centers are typically located within or near major cities such as Nairobi, Mombasa, Kisumu, Nakuru, and Eldoret. Through the port of Mombasa, Kenya has Indian Ocean trading partners and trade agreements to promote economic development. It is also part of the East African Community (EAC) along with the neighboring countries of Uganda and Tanzania. Each of these EAC countries have a major port on Lake Victoria: Mwanza in Tanzania, Kampala in Uganda, and Kisumu in Kenya. There are numerous efforts by the EAC to promote economic development of the region.

This component of the rating system that deals with regionally-sourced building materials should perhaps have greater emphasis in the context of Kenya since so much of economic development centers on this issue. The issue could be taken into consideration where the raw materials are sourced and where the transformation of the raw materials occurs since there are industries in Kenya that import raw materials for transformation into finished products. For example, in Kenya, aluminum sections are imported from Europe, China and the Middle East and made into aluminum windows, doors, curtain walls and storefronts. Similarly, galvanized steel coil stock is imported and transformed into steel roofing sheets. An example of a material both sourced and transformed locally is the creation of building blocks from laterite-containing local soils on site. This is of the most benefit to sustainability of a project and to the local economy (Ozolins, 2010).

2.6.30 MR Credit 6 – Rapidly renewable materials. This credit aims at stopping waste of finite and long-cycle renewable materials. Rapidly renewable materials are defined by the USGBC as those that are planted and harvested in a cycle of 10 years or less. Earning this LEED rating point requires that 2.5% of project material cost (CSI 3-10 & 31-32) was spent on rapidly renewable materials. Products of rapidly renewable materials include cork flooring, bamboo flooring, cotton batt insulation, linoleum flooring (made from linseed oil), sunflower seed board panels, wheatboard cabinetry, wool carpet, bio-based paints and plastics, etc. (LEED, 2009; Ozolins, 2010).

Eucalyptus and pine are two exotic species of wood that have been introduced to Kenya. Eucalyptus is primarily wild and grows from the stump when it is cut down. It is a heavy wood but is serviceable for roof trusses and rafters. It can also be used for flooring. Pine has been planted for use in the construction of furniture and for ceilings in buildings. It is very light and not very strong. Bamboo is found in Kenya. Also, local reeds and grasses have been used for millennia for basket-weaving, clothing and for housing in the hotter coastal areas. Such rapidly renewable materials can be identified for the individual country and their use promoted in innovative building materials (Ozolins, 2010).

2.6.31 MR Credit 7 – Certified wood. This credit encourages environmentally responsible forest management by using Forest Stewardship Council (FSC) certified wood. To earn this LEED point, 50% of wood-based materials (based on cost) must be certified by FSC. Also, the Chain of Custody (CoC) certification is required for transport companies if the transport of the FSC materials to the next stage changes ownership of the material/product (LEED, 2009).

This point requires wood to be purchased from a source certified as having been harvested in a sustainable manner. Such certification does not yet exist in the typical context of Kenya. However, there are re-forestation projects from which wood is harvested for use in construction. Such sources could be identified and listed as acceptable sources and some sort of certification could be sought that would vouch for its sourcing (Ozolins, 2010).

2.6.32 EQ Prerequisite 1 – Minimum indoor air quality performance. Founded upon ASHRAE 62.1-2007, this prerequisite is meant to enhance improved indoor air quality in buildings. The natural ventilation (passive system) requirement is that the area of operable roof or wall openings should equal or exceed 4% of the occupiable floor area. However, mechanically ventilated (active) systems should conform to either the local code or ventilation rate procedure based on design occupancy and size of room (LEED, 2009).

This point prescribes standards for indoor air quality based on the U.S. standards. Both mechanical and naturally ventilated spaces are addressed. In the typical context of Kenya, buildings are practically always naturally ventilated. The ASHRAE standards should be reviewed for their relevancy to Kenyan context. The appropriate parts could be incorporated to provide a performance standard for natural ventilation (Ozolins, 2010).

2.6.33 EQ Prerequisite 2 – Environmental tobacco smoke (ETS) control. The intent of this requirement is to reduce exposure of occupants, indoor surfaces, and air distribution systems to ETS. The overall strategy is to separate smokers from non-smokers. This LEED rating prerequisite is fulfilled through one of the following requirements:

1. Prohibit smoking in the building and locate smoking areas 25 feet away from entries/windows/air intakes;
2. Prohibit smoking indoors except in designated smoking rooms to contain smoke. Rooms must be under negative pressure with dedicated exhaust fan and have deck to deck partitions;
3. In case of residential buildings, prohibit smoking in common areas, air seal walls between units, and weather-strip doorways (LEED, 2009).

The required baseline references for this prerequisite are: (a) ASTME-779-03, Standard Test Method for Determining Air Leakage Rate by Fan Pressurization; (b) Residential Manual for Compliance with California 2001 Energy Efficiency Standards (LEED, 2009).

In a naturally ventilated building, all spaces are separately ventilated because there is no central air handling equipment or ductwork connecting the rooms. In the Kenyan context, it would be better to state this requirement as a simple prohibition from smoking inside the building or the provision of a separate smoking lounge away from the building's other interior spaces (Ozolins, 2010).

2.6.34 EQ Credit 1 – Outdoor air delivery monitoring. This credit strives to improve ventilation system monitoring for occupant comfort and well-being. The point encourages monitoring of fresh air delivery to indoor spaces using CO_2 sensors in all rooms, and is earned for 30% above ASHRAE 62.1-2007. Information from the sensors is fed to HVAC or building automated system (BAS) to trigger corrective action.

In the Kenyan context, there is so much air moving in and out through leaky windows and doors, that the provision of fresh air inside is not too much of a concern (LEED, 2009; Ozolins, 2010).

2.6.35 EQ Credit 2 – Increased ventilation. This point rewards greater levels of ventilation for indoor air quality. This includes provision of additional outdoor air for comfort, well-being, and productivity. In case of mechanical ventilation, this point is earned for 30% above ASHRAE 62.1-2007. For natural ventilation, the LEED project should meet the thresholds for Carbon Trust Good Practice Guide 237, and either (a) Chartered Institution of Building Services Engineers (CIBSE) Application Manual 10-2005, Natural Ventilation in Non-Domestic Buildings; or (b) Airflow Model.

As in the section above, this is not of much concern in Kenya since there is plenty of natural ventilation occurring through leaky doors and windows (LEED, 2009; Ozolins, 2010).

2.6.36 EQ Credit 3.1 – Construction IAQ management plan: During construction; EQ Credit 3.2 – Construction IAQ management plan: Before occupancy. The intent of these credits is to reduce indoor air quality problems from the construction/renovation process. The criterion concerns the protection of absorptive building materials before they are installed and protecting components of the air handling system from contamination prior to their startup.

EQ Credit 3.1 requires that during construction, the project must:

1. Meet or exceed control measures of Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
2. Protect on-site absorptive materials from moisture damage.

3. Install MERV (minimum efficiency reporting value) 8 filters on return grilles if air handler is used. This is based on ASHRAE 52.2-1999 (air filters).

On the other hand, EQ Credit 3.2 is based on US EPA Compendium of Methods for the Determination of Air Pollutants in Indoor Air, and the credit requires that before occupancy:

- Flush the building with 14,000 cubic feet of air per square foot, or
- Flush with 3,500 cubic feet per square foot. Once occupied, continue flushing until 14,000 cubic feet per square foot, or
- Conduct indoor air quality testing plus additional flush out if the maximum is exceeded.

This is not very relevant to typical Kenyan context since ducted air handling systems are rare, the air change rate is typically very high already and absorptive materials are not very much used (LEED, 2009; Ozolins, 2010).

2.6.37 EQ Credit 4.1, 4.2, 4.3 & 4.4 – Low emitting materials: Adhesives and sealants, paints & coatings, flooring systems, and composite wood and agrifiber products.

The intent of these credits is to reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants. The credits contain established criteria which materials used on the interior of the building must comply with in order to earn LEED rating points. A summary of references for various regulated low emitting materials is presented in Table 2.5 and includes adhesive and sealants (EQ Credit 1), paints and coatings (EQ Credit 4.2), flooring systems (EQ Credit 4.3), and composite wood and agrifiber products (EQ Credit 4.4).

Because of the porosity between inside and outside in Kenyan context, the off gassing of finish materials is not an issue of critical concern. Furthermore, such products with low amounts of volatile organic compounds (VOC's) are not readily available in the country (LEED, 2009; Ozolins, 2010).

Table 2.5

Summary of References for Various Regulated Low Emitting Materials

Regulated Material	Reference
Adhesives & sealants	• Adhesives/sealants – South Coast Air Quality Management District (SCAQMD) #1168; • Aerosols – Green Seal Standard 36
Paints & coatings	• Finishes, stains, and sealers – SCAQMD #1113; • Paints – Green Seal Standards #3 and #11
Carpet systems	• Carpet – Green Label Plus Testing (Carpet & Rug Institute); • Carpet Cushion – Green Label Plus Testing (Carpet & Rug Institute); • SCAQMD #1113; SCAQMD #1168
Composite wood & agrifiber products	• N/A – No added urea-formaldehyde

2.6.38 EQ Credit 5 – Indoor chemical and pollutant source control. This credit is based on ASHRAE 52.2-1999 (air filters) and its intent is to minimize exposure of building occupants to hazardous particulates and chemicals. The credit is concerned with isolating interior sources of air pollution such as where there is a concentration of photocopiers or where cleaning supplies are stored and decanted and with limiting the amount of dirt brought in on people's shoes.

The following requirements must be met in order to earn this point:

1. Permanent entryway systems at least 10 feet long in the primary direction of travel to capture dirt (grill, grate, etc.).
2. Rooms with chemicals must be sealed, under negative pressure, and exhausted outside (no recirculation), deck to deck walls, and self-closing doors.

3. In mechanically ventilated buildings, MERV 13 filters (both return and incoming outside air).
4. Provide containment for disposal of hazardous liquid waste.

Most rooms in the typical Kenyan context have windows. Care should be taken that this is still the case and that the windows are easily operable in copy rooms and storerooms. Also, care should be taken that, in some kind of blind imitation of a western-type skyscraper, unventilated interior spaces do not become the norm. This point stipulates that some kind of walk-off mat or recessed grate be provided at major entries to provide a place for people to wipe their feet off. This is very useful in Kenya where the dry season brings so much dust, the wet season so much mud and where paved exterior surfaces are not plentiful. A provision for walk-off mats or recessed grates at entries to buildings is very useful (LEED, 2009; Ozolins, 2010).

2.6.39 EQ Credit 6.1 – Controllability of systems: Lighting; EQ Credit 6.2 – Controllability of systems: Thermal comfort. EQ Credit 6.1 encourages individual/group control of lighting in interior spaces, and requires the following:

1. Individual lighting controls for 90% of building occupants. In this case, the lights can be desk lamps (plug-in) and they only need on/off (not dimmable); and
2. Lighting controllability for 100% of multi-occupant spaces to meet group needs and preferences. This may apply to:

- Multi-occupant spaces such as break rooms, conference rooms, lecture halls, cafeterias, and classrooms.
- Infrequently occupied spaces (e.g., lobbies, bathrooms, and janitor’s closets).

EQ Credit 6.2 is based on ASHRAE 55-2007 (thermal comfort) and ASHRAE 62.1-2007 (ventilation). This point encourages individual/group control of thermal comfort in interior spaces, and requires comfort controls for 50% of individual building occupants. For natural ventilation, this must be within 20’ deep and 10’ to the side of an operable window. In the case of mechanical ventilation, the control applies to any one of the following: radiant temperature, air flow, air temperature, and relative humidity.

In Kenya, lighting controls, windows and ceiling fans (if available) are controlled individually. Consequently, this credit is not of much relevance at the moment (LEED, 2009; Ozolins, 2010).

2.6.40 EQ Credit 7.1 – Thermal comfort: Design. The intent of this credit is to provide comfortable thermal environment by encouraging buildings to be designed for thermal comfort. The credit requires the project team to design HVAC systems and building envelope in compliance to ASHRAE 55-2004. Naturally ventilated spaces can also use ASHRAE 55-2004 or the CIBSE Applications Manual 10 as a guide. Since mechanical systems are not commonly used in Kenyan buildings, this credit is of low priority. The requirements related to natural ventilation would be good for reference to see how they would apply or not to the typical Kenyan context (LEED, 2009; Ozolins, 2010).

2.6.41 EQ Credit 7.2 – Thermal comfort: Verification. The intent of this credit is to encourage assessment of the building’s thermal comfort based on ASHRAE 55-2004. The credit is concerned with the thermal performance of the building over time as experienced by the users of the building. Following are requirements for earning this point:

1. Implement comfort survey to 100% of building occupants 6-18 months after occupancy.
2. Survey must be anonymous, but individuals should be able to indicate which zone they work in.

3. Plan for corrective action if more than 20% occupants are dissatisfied with (e.g., set-points, schedules, operating modes, etc.).
4. Provide building monitoring system to ensure the building meets the standards of EQ Credit 7.1 (thermal comfort: design).

As mentioned elsewhere in this paper, this sort of post-occupancy evaluation is very useful in seeing how a given building is performing and what deficiencies need to be corrected or at least not repeated in a subsequent building (LEED, 2009; Ozolins, 2010).

2.6.42 EQ Credit 8.1 – Daylight and views: Daylight; EQ Credit 8.2 – Daylight and views: Views. The intent of EQ Credit 8.1 is to connect occupants with outdoors through daylight, and is based on ASTM D1003-07e1 – Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics. This point can be earned by fulfilling one of the following requirements:

1. Through computer modeling, show 75% of regularly occupied spaces achieve a minimum of 25 footcandles (fc) of daylight and maximum of 500 fc. (modeled for September 21 at 9am and 3pm).
2. Prescriptive: Perform a calculation based on window height and width; visible light transmittance of glass; and floor area.
3. Daylight measurement: Measure on 10’ grid and show more than 25fc or 2% daylight factor.
4. Combination of any of the above options.

The intent of EQ Credit 8.2 is to provide connection to outdoors through views. Earning this point requires a direct line of sight for 90% of building areas to glazing between 2’6”-7’6” from a height of 42”.

Due to the intermittent availability of electricity, day lighting is simply a necessity. That fact, together with the natural ventilation of all interior spaces, is simply the way things are done in the typical context of Kenya. These aspects thus allow virtually every space a view of the out-of-doors. It is good for a green building rating system to reward this reality so that it is recognized and valued as a positive in terms of sustainability (LEED, 2009; Ozolins, 2010).

2.6.43 ID Credit 1.1, 1.2, 1.3, and 1.4 – Innovation in design. These points are meant to provide teams with opportunity for exceptional or innovative performance. For example, a project can earn up to 5 points by implementing the following:

1. Innovative ideas and performance not covered in LEED, such as organic landscape; plants salvage and reuse; onsite composting and exemplary onsite recycling; active LEED sustainable education; and pest management.
2. Exceptional performance covered in LEED (typically by doubling credit requirements or next level percentage; e.g., exemplary water conservation, exemplary recycled content, etc.).

This is important also to green building efforts in typical Kenyan context since there is much to learn from traditional building and use of materials to which the building culture there is still very close (LEED, 2009; Ozolins, 2010).

2.6.44 ID Credit 2 – LEED accredited professional. This credit is a strategy to support and encourage the design integration required by LEED to streamline the application and certification process. This point is earned when at least one principal participant on the project team is a LEED accredited professional. (A LEED project does not require a LEED AP).

A design professional with knowledge of green building in typical Kenyan context would be very useful to have on a design team, especially when consultants are involved in a project that do not have first-hand familiarity with the particular context for which they are designing. In the same way that a LEED-accredited professional can help clients and consultants understand how a project can be made sustainable in the U.S. context, a professional with training and experience in sustainable building design and construction in Kenya could have an important impact on the outcome of a building project (LEED, 2009; Ozolins, 2010).

2.6.45 Regional priority credits (RB Credit 1). The strategy of these points is to provide incentive for achievement of credits that address geographic specific environmental priorities (LEED, 2009). Regionally specific priorities for the Kenyan building design and construction context would have to be researched and identified. Among them would be:

- Energy independence through renewable energies
- Water conservation and re-use
- Promotion of local industry and labor
- Security from theft of building materials
- Passive cooling and heating
- Locally and regionally important issues such as reforestation (Ozolins, 2010).

2.6.46 Summary: Applicability of LEED rating system criteria to the context of the building practices in Kenya. Based on the cross-walk assessment conducted in Sections 2.6, the following is a summary of LEED rating criteria that are meaningful, or relevant, to the typical context of building and construction practices in Kenya:

Sustainable Sites:

- Prevent construction activity from causing site and air pollution.
- Protect or restore the natural state of the building site in terms of ecosystem, agriculture, plants and animal habitat.

- Build/construct on a previously developed site.
- Preferably locate the project site in a location with higher population density.
- Build/construct on a contaminated site such as brownfield.
- Preferably build/construct near to existing transport and utilities infrastructure
- Provide secure bicycle storage space for building occupants/users.
- Encourage building occupants to use vehicles that are fuel-efficient and emit lesser pollutants.
- Minimize the number of car parking spaces on the building premises/site.
- Maximize open space on the building/site.
- Control the quantity of storm water runoff from the building/site.
- Control the quality of storm water runoff from the building/site.
- Preferably use roof and non-roof materials with higher heat reflection.

Water Efficiency:

- Implement strategies to minimize the amount of water used in the building.
- Treat and re-use waste water in the building.
- Collect rainwater for use in the building.

Energy and Atmosphere:

- Implement strategies to minimize the amount of energy used in the building.
- Preferably use renewable energy that is generated on the building site (e.g., solar and wind).
- Implement strategies to measure and verify energy use in the building.

Materials and Resources:

- Preferably re-use an existing building structure instead of constructing a new one.

- Preferably use recycled or salvaged building materials.
- Preferably use materials that are available close to the building/site.
- Preferably use building materials that are rapidly-renewable or replenishable.

Indoor Environmental Quality:

- Prohibit smoking indoors.
- Provide walk-off mats, grills, or grates at building entries.
- Implement strategies to achieve maximum daylight entering the building.

The above LEED rating criteria are an important platform for developing the research model for this investigative study.

2.7 Adoption of LEED Green Building Rating System for Other Countries: Case Study of LEED-India

Although green building practices were first adopted in developed countries such as the U.S, U.K, and Canada, various developing countries were quick to embrace the movement. This section provides a case study analysis of how the Indian building sector adopted green building practices. Lessons learnt from this analysis are useful for understanding factors that can positively or negatively influence adoption of green building in a developing country such as Kenya. The section is majorly founded on the findings of a previous research conducted by Potbhare (2008) entitled "Adoption of green building guidelines in the developing countries based on U.S. & India experiences." Permission was obtained to borrow relevant ideas from Potbhare's (2008) study (Appendix D).

2.7.1 LEED-India. The Indian Green Building Council (IGBC) released India's first version of green building rating standard known as LEED-India version 1.0 in 2007 (IGBC 2010). Since the structure of credits and rating criteria in LEED-India was based on that of

LEED-NC, Potbhare (2008) conducted a cross-walk comparative analysis of the two standards to identify similarities and/or differences in rating attributes. Results of the analysis indicated that the following credit criteria in LEED-NC were retained in LEED-India with no changes:

Sustainable sites category:

- Development density and community connectivity
- Alternative transportation: public transportation access
- Stormwater design: quantity control
- Heat island effect: non roof
- Heat island effect: roof
- Light pollution reduction

Water efficiency category:

- Water efficient landscaping: reduce by 50%
- Water efficient landscaping: no potable use or no irrigation

Energy and atmosphere category:

- Measurement and verification of building energy consumption

Materials and resources category:

- Storage and collection of recyclables
- Building reuse: maintain 75% existing walls, floors and roof
- Construction waste management: divert 50% from disposal
- Certified wood

Indoor environmental quality category:

- Minimum indoor air quality performance
- Environmental tobacco smoke control

- Increased ventilation
- Construction indoor air quality management plan
- Low-emitting materials: adhesives and sealants
- Low-emitting materials: paints and coatings
- Low-emitting materials: carpet systems
- Low-emitting materials: composite wood and agrifiber products
- Indoor chemical and pollutant source control
- Controllability of systems: lighting
- Controllability of systems: thermal comfort
- Thermal comfort: design
- Thermal comfort: verification
- Daylight and views: daylight 75% of spaces
- Daylight and views: daylight 90% of spaces

Innovation and design category:

- Innovation and design
- LEED accredited professional

The above analysis implies that it was possible to adopt some LEED-NC (USGBC) rating criteria for the context of India; regardless of the different building practices in the two countries. In other words, LEED-NC (USGBC) – though created for the context of the U.S. – has potential to be adopted for other countries. This might probably be true for Kenya too.

2.7.2 Barriers to green building adoption. In addition to the cross-walk analysis, Potbhare (2008) shed light on factors that are likely to impede adoption of green building guidelines in any country. These factors include:

1. Lack of laws and regulations to guide the construction industry toward adopting green building.
2. Lack of information platforms pertaining to green building. Examples of such platforms include demonstration projects, reference manuals, and websites.
3. Lack of clear guidelines on cost benefits of venturing into green building.
4. Lack of incentives such as grants or tax relief from the government that are tailored toward promoting green building adoption.
5. Lack of stakeholder awareness and training in green building.
6. Lack of institutional leverage to promote green building. Examples of such institutions include non-profit organizations and environmental lobby societies. For instance, LEED was created by United States Green Building Council – a non-profit organization.

2.8 Other Major International Green Building Rating Systems

As alluded elsewhere in this study, the first generation of rating tools originated in developed countries (Cole, 2005) and primarily focused on environmental assessments of buildings (Cole, 1998). This section provides an overview of major international green building rating systems beside LEED.

2.8.1 BREEAM. The British Research Establishment Environmental Assessment Methodology (BREEAM) developed in 1990 by the British Research Establishment was the "first real attempt to establish a comprehensive means simultaneously assessing a broad range of environmental considerations in building" (Smith, Fischlein, Suh, & Huelman, 2006; Haapio, 2008). As the pioneer green building rating system, it subsequently influenced the development of other rating systems, including LEED, Green Globes, and Green Star (Cole, 2005; Haapio, 2008). Also, numerous rating systems have been subsequently adapted from existing assessment tools (Cole, 2005; Haapio, 2008).

BREEAM has assessment systems for a number of building types, among them Courts, Eco homes, Industrial, Offices, Healthcare, Prisons, Retail, and Education. It also offers a Bespoke version, which can be tailored to any building type not covered by another system. Credit categories include Management; Health and Wellbeing; Energy; Transport; Water; Materials; Land Use and Ecology; and Pollution. There are four levels of achievement: Pass, Good, Very Good, and Excellent. In order to qualify, buildings must be evaluated by a third-party assessor trained and licensed by the Building Research Establishment (BRE). BREEAM is administered by the BRE, a subsidiary of the BRE Trust, a charitable company. BRE's operation of BREEAM is accredited under the International Standard for Organization (ISO) 9001 (BRE, 2010).

2.8.2 BREEAM international. More than 3,000 buildings certified by BREEAM have been constructed outside the United Kingdom. In response to demand, in 2008 BRE launched BRREAM Europe and BREEAM Gulf. BREEAM Europe pilot schemes were developed for retail, office, and industrial uses. BREEAM Gulf schemes have been developed for retail, offices, leisure activities, hotels, and apartments.

There is also the International Bespoke BREEAM option, whereby a project team can send project information for BRE to prepare a proposal outlining the fee and the time frame for tailoring BREEM to suit the building type and location. On a country or regional basis, BRE is willing to work with emerging organizations such as green building councils to help standardize the assessment system while accommodating regional variations (BRE, 2010).

2.8.3 CASBEE. The Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) was developed in Japan. Representatives of the government, academia, and industry came together in 2001 to create the Japanese Green Build Council (JaGBC/Japan Sustainable Building Consortium (JSBC) and develop CASBEE. The Building Environmental Efficiency (BEE) concept evolved from the World Business Council for Sustainable Development's concept of eco-efficiency (Bunz, Henze, & Tiller, 2006).

There are tools in CASBEE for New Construction, Urban Development, Urban Area + Buildings, and Home (Detached House) available in English. Additional programs are in Japanese only. These include CASBEE for New Construction (brief version – for tailoring by local municipalities), Existing Building, Renovation, and Heat Island.

About 80 criteria are broken down into four main categories: Energy Efficiency, Resource Efficiency, Local Environment, and Indoor Environment. The BEE assessment further classifies these categories into two other categories. The first one is concerned with the quality of the environment for building users and is labeled "Q" for "Quality." The second one is for negative environmental impact that might be felt outside the building's enclosure and is labeled "L" for "Loading." The "Q" category includes Indoor Environment, Quality of Service, and Outdoor Environment on Site. The "L" category includes Energy, Resources, and Materials, and Off-Site Environment. The BEE is determined by dividing the Q-value by the L-value; therefore, the higher the Q-value and lower the L-value, the more sustainable the building. It is possible to rank all buildings by increasing BEE value from class C (poor), class B-, class B+, class A, to class S (excellent) (JSBC, 2010).

2.8.4 Green star. This was developed in Australia in 2003 with the assistance of the BRE and with BREEAM as its basis. Subsequent changes made the assessment methodology more similar to LEED than to BREEAM (Saunders, 2008). In 2009, rating tools were available for Retail, Education, Office Design, Office as Built, and Office Interiors. Pilot programs were underway for industrial, multi-unit residential, mixed use, healthcare, and office-existing building.

The categories in which points can be earned are Management, Indoor Environmental Quality, Energy; Transport, Water, Materials, Land Use and Ecology, Emissions, and Innovation. Once a score is established for each category, the categories are weighted by dividing the number of points achieved in a category by the number available, and multiplying by 100. Points that are not achievable in a specific project are excluded from the category total. After an approved third-party assessor reviews the project team's self-assessment score, projects scoring 45 points or more are certified. There are three levels of certification: Four Star Green Certified, signifying "Best Practices" (45 to 59 points required); Five Star Green certified, signifying "Australian Excellence" (60 to 74 points); and Six Star Green Certified, signifying "World Leadership (GBCA, 2010)."

2.8.5 HK-BEAM. The Hong Kong Building Environmental Assessment Method (HK-BEAM) applies to new construction and renovations for all building types. HK-BEAM assesses the entire building process from planning to construction to management and operation. It is a program of the HK-BEAM Society, a nonprofit organization made up of members from the real estate and building construction professions.

HK-BEAM was developed with BREEAM as a starting point and was first launched in 1996. By early 2009, there were 170 certified buildings, totaling 77 million square feet in Hong Kong and mainland China. The program identifies more than 100 criteria in the following categories: Site Aspects, Energy Use, Water Use, Indoor Environmental Quality, and

Innovations and Additions. Four levels of certification may be achieved, with minimum requirements for both the overall score and the indoor environmental quality (IEQ) score. The levels are Bronze, Above Average (40% overall, 45% IEQ); Silver, Good (55% overall, 50% IEQ); Gold, Very Good (65% overall, 55% IEQ); and Platinum, Excellent (75% overall, 65% IEQ). Third-party verification by an approved assessor is required (HK-BEAM, 2010).

2.8.6 SBTool. This is a framework for a building assessment system for commercial, residential, and mixed-use new and existing construction, and it is intended as a toolkit for a national or regional organization to use to develop a local sustainable building assessment system. Because the SBTool is designed to develop an assessment system specific to a particular region, it requires expertise from the national or regional third-party organization tailoring the tool. By the end of 2009, SBTool had been used in at least 20 countries.

In 1996, a section of Natural Resources Canada, now known as Canmet Energy, initiated a research project in whole-building assessment; it presented the resulting GBTool at an international conference in Vancouver in 1998. In 2002, it turned over the GBTool to the International Initiative for a Sustainable Built Environment (iiSBE), an international collaborative nonprofit organization, at which time the framework was renamed SBTool.

To implement the system, the iiSBE provides a series of Microsoft Excel spreadsheets for download from its website, www.iisbe.org. Once the third-party organization uses the SBTool to establish scope, eligible occupancy types, and locally relevant benchmarks and weights, individual teams can use the tailored SBTool to assess a specific project. Criteria include site selection, project planning, and development; energy and resource consumption; environmental loadings; indoor environmental quality; service quality; social and economic aspects; and cultural and perceptual aspects. Design teams can use the SBTool to set performance targets and to self-assess a performance score. Teams submit the project's score to an independent assessor for review. The independent assessor forwards the reviewed assessment to the iiSBE for quality assurance and certification (IISBE, 2010).

2.8.7 Green Globes. The Green Globes system is a green management tool that includes an assessment protocol, rating system and guide for integrating environmentally friendly design into commercial buildings. Once complete, it also facilitates recognition of the project through third-party verification (FGBC, 2012).

Green Globes was originally developed in Canada by a private company using the U.K's BREEAM as a baseline, and then in 2004, the Green Building Initiative (GBI) acquired the rights to promote Green Globes in the U.S. The Oregon-based non-profit Green Building Initiative (GBI) is a not for profit organization whose mission is to accelerate the adoption of building practices that result in energy-efficient, healthier and environmentally sustainable buildings by promoting credible and practical green building approaches for residential and commercial construction (FGBC, 2012; Reeder, 2010).

2.8.8 World Green Building Council. The World Green Building Council (WGBC) was founded in 2002 and is a coalition of national green building councils (WorldGBC, 2011). Its mission statement is "to facilitate the global transformation of the building industry towards sustainability through market driven mechanisms" (WorldGBC, 2011). With member organizations in over 80 countries, WGBC is the largest international organization influencing the green building marketplace (WorldGBC, 2011). Each year the WGBC promotes World Green Building Week, during which member organizations deliver special events promoting public awareness of sustainability. Its membership includes U.S., India and Kenya (WorldGBC, 2011).

2.9 Summary of Literature Review

Section 2.1 presents an overview of the literature that is covered in this chapter. This is followed by section 2.2, which defines what sustainability and sustainable building means in regard to different economic, environmental and social contexts. For example, the economic, environmental and social attributes that make sense to the U.S. building industry may not necessarily make sense to the Kenyan building industry since the building practices in both the U.S. and Kenya are unique to their respective contexts. This baseline understanding is imperative for developing sustainability standards and best practices that are relevant to Kenya.

Section 2.3 presents a cross-cutting overview of roles of key players, or actors, in Kenyan building industry. This understanding is helpful in identifying what/which stakeholders and stakeholder organizations are likely to be front-runners in embracing green building in Kenya.

The case summaries presented in section 2.4 indicate that the Kenyan society has a quest for green building. An important lesson from this discussion is that some of the highlighted green building features are only relevant to Kenya and may not necessarily correspond to the green building attributes that have been developed for other countries.

Section 2.5 sheds light on the adoption and rating attributes of LEED rating system. Notably, LEED standard is member-driven, committee-based, consensus-focused, and voluntary-based. Also, LEED is composed of various rating criteria and credit categories. These attributes provide helpful ideas for establishing a green building rating in another country such as Kenya. Additionally, the in-depth cross-walk assessment in section 2.6 is helpful in understanding what attributes of LEED rating system would apply to the typical building practices in Kenya.

The case study of Potbhare (2008) in section 2.7 reveals that LEED rating system was adopted as a baseline to frame a green building standard in India, despite the differing economic, environmental, and social contexts between the U.S. and India. This is an indication that LEED can be adopted for another country setting – such as Kenya. Also, the section provides a highlight of factors that are likely to impact initial adoption of green building guidelines in a new society – such as Kenya.

Section 2.8 discusses other major international green building rating systems besides LEED. It also highlights the role of the World Green Building Council as an umbrella governing body over various green building councils.

Overall, the extensive literature reviewed in this chapter was meant to provide a solid foundation for pursuing the purpose of this research study as defined by the scope.

CHAPTER 3

Methodology

This study sought to identify (a) green building rating attributes that could be adopted for Kenya, and (b) barriers to initial adoption of green building practices and a green building rating system in Kenya. A major part of the study was founded upon select rating and adoption attributes of existing green building standards, especially the Leadership in Energy and Environmental Design (LEED). Also, the study was built upon findings of a pilot survey which revealed that despite the interest to transition from conventional to green building practices in Kenya, there was no tool for defining and measuring green building goals. The pilot survey further indicated that certain criteria for existing green building rating systems could potentially be adopted to develop meaningful green building guidelines in Kenya.

The overarching premise of the study was guided by the following primary research questions:

<u>Research Question 1:</u> What green building rating attributes are applicable to Kenyan building industry, as identified and validated in this research?

<u>Research Question 2:</u> What is the likelihood of adopting certain green building rating attributes and what is their level of importance, as perceived by Kenyan building professionals?

<u>Research Question 3:</u> Are there any statistically significant differences in perceived importance of certain green building rating attributes among Kenyan building professionals with differing primary occupations, sectors of occupation, and years of experience?

<u>Research Question 4:</u> What are the barriers to adoption of green building practices in Kenya and what is their level of importance, as perceived by Kenyan building professionals?

Research Question 5: Are there any statistically significant differences in perceived importance/severity of barriers to adoption of green building practices and rating system among Kenyan building professionals with differing primary occupations, sectors of occupation, and years of experience?

Additionally, the study pursued one secondary research question, 'What sources of information are potentially useful for promoting awareness of green building in Kenya?'

The research methodology presented in this chapter includes: genesis of research agenda; rationale for research design; rationale for research strategy; rationale for focus group research technique; triangulation process; instrument development; instrument validation; population and sample selection; instrument pilot-testing; reliability of measures; data collection procedures; data analysis procedures; and summary of methodology.

3.1 Genesis of Research Agenda

The research agenda for this study was developed through a number of ways. First, the researcher developed a broad idea of the research based on his interest in international development and green building. This interest was further inspired by his twelve years of experience in the Kenyan building industry and subsequent nine years of experience in the U.S. Second, a review of the literature on green building enabled the researcher to identify the underpinning statement of need for the study. Third, as a LEED professional and member of the U.S. Federal Government Sustainability Work Group, the researcher possessed the relevant background to pursue this area of study. Fourth, he took the following courses as part of his graduate studies: international construction, sustainable construction, research proposal writing, and research methods in construction. These courses particularly helped him to: (i) identify the tenets and processes involved in this study, (ii) ascertain the relevance of the research to Kenya's building industry, (iii) conceptualize how this study should be designed in order to get the needed data, (iv) develop the questions for this research, (v) determine and refine the research instruments and methods for this research, and (vi) develop and test the data analysis techniques which were adopted in this research. Fifth, reviewing his findings with professionals in the building industry, academia, officials of USGBC, and his research supervisor enabled him to develop the research agenda including feasible scope and timeline.

3.2 Rationale for Research Design

A research design helps the researcher to plan how to collect and analyze data (Leedy & Ormrod, 2005). Russell (2000) explains that a research approach is influenced by the research purpose and suggests that research can be categorized as *exploratory*, *descriptive*, and *explanatory*. He further argues that *exploratory* research can be considered when the research aims to uncover issues of a phenomenon under investigation by acquiring evidence to answer a "*what*" type of research question. *Descriptive* research is used when the researcher aims to describe the nature of a phenomenon under study, and is suitable for obtaining data to explain "*how*" such a phenomenon occurs (Russell, 2000). Russell (2000) further argues that *Explanatory* research builds upon *exploratory* and *descriptive* research and goes on to identify the reasons for something that occurs. It aims to answer a "*why*" type of research question. Based on this discussion, the current study was considered to be "*exploratory*" since it attempted to answer "*what*" type of questions.

3.2.1 Qualitative versus quantitative research. Research can also be categorized as qualitative or quantitative. Qualitative research is a multi-method approach involving an interpretive, naturalistic approach to its subject matter. It attempts to study things in their natural settings and interpret the meaning humans bring to them (Leedy & Ormrod, 2005). On the other hand, quantitative research involves measurement and analysis of causal relationships (Leedy & Ormrod, 2005). Yao (2004) states that combining several research methods may increase the rigor of a study because the different methods can compensate for each other's weaknesses and enhance one another's strengths. In concurrence, other researchers assert that integrating both qualitative and quantitative techniques in a research provides greater richness in the findings (Spradley, 1980; White, 2002). While the pilot phase of this study utilized qualitative techniques such as focus group, personal interviews and triangulation, the quantitative research design was determined to be appropriate for the main study since the design would allow collection of data from a large number of participants fitting a specific demographic and attitudinal profile. Furthermore, since this was a country-wide exploratory study, it was important to use a reasonably large sample of participants as a way of broadening representation from across the country.

3.3 Rationale for Research Strategy

Yin (2003) contends that there are many ways to conduct research governed by the relationship between research questions and the research strategy. He suggests that research strategy could be defined by three conditions: (a) the type of research questions, (b) the control of the researcher, and (c) the focus on contemporary events. Table 3.1 presents a summary of relevant situations for different research strategies (Yin, 2003). As illustrated in Table 3.1, the possible research strategies could be *experimental*, *survey*, *archival analysis*, *historical*, and *case studies*. Columns 1 & 2 show the appropriate research strategy for each type of question. Column 3 explains whether or not there is required control over behavioral events for each research strategy. Column 4 explains whether or not the research strategy focuses on contemporary events. Column 3 indicates that an *experimental* strategy is not appropriate for this study because this study does not involve designing the environment in which to address its objectives. The researcher did not intend to control the behavior of respondents in giving opinions on the subject matter. Also, according to Column 4, the *historical* research strategy is not deemed appropriate since the questionnaires for this study focus on contemporary events. Since the study attempted to answer "*what"* type of questions, the appropriate research strategy/strategies could take the form of "*survey,*" or "*archival analysis,"* as shown in Column 2. The study was therefore conducted using a survey strategy.

Table 3.1

Relevant Situations for Different Research Strategies

Strategy	Form of Research Question	Required Control over behavioral events?	Focuses on Contemporary events?
Experiment	how, why?	Yes	Yes
Survey	who, what, where, how many, how much?	No	Yes
Archival Analysis	who, what, where, how many, how much?	No	Yes/No
History	how, why?	No	No
Case Study	how, why?	No	Yes

Source: Yin (2003)

3.4 Rationale for Focus Group Research Technique

The pilot phase of this study partly utilized focus group tools to collect and validate salient information that was necessary to develop a comprehensive and meaningful research instrument for the main survey. Morgan (1996) describes focus group as "a research technique that collects data through group interpretation on a topic determined by the researcher." Apparently, the focus group research technique was not developed until the 1940's (Morgan, 1997; Morgan, 2002). Since then, focus group research techniques became increasingly adopted in various fields such as applied marketing, education, political science, public health, and sociology (Krueger & Kasey, 2000; Morgan, 1996; Morgan, 1997). Litoselliti (2003) identified various research areas in which focus group research tools would be useful, including 1) discovering new information (for example, about a new product), and consolidating old knowledge, and 2) gaining information on a participant's view, attitudes, beliefs, responses, motivations, and perceptions on a topic. This assertion by Litoselliti (2003) is relevant to the study since the core theme involves exploring a relatively new and evolving concept (green building) in a country (Kenya) where the concept is yet to be fully embraced. Also, the study looks at the possibility of transforming the conventional building practices into a new culture – green building.

3.4.1 Focus groups and other research methods. Focus groups can be used either as an independent qualitative research tool or in combination with other methods, including quantitative techniques. For example, Morgan (1996) notes that a content analysis of published research in sociological abstracts showed that in 60% of the cases where focus groups were used, they were conducted in combination with other research methods. Consequently, the current study used the focus group technique to develop the questionnaire instrument, and then employed quantitative research tools to analyze the collected data. Also, due to resource and time constraints, the focus group approach for this study involved both in-person and on-line interviews. This was in regard to an assertion by Litoselliti (2003) that "although focus group studies are typically conducted in person, some have been used in on-line settings."

Overall, the process involved two different focus groups. Almost 50% of the participants were generated through referrals also known as the snowball technique (Patton, 1990; Mason, 1996; Skulmoski and Hartman, 2002) and peer selection (Hartman and Baldwin, 1995). Prior to convention of each focus group, the researcher contacted each participant to prepare them and address any issues/concerns they had. This was meant to improve the overall quality of the survey and help the researcher to validate each participant's suitability for the focus group survey. The summary notes that were taken during each focus group meeting were incorporated into the survey instrument. Follow-up for clarification was done through emails.

3.4.2 Focus Group I. This group consisted of 14 participants and its focus was to review the researcher's raw list of potential factors that inhibit the initial adoption of green building guidelines in Kenya, and provide open-ended comments. All participants were recruited through snow ball sampling and comprised of highly qualified professionals with at least 15 years' of experience in Kenyan building industry. Stratified sampling was further utilized to ensure that at least each of the 8 Provincial Works departments in Kenya were represented (i.e., Coast, Central, Eastern, Nairobi, Rift Valley, Western, Nyanza, and North-eastern). Due to geographical dispersion and resource constraints, it was not feasible for all participants to convene at one venue. Consequently, 5 participants attended the meeting via teleconference call.

3.4.3 Focus Group II. The second focus group consisted of 12 building professionals with international experience who were actively involved in managing building projects in Kenya. Only professionals that demonstrated relevant knowledge and experience of LEED and/or other green building rating systems were invited to participate. The participants represented organizations such as foreign embassies, U.N organizations, and international construction companies operating in Kenya.

The group convened to review the researcher's list of the LEED rating criteria and provide opinions/comments as to which criteria would be relevant to the Kenyan context of building practices. The raw list of criteria was derived from review of the reference guideline of

LEED 2009 for New Construction and Major Renovation. Additionally, the researcher obtained permission to borrow and modify the research findings from a study previously conducted by Ozolins (2010) which included a detailed analysis of the applicability of LEED criteria to the context of building design and construction in Madagascar and Tanzania (Appendix G). The reason for borrowing Ozolins' (2010) findings was because the building practices in Tanzania and Kenya are similar in context.

3.5 Triangulation Process

Before concluding the pilot phase of the study, triangulation was carried out using eight senior building professionals representing eight different provinces of Kenya. According to O'Donoghue and Punch (2003), triangulation is a "method of cross-checking data from multiple sources to search for regularities in the research data. Altrichter, Feldman, Posch, and Somekh (2008) contend that triangulation "gives a more detailed and balanced picture of the situation." Overall, the purpose of triangulation was to validate and test for reliability of the information garnered from the pilot study.

3.6 Instrument Development

Project Management Institute describes questionnaires and surveys as written sets of questions designed to quickly accumulate information from a wide number of respondents (PMBOK, 2008). The advantage of using a questionnaire as compared to laboratory evaluations, expert reviews, and checklists is that a questionnaire is relatively easy to administer and also the real end users of the product are involved in the process (Vuolle et al., 2008).

As discussed elsewhere in this study, the 42-item questionnaire for this study was constructed using information that was obtained from extensive review of literature and findings from the pilot study. The survey was constructed on the online website, www.surveymonkey.com and consisted of five sections. Section I was designed to gather demographic information about the respondents including their primary occupations (Question #1), sectors of occupation (Question #2), and years of experience (Question #3). Section II was structured to investigate barriers that exist to initial adoption of green building practices and rating system in Kenya, and the questions were distributed as shown in Table 3.2. Section III (i.e., Question #15 on the survey instrument) was designed to gather information relative to the respondents' sources of information regarding green building, and was meant to add rigor to Section II.

Table 3.2

Distribution of Questions in Section II of Survey Instrument

Category of Barrier	Corresponding Question #
Technical and Awareness	4, 5, and 6
Institutional	7, 8, and 9
Regulatory and Policy	10, and 11
Socio-economic	12, 13, and 14

Questions in Section IV of the survey instrument were structured to gather data on the respondents' perspectives toward adopting certain LEED rating characteristics for a green building standard in Kenya. The list of the potential LEED rating criteria was initially derived from the findings of a similar study conducted by Ozolins (2010) for the context of Madagascar and Tanzania. This list was then reviewed and validated during the pilot phase of the study and compiled into questionnaire items. As a way of improving the quality of responses, the sequence of the questions was carefully arranged to ensure that questions that belonged to the same category of green building attribute were not consecutively placed; for example, a question in 'sustainable sites' category would not be followed by another question of the same category.

Also, certain terminologies were re-defined to ensure ease of interpretation in the Kenyan context; for example, the term "elevator" as used in the LEED rating standard was worded as "lift," since that is the common reference in the Kenyan context. The resultant list of questions, according to their respective green building attribute categories, is presented in Table 3.3. Lastly, the open-ended question (Question #42) in Section V was designed to collect any additional information and/or comments that the respondents had.

Table 3.3

Distribution of Questions in Section IV of Survey Instrument

Category of Green Building Attribute	Corresponding Question #
Sustainable Sites	16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, and 40
Water Efficiency	17, 25, and 33
Energy and Atmosphere	19, 27, and 35
Materials and Resources	21, 29, 37, and 41
Indoor Environmental Quality	23, 31, and 39

3.6.1 Likert scale. All questions in Sections II and III were rated using a Likert scale consisting of five ranking scores: 'Strongly Agree,' 'Agree,' 'Somewhat Agree,' 'Disagree,' and 'No Opinion/Do Not Know.' The Likert scale is a defendable approximation of an interval scale (Likert, 1932). If the summed responses fulfill these assumptions, parametric statistical tests such as the analysis of variance can be applied (Dawes, 2008). Symmetry of Likert-type responses is implied by the wording of the question and response item scaling and coding. The scaling strategy implies an interval level of measurement as equidistance between response options is assumed (Ott & Longnecker, 2001; Meyers, Guarino, & Gamst, 2005).

3.7 Instrument Validation

As recommended by Straub (1989), the next step entailed validation of the survey instrument prior to its deployment. Gay (1996) proclaims that "content validity is determined by expert judgment. There is no formula by which it can be computed and there is no way to express it quantitatively." Since green building concept is fairly new and still evolving, only experienced individuals were invited to participate in this exercise. The instrument was therefore reviewed by 7 different experts who were champions of green building in their respective organizations, including USGBC, DOE, EPA, and GSA. The select experts examined how well the survey was designed for respondents to answer properly, and also ensured that all the proposed constructs/factors adequately covered the domain areas required to answer the research questions. Also, care was taken in the design of the instrument to allow for respondents participants to take a break and re-enter the survey at the point where they left off, and to make any changes in their entries before finalizing their submission. It was also designed to allow respondents to skip questions that they did not want to answer.

After incorporating feedback from the experts, the instrument was thoroughly reviewed by the major research advisor for content validity, clarity, and format. It was thereafter submitted to the Institutional Review Board (IRB) of North Carolina Agricultural and Technical State University to be reviewed for compliance with research protocol and protection of rights for human subject participants. Upon review, the IRB approved the study vide Notice of IRB Exemption #12-0031 dated 10/05/2012 (Appendix F).

3.8 Population and Sample Selection

The main survey was conducted by administering a questionnaire on a sample of stakeholders in Kenyan building industry in order to understand their awareness and perspectives towards adopting green building practices and rating system. The study targeted occupation categories that were deemed likely to play an early and key role toward embracing green building concept in the country. This included a population of 1,238 building professionals that were registered with the Board of Registration of Architects & Quantity Surveyors of Kenya (BORAQS) as of August 31, 2012. BORAQS database was selected for this study as it represented a convenient location for obtaining the population and sample that would fit the criteria of this study. Further, since BORAQS is a national database, all professionals across Kenya had an equal chance of participating regardless of where they were physically located. In order to conform to appropriate research ethics, the researcher obtained permission BORAQS' Registrar prior to contacting the professional members (Appendix E).

The ultimate sample for the study was selected by a three-step convenience sampling process. The first step involved selecting only those professionals that had an active email on their registration profiles. This yielded a total of 608 professionals. Secondly, an email was sent to all the 608 individuals seeking for their consent to participate in the survey (Appendix G). To this, only 311 positive responses had been received by the two-week deadline of October 19, 2012. The others were either non-responsive or had "undeliverable" email responses.

After removing the emails of positive responses from the list, the researcher sent an email reminder to those who did not respond in the first round, specifying another 2-week response deadline (Appendix G). This increased the number of potential survey participants to 361 as of November 2, 2012. The above process was repeated for a further two weeks, yielding a total of 376 potential participants by November 16, 2012.

One positive attribute about this strategy of participant selection was that it was an unbiased geographic representation of Kenyan building industry, key building professionals, and decision makers. Furthermore, only those who accepted (with a "Yes") to participate in the study received the actual survey (Appendix I). This helped to minimize the degree of un-responsiveness during the actual survey. It is also worthwhile noting that all emails throughout this research exercise were sent as "Blank Carbon Copies (Bcc)" in order to ensure privacy and confidentiality throughout the process. Additionally, the Informed Consent section of the survey instrument noted that all information would be kept confidential; that the survey would not contain information that would personally identify the respondents; and that the survey would not ask for respondents' names (Appendix I).

3.8.1 Convenience sampling. Merriam (1998) argues that non probability sampling makes no attempt to randomize the sample. The study utilized a type of non-probability sampling called convenience sampling, which allows the investigator to rely on research subjects who were readily available (Babbie, 2007). This comprised of Kenyan building professionals who were registered with BORAQS and with an active email address on record. BORAQS is Kenya's nationally accredited body for building professionals (BORAQS, 2012).

3.9 Instrument Pilot-testing

In order to fast-track the process, pilot-testing of the survey instrument was conducted concurrently with the final round of the pre-notice period (i.e., November 2 – 16, 2012). The purpose of pilot-testing the survey instrument was to test how respondents would respond to the questions as a way of helping the researcher to examine the respondents' opinions and interpretations of the survey instrument.

The questionnaire was emailed to 20 randomly selected potential survey respondents (i.e., those who had already responded with a "Yes" to the pre-notice request) with instructions that this was a pilot-test and that the final questionnaire would be emailed to them one week thereafter. They were also requested to complete the survey by November 16, 2012.

Out of the 20 potential survey respondents that received the prototype survey instrument, only 19 had responded by the cut-off date of November 16, 2012. Feedback from the respondents was obtained and utilized to revise the online questionnaire. A copy of the final instrument is attached as Appendix I.

Validity is concerned with whether the question or score can measure what it is supposed to measure (Oppenheim, 1992). For this study, the pilot-testing and approval procedure added rigor to the validity of the instrument and enabled the researcher to formulate the meaning of the survey data. It also contributed toward determining the length of the instrument in order to improve the response rate.

3.10 Reliability of Measures

Reliability refers to the consistency or stability of a test (Breakwell et al., 2006). Oppenheim (1992) defines reliability as "the consistency of a measure and the probability of obtaining similar results if the measure is to be duplicated." For this study, there were at least three steps to ensure reliability in the constructs of the survey instrument. First, the instrument was developed through a rigorous step-by-step process described above. Second, the survey constructs partly utilized findings of prior research by Potbhare (2008) and Ozolins (2010) (see Appendices C and D).

Third, a reliability test was carried out using Cronbach's alpha (α) coefficients to determine if all constructs of the survey instrument fell within acceptable levels. Cronbach's alpha (α) is defined as a measure of the internal consistency of the items in a scale. Alpha levels above 0.70 are considered adequate (Barnett, 2002). As shown in Table 3.4, the Cronbach's alpha coefficients for ‘technical and awareness,’ ‘institutional,’ ‘regulatory and policy,’ and ‘socio-economic’ barriers were at least 0.70. Also, the Cronbach’s alpha coefficients for ‘sustainable sites,’ ‘water efficiency,’ ‘energy and atmosphere,’ ‘materials and resources,’ and ‘indoor environmental quality’ were all above 0.70. This implies that the measures in the survey instrument were reliable (Huizingh, 2007). It should also be reiterated that the rigorous review procedures that were involved in developing the instrument played a significant role of ensuring internal consistency of the question items.

Table 3.4

Internal Consistency Reliability Coefficients for Constructs of Green Building Adoption Barriers and Green Building Attributes

Construct	Number of Questions	Cronbach’s Alpha (α)
Green Building Adoption Barriers		
Technical and Awareness	3	0.91
Institutional	3	0.70
Regulatory and Policy	2	0.78
Socio-economic	2	0.96
Green Building Attributes		
Sustainable Sites	13	0.80
Water Efficiency	3	0.98
Energy and atmosphere	3	0.79
Materials and resources	4	0.76
Indoor environmental quality	3	0.88

3.11 Data Collection Procedure

Due to the geographic dispersion of the study participants, data for the main phase of the study was collected electronically. Research shows that internet surveys present a more diverse and representative population than other means of surveying, such as pencil-and-paper surveys (Farrell & Petersen, 2010; Lewis, Watson, & White, 2008). A number of researchers have suggested that e-mail surveys cost less than traditional mail surveys (Bachmann & Elfrink, 1996; Kiesler & Sproull, 1986; Parker, 1992; Schaefer, 1998; Sproull, 1986). Kaplowitz, Hadlock, and Levine (2004) found web-based surveys distributed via e-mail had similar response rates as paper-based surveys. In regard to quality, Coderre, Mathieu, and St-Laurent (2004) argue that when the issue under investigation is of equal interest, the quality of the information provided by internet surveys is similar to that using mail or telephone surveys. Gaide (2005) adds to this by asserting that electronic questionnaires are associated with higher response rates, and decreased entry errors. Above all, since sustainability is a key underlying factor in this study, electronic transmission was considered the most environmentally friendly way of data collection. Tse (1988) argues that e-mail surveys are better than traditional mail methods since e-mail can be construed as environmentally friendly.

As alluded earlier in this chapter, the actual survey instrument was distributed to the sample participants on November 17, 2012. Two weeks later, a follow-up notice was emailed to those who had not yet responded (Appendix H). The second and final round of follow-up notice went out after another interval of two weeks (Appendix H). The close-out date for data collection was December 31, 2012.

3.12 Data Analysis Procedure

This study targeted building professionals who were registered members of the Board of Registration of Architects and Quantity Surveyors of Kenya (BORAQS), and had an email on their registration profiles. The unit of data analysis was the individual since the study was concerned with the perceptions of individuals; that is, Kenyan building professionals' perceptions toward adoption of green building practices and green building rating system. The dependent variable for the analysis was ‘adoption of green building practices and green building rating system in Kenya.’ Independent or predictor variables composed of two broad sets of categories. For green building rating attributes, the predictor variables were categorized into ‘sustainable sites,’ ‘water efficiency,’ ‘energy and atmosphere,’ ‘materials and resources,’ and ‘indoor environmental quality.’ For green building adoption barriers, the predictor variables were categorized into ‘technical and awareness,’ ‘institutional,’ ‘regulatory and policy,’ and ‘socio-economic.’ Theoretically, the predictor, or independent, variables were expected to affect, or influence, adoption of green building practices and green building rating system in Kenya. Additional variables that were analyzed were categorized as demographic, which included ‘primary occupation,’ ‘sector of occupation,’ and ‘years of experience.’

After collection, all data was exported to Statistical Package for the Social Sciences (SPSS) version 20 for computation of results. In order to facilitate easy storage, data was coded by assigning character symbols before it was entered into SPSS. Each question or item in the questionnaire was given a unique variable name and a separate record was kept for how each variable was coded.

Prior to the analysis, the coded survey data was cleaned and it was found that all the 347 responses were usable, although some respondents had skipped a few questions. Missing data was detected by running frequency counts in SPSS. According to the criteria recommended by Hair, Anderson, Tatham, and Black (1998), variables with a missing value larger than 30% should be removed. Unanswered questions in this survey were less than 1% in each case and could not, therefore, prevent the variables from receiving further analysis. Also, the few instances with missing data were resolved by imputing field means into the empty cell. Outliers were detected by converting case scores into *z*-scores and comparing them to the critical value of +/- 3.29, $p < .001$ (Creswell, 2003; Huizingh, 2007). Seven cases exceeded this value and so they were removed. The data was then re-organized and simplified for clarity and consistence.

A combination of descriptive statistics, one-way analysis of variance (ANOVA), and content analysis was then utilized for the analysis. The procedures were carefully handled not to accidentally edit or manipulate any data as that would compromise the integrity of results.

3.12.1 Descriptive statistics. Descriptive statistics involves arranging, summarizing, and processing a set of data in such a way that meaningful essentials of the data can be produced and interpreted (Keller & Warrack, 2003). With the help of this procedure, many variables could be compared and the importance was assigned to each of them. Descriptive analyses for this study included frequencies, percentages, mean values, and mean rankings.

3.12.2 One-way Analysis of Variance (ANOVA). One-way Analysis of Variance (ANOVA) was utilized to investigate statistical differences in responses from differing respondents' group variables of 'primary occupation,' 'sector of occupation,' and 'years of experience.' The output from SPSS for the one-way ANOVA provided the parameters used for determining the significance levels. These parameters included degrees of freedom (df), mean square, F value, and level of significance (p). Degree of freedom (df) is used to obtain the observed level of significance (p). Mean square is the sum of squares divided by df, and F is the ration of two mean squares. An ANOVA significance level (Sig.) or *p* value of 0.05 was used as the threshold. In other words, if the calculated result was less than 0.05, it meant that there was a statistically significant difference between the comparison groups.

3.12.3 Content analysis. Content analysis was utilized to analyze data for open-ended survey questions. Content analysis refers to "any qualitative data reduction and sense-making effort that takes a volume of qualitative material and attempts to identify core consistencies and meanings" (Patton 2002). The data is organized according to clearly defined context specific categories so each data point can only be assigned to one category (Bordens & Abbot, 1996; Fellows & Liu, 1997). According to Neuman (2003), content analysis "yields repeatable, precise results about the text." The combination of statistical and content analysis during data interpretation was necessary for building rigor into the analysis process and ensuring robust outcome of results in this study.

3.13 Summary of Methodology

This chapter presented the research methods and procedures that were employed in this study, including the rationale for choosing them. It also described the population and sampling criteria, instrumentation process, and data collection and analysis techniques that were used.

CHAPTER 4

Results and Data Analysis

This study sought to identify (a) green building rating attributes that could be potentially adopted for the Kenyan building industry, and (b) barriers to initial adoption of green building practices and rating system in Kenya. Alongside these two primary objectives, the study investigated if there were any statistically significant differences in responses based on respondents' primary occupation, sector of occupation, and years of experience. This chapter presents a detailed analysis of data collected and results. The discussion includes demographic profile of survey respondents, analysis of research questions, and summary.

4.1 Demographic Profile of Survey Respondents

As discussed elsewhere in this paper, data for this study was collected between November 17, 2012 and December 31, 2012. The target sample was 608 and the response rate was 347 (57.1%). Singleton and Straits (2005) assert that while a sample size of 2,500 might yield only a standard error of 1%, this size should not be regarded as the standard sample size. They further argue that while 30 respondents may be adequate to produce statistically significant results, most researchers would recommend at least 100 (Singleton & Straits, 2005). The sample and response rate for this study was therefore considered statistically reasonable.

Descriptive statistics were utilized to analyze responses to questionnaire items in Section I (i.e., Q1-3). Three demographic variables, including primary occupation, primary sector of occupation, and years of experience were used to profile the survey respondents. Results of the demographic distribution of responses according to 'primary occupation,' 'sector of occupation,' and 'years of experience' are displayed in Figure 4.1, Figure 4.2, and Figure 4.3 respectively.

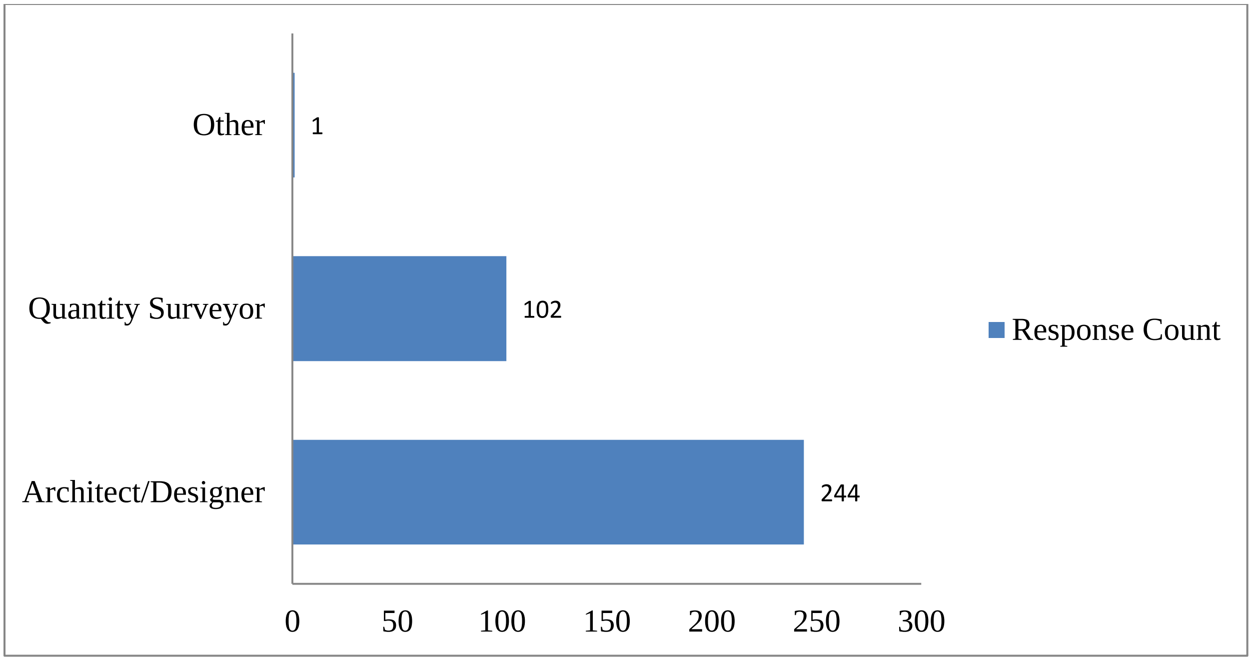

Figure 4.1. Demographic distribution of responses according to 'primary occupation' (n = 347).

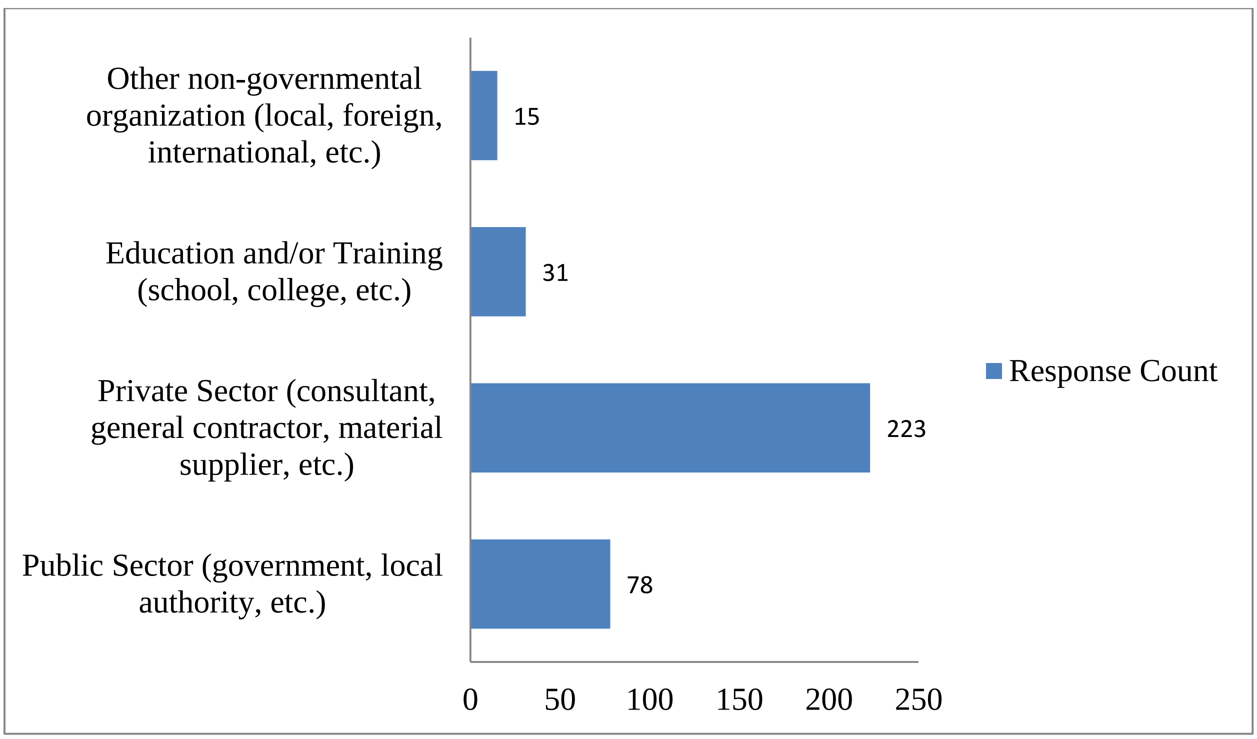

Figure 4.2. Demographic distribution of responses according to 'sector of occupation' (n = 347).

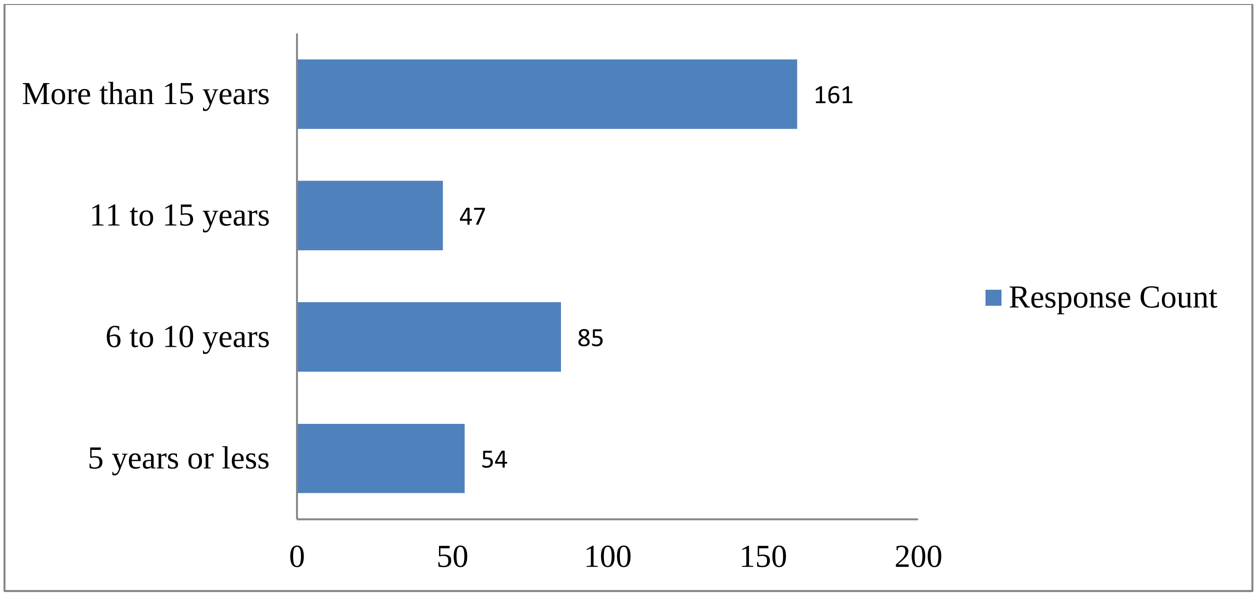

Figure 4.3. Demographic distribution of responses according to ‘years of experience’ (*n* = 347).

Among the 347 survey respondents, 244 (70.3%) identified their primary occupations as Architects/Designers; 102 (29.4%) identified themselves as Quantity Surveyors; and 1 (0.3%) as Engineer. In regard to primary sectors of occupation, 78 (22.5%) of the respondents belonged to public sector; 223 (64.3%) were from private sector; 31 (8.9%) from education and/or training; and 15 (4.3%) from other non-governmental organizations. A total of 54 (15.6%) respondents had cumulative of up to 5 years’ experience in Kenyan building industry; 85 (24.5%) had between 6 to 10 years; 47 (13.5%) had between 11 to 15 years; and 161 (46.4%) had over 15 years’ experience.

4.2 Analysis of Research Questions

Each research question for this study was examined independently thereby adding rigor to the data analysis process.

4.2.1 Research Question 1. *What green building rating attributes are applicable to Kenyan building industry, as identified and validated in this research?*

The results of descriptive analysis in Table 4.7 indicated that all the 26 green building rating attributes identified and tested in this study were perceived to be important. This is because, according to the scale of importance that was employed in this study, their mean rating scores ranged from moderate, to moderately high, to high. Consequently, this study asserts that the green building rating attributes and corresponding categories presented in Table 4.1 are applicable to Kenyan building industry.

Table 4.1

Green Building Rating Attributes That Are Applicable to Kenyan Building Industry

Category	Green Building Rating Attribute
Sustainable Sites	• Prevent construction activity from causing site and air pollution. • Protect or restore the natural state of the building site in terms of ecosystem, agriculture, plants and animal habitat. • Build/construct on a previously developed site. • Preferably locate the project site in a location with higher population density. • Build/construct on a contaminated site such as brownfield. • Preferably build/construct near to existing transport and utilities infrastructure. • Provide secure bicycle storage space for building occupants/users. • Encourage building occupants to use vehicles that are fuel-efficient and emit lesser pollutants. • Minimize the number of car parking spaces on the building premises/site. • Maximize open space on the building/site. • Control the quantity of storm water runoff from the building/site. • Control the quality of storm water runoff from the building/site. • Preferably use roof and non-roof materials with higher heat reflection.
Water Efficiency	• Implement strategies to minimize the amount of water used in the building. • Treat and re-use waste water in the building. • Collect rainwater for use in the building.
Energy and Atmosphere	• Implement strategies to minimize the amount of energy used in the building. • Preferably use renewable energy that is generated on the building site (e.g., solar and wind). • Implement strategies to measure and verify energy use in the building.

Table 4.1

(Cont.)

Category	Green Building Rating Attribute
Materials and Resources	• Preferably re-use an existing building structure instead of constructing a new one. • Preferably use recycled or salvaged building materials. • Preferably use materials that are available close to the building/site. • Preferably use building materials that are rapidly-renewable or replenishable.
Indoor Environmental Quality	• Prohibit smoking indoors. • Provide walk-off mats, grills, or grates at building entries. • Implement strategies to achieve maximum daylight entering the building.

4.2.2 Research Question 2. *What is the likelihood of adopting certain green building rating attributes and what is their level of importance, as perceived by Kenyan building professionals?*

Descriptive statistics were utilized to answer this research question. The analysis was conducted on survey items Q16-Q41. After exporting the data from the Survey Monkey to SPSS 20, each green building rating attribute corresponding to the survey items was identified with one of the following categories: ‘sustainable sites,’ ‘water efficiency,’ ‘energy and atmosphere,’ ‘materials and resources,’ and ‘indoor environmental quality.’ The following formula was then used to calculate and rank the importance of each attribute and corresponding category:

$$\text{Mean rating} = \frac{\sum_{i=1}^{5} W * F_i}{n}\text{, where,}$$

W = weight assigned or scale value of respondent’s response for the specified survey item (variable): W=1, 2, 3, 4 and 5;

F_i = frequency of the i^{th} response;

n = total number of respondents to the survey item (variable); and

i = response scale value = 1,2,3,4 and 5 for no opinion/do not know, disagree, somewhat agree, agree, and strongly agree, respectively.

For the purpose of this analysis, responses with variable means below 2.5 were considered low/not important; those between 2.5 and 3.0 were considered moderate; those between 3.0 and 4.0 were considered moderately high; while those above 4.0 were considered high. The results of data analysis for each category of green building ratting attributes are presented in Tables 4.2 – 4.6.

Table 4.2

Mean Ratings for Responses on 'Sustainable Sites' Green Building Attributes

Survey Item	Item Description	Response Count	Mean Rating
Q18	Protect or restore the natural state of the building site in terms of ecosystem, agriculture, plants and animal habitat	341	4.37
Q38	Control the quality of storm water runoff from the building/site	340	4.25
Q36	Control the quantity of storm water runoff from the building/site	341	4.22
Q16	Prevent construction activity from causing site and air pollution	341	4.20
Q34	Maximize open space at the building/site	340	3.98
Q40	Use roof and non-roof materials with higher heat reflection	341	3.85
Q26	Build/construct near to existing transport and utilities infrastructure	341	3.76
Q30	Encourage building occupants to use vehicles that are fuel-efficient and emit lesser pollutants	341	3.68
Q28	Provide secure bicycle storage space for building occupants	341	3.61
Q24	Build/construct on a contaminated site (e.g., industrial site or brownfield)	341	3.34
Q20	Build/construct on a previously developed site	340	3.03
Q32	Minimize the number of car parking spaces at the building premises/site	341	2.85
Q22	Build/construct in a densely populated neighborhood	339	2.74

Overall Rating Average: 3.68

Table 4.3

Mean Ratings for Responses on 'Materials and Resources' Green Building Attributes

Survey Item	Item Description	Response Count	Mean Rating
Q37	Use materials that are closely available to the building/site	340	4.13
Q29	Build/construct using recycled or salvaged building materials	341	3.85
Q41	Use building materials that can be renewed or replenished rapidly	341	3.85
Q21	Re-use an existing building structure instead of constructing a new one	341	3.15

Overall Rating Average: 3.75

Table 4.4

Mean Ratings for Responses on 'Water Efficiency' Green Building Attributes

Survey Item	Item Description	Response Count	Mean Rating
Q33	Collect rainwater for use in the building	341	4.66
Q25	Treat and re-use waste water in the building	340	4.55
Q17	Minimize the amount of water used in the building	340	4.40

Overall Rating Average: 4.54

Table 4.5

Mean Ratings for Responses on 'Energy and Atmosphere' Green Building Attributes

Survey Item	Item Description	Response Count	Mean Rating
Q19	Minimize the amount of energy used in the building	341	4.88
Q27	Use renewable energy that is generated on the building site	341	4.63
Q35	Measure and verify energy use in the building	341	4.39

Overall Rating Average: 4.63

Table 4.6

Mean Ratings for Responses on 'Indoor Environmental Quality' Green Building Attributes

Survey Item	Item Description	Response Count	Mean Rating
Q39	Use strategies to achieve maximum daylight entering the building	341	4.68
Q23	Prohibit smoking inside the building	341	3.71
Q31	Provide walk-off mats, grills, or grates at building entries	341	3.20

Overall Rating Average: 3.86

The descriptive data analyses in Tables 4.2 4.3, 4.4, 4.5, and 4.6 were further compiled and ranked according to mean rating, as shown in Table 4.7. The output of SPPS indicates that all the three green building attributes which belong to the category of 'energy and atmosphere' were ranked by respondents as having top-most importance. Q19 *(minimize the amount of energy used in the building)* was ranked the most important overall with a mean rating of 4.88; Q27 *(use renewable energy that is generated on the building site)* had a mean rating of 4.63 was ranked 4th overall; while Q35 *(measure and verify energy use in the building)* was ranked 7th overall.

Besides the 'energy and atmosphere' category, the 'water efficiency' green building attributes were also rated as highly important. Q33 *(collect rainwater for use in the building)* took 3rd place overall with a mean rating of 4.66; Q25 *(treat and re-use waste water in the building)* was 5th overall with a mean rating of 4.55; while Q17 *(minimize the amount of water used in the building)* was ranked 6th overall with a mean rating of 4.40.

Out of the three 'indoor environmental quality' green building attributes, only one was rated as being highly important. This was Q39 *(use strategies to achieve maximum daylight entering the building)*, and had a mean rating of 4.68. Second in this category was Q23 *(prohibit smoking inside the building)* which was rated moderately high in importance with a mean value of 3.71. Q31 *(provide walk-off mats, grills, or grates at building entries)* was rated as being moderately important and had a mean rating of 3.20.

Among ‘materials and resources’ green building attributes, only Q37 *(use materials that are closely available to the building/site)* was rated as highly important, and had a mean value of 4.13. Both Q29 *(build/construct using recycled o salvaged building materials)* and Q41 *(use building materials that can be renewed or replenished rapidly)* were rated as being of moderately high importance with a mean value of 3.85. However, Q21 *(re-use an existing building structure instead of constructing a new one)* was rated as having moderate importance and received a mean rating of 3.15.

Out of the thirteen green building attributes in the category of ‘sustainable sites,’ four were rated as being highly important. These were: Q18 *(protect or restore the natural state of the building site in terms of ecosystem, agriculture, plants and animal habitat)* which had a mean rating of 4.37 and was ranked 8th overall; Q38 *(control the quality of storm water runoff from the building/site)* which had a mean rating of 4.25 and was ranked 9th overall; Q36 *(control the quantity of storm water runoff from the building/site)* which had a mean rating of 4.22 and was ranked 10th overall; and Q16 *(prevent construction activity from causing site and air pollution)* which had a mean rating of 4.13 and was ranked 11th overall.

Seven of the green building attributes in the category of ‘sustainable sites’ were rated as having moderately high importance. These were: Q34 *(maximize open space at the building/site)* which had a mean rating of 3.98 and was ranked 13th overall; Q40 *(use roof and non-roof materials with higher heat reflection)* which had a mean rating of 3.85 and was ranked 14th overall; Q26 *(build/construct near to existing transport and utilities infrastructure)* which had a mean rating of 3.76 and was ranked 17th overall; Q30 *(encourage building occupants to use* *vehicles that are fuel-efficient and emit lesser pollutants)* which had a mean rating of 3.68 and was ranked 19th overall; and Q28 *(provide secure bicycle storage space for building occupants)* which had a mean rating of 3.61 and was ranked 20th overall; Q24 *(build/construct on a contaminated site (e.g., industrial site or brownfield))* which had a mean rating of 3.34 and was ranked 21st overall; and Q20 *(build/construct on a previously developed site)* which had a mean rating of 3.03 and was ranked 24th overall.

Out of the entire list of twenty green building attributes investigated, only two were determined to be of moderate importance to the context of building practices in Kenya. Both belonged to the category of 'sustainable sites.' They were: Q32 *(minimize the number of car parking spaces at the building premises/site)* which had a mean rating of 2.85 and was ranked 25th overall; and Q22 *(build/construct in a densely populated neighborhood)* which had a mean rating of 2.74 and was ranked 26th overall.

Table 4.7

Comparative Ranking for Green Building Attributes in Order of Importance

Survey Item	Item Description	Category*	Mean Rating	Rank
Q19	Minimize the amount of energy used in the building	EA	4.88	1
Q39	Use strategies to achieve maximum daylight entering the building	IQ	4.68	2
Q33	Collect rainwater for use in the building	WE	4.66	3
Q27	Use renewable energy that is generated on the building site	EA	4.63	4
Q25	Treat and re-use waste water in the building	WE	4.55	5
Q17	Minimize the amount of water used in the building	WE	4.40	6
Q35	Measure and verify energy use in the building	EA	4.39	7
Q18	Protect or restore the natural state of the building site in terms of ecosystem, agriculture, plants and animal habitat	SS	4.37	8

Table 4.7

(Cont.)

Survey Item	Item Description	Category[*]	Mean Rating	Rank
Q38	Control the quality of storm water runoff from the building/site	SS	4.25	9
Q36	Control the quantity of storm water runoff from the building/site	SS	4.22	10
Q16	Prevent construction activity from causing site and air pollution	SS	4.20	11
Q37	Use materials that are closely available to the building/site	MR	4.13	12
Q34	Maximize open space at the building/site	SS	3.98	13
Q29	Build/construct using recycled or salvaged building materials	MR	3.85	14
Q40	Use roof and non-roof materials with higher heat reflection	SS	3.85	14
Q41	Use building materials that can be renewed or replenished rapidly	MR	3.85	14
Q26	Build/construct near to existing transport and utilities infrastructure	SS	3.76	17
Q23	Prohibit smoking inside the building	IQ	3.71	18
Q30	Encourage building occupants to use vehicles that are fuel-efficient and emit lesser pollutants	SS	3.68	19
Q28	Provide secure bicycle storage space for building occupants	SS	3.61	20
Q24	Build/construct on a contaminated site (e.g., industrial site or brownfield)	SS	3.34	21
Q31	Provide walk-off mats, grills, or grates at building entries	IQ	3.20	22
Q21	Re-use an existing building structure instead of constructing a new one	MR	3.15	23
Q20	Build/construct on a previously developed site	SS	3.03	24
Q32	Minimize the number of car parking spaces at the building premises/site	SS	2.85	25
Q22	Build/construct in a densely populated neighborhood	SS	2.74	26

[*] Categories of green building attributes include Sustainable Sites (SS), Water Efficiency (WE), Energy and Atmosphere (EA), Materials and Resources (MR), and Indoor Environmental Quality (IQ).

4.2.3 Research Question 3. *Are there any statistically significant differences in perceived importance of certain green building rating attributes among Kenyan building professionals with differing primary occupations, sectors of occupation, and years of experience?*

One-way ANOVA was used to test for significant differences in perceived importance of certain green building rating attributes among Kenyan building professionals with differing primary occupations, sectors of occupation, and years of experience. The analysis was conducted on survey items Q16-Q41. After exporting the data from the Survey Monkey to SPSS 20, each green building rating attribute corresponding to the survey items was identified with one of the following categories: 'sustainable sites,' 'water efficiency,' 'energy and atmosphere,' 'materials and resources,' and 'indoor environmental quality.' Since respondents skipped some questions, the sample size (n) and degree of freedom (df) was not the same in all questions. It was therefore necessary to perform the tests on individual questions instead of individual categories. The results were, however, reported according to the five green building rating categories.

4.2.3.1 One-way ANOVA based on respondent primary occupation. The one-way ANOVA test on 'primary occupation' was performed on three groups of respondents, Architect/Designer; Quantity Surveyor; and Other (see Figure 4.1). Only 1 respondent indicated "other" and was therefore not included in this analysis since the corresponding n-1 value would equal zero. The output of SPSS presented in Table 4.8 indicates that:

1. There was statistically significant difference in perceived importance of Q36 *(control the quantity of storm water runoff from the building/site)* among Kenyan building professionals with differing primary occupations ($p = 0.0324$). However, there was no statistically significant difference in perceived importance of the other sustainable sites'

green building rating attributes among Kenyan building professionals with differing primary occupations.

2. There was statistically significant difference in perceived importance of Q25 *(treat and re-use waste water in the building)* among Kenyan building professionals with differing primary occupations (p = 0.0285). However, there was no statistically significant difference in perceived importance of the other 'water efficiency' green building rating attributes among Kenyan building professionals with differing primary occupations.
3. There was no statistically significant difference in perceived importance of 'energy and atmosphere' green building rating attributes among Kenyan building professionals with differing primary occupations.
4. There was no statistically significant difference in perceived importance of 'materials and resources' green building rating attributes among Kenyan building professionals with differing primary occupations.
5. There was no statistically significant difference in perceived importance of 'indoor environmental quality' green building rating attributes among Kenyan building professionals with differing primary occupations.

Table 4.8

One-Way ANOVA for Perceived Importance of Green Building Rating Attributes Among Kenyan Building Professionals with Differing 'Primary Occupations'

		Sum of Squares	*df*	Mean Square	*F*	Sig. (*p*)
Sustainable Sites						
Q16	Between Groups	.330762282	1	.165381141	0.22	0.8007
	Within Groups	28.1082621	340	.739691108		
	Total	28.4390244	341			

Table 4.8

(Cont.)

		Sum of Squares	*df*	Mean Square	*F*	Sig. (*p*)
Sustainable Sites (Cont.)						
Q18	Between Groups	1.84837746	1	.924188729	1.48	0.2396
	Within Groups	23.6638177	340	.622732044		
	Total	25.5121951	341			
Q20	Between Groups	.497948718	1	.233974359	0.35	0.7094
	Within Groups	24.3012821	339	.675035613		
	Total	24.7692308	340			
Q22	Between Groups	1.52157248	1	.760786241	0.82	0.4485
	Within Groups	31.5054545	338	.926631016		
	Total	33.027027	339			
Q24	Between Groups	3.75340449	1	1.87670225	1.38	0.2658
	Within Groups	47.7202797	340	1.36343656		
	Total	51.4736842	341			
Q26	Between Groups	.922798972	1	.461399486	0.43	0.6527
	Within Groups	40.6381766	340	1.0694257		
	Total	41.5609756	341			
Q28	Between Groups	3.35723716	1	1.67861858	1.50	0.2351
	Within Groups	42.3988604	340	1.11575948		
	Total	45.7560976	341			
Q30	Between Groups	.980612883	1	.490306442	0.42	0.6572
	Within Groups	43.8974359	340	1.15519568		
	Total	44.8780488	341			
Q32	Between Groups	2.26923077	1	1.13461538	1.29	0.2873
	Within Groups	31.6282051	340	.878561254		
	Total	33.8974359	341			
Q34	Between Groups	2.31762974	1	1.15881487	1.84	0.1736
	Within Groups	22.0244755	339	.629270729		
	Total	24.3421053	340			
Q36	Between Groups	5.48333333	1	2.74166667	3.77	**0.0324**
	Within Groups	26.9166667	340	.727477477		
	Total	32.4	341			
Q38	Between Groups	3.31481481	1	1.65740741	2.18	0.1278
	Within Groups	28.1851852	339	.761761762		
	Total	31.5	340			
Q40	Between Groups	.006481481	1	.003240741	0.00	0.9958
	Within Groups	28.7685185	340	.77752758		
	Total	28.775	341			

Table 4.8

(Cont.)

		Sum of Squares	*df*	Mean Square	*F*	Sig. (*p*)
Water Efficiency						
Q17	Between Groups	.830769231	1	.415384615	0.57	0.5681
	Within Groups	26.7692308	339	.723492723		
	Total	27.6	340			
Q25	Between Groups	2.68589744	1	1.34294872	3.93	**0.0285**
	Within Groups	12.2884615	339	.341346154		
	Total	14.974359	340			
Q33	Between Groups	1.4592245	1	.737961226	2.88	0.0686
	Within Groups	9.74358974	340	.256410256		
	Total	11.2195122	341			
Energy and Atmosphere						
Q19	Between Groups	.031269543	1	.015634772	0.14	0.8730
	Within Groups	4.35897436	340	.114709852		
	Total	4.3902439	341			
Q27	Between Groups	1.09624071	1	.548120353	1.68	0.2004
	Within Groups	12.4159544	340	.326735643		
	Total	13.5121951	341			
Q35	Between Groups	.160655966	1	.080327983	0.13	0.8790
	Within Groups	23.5954416	340	.620932674		
	Total	23.7560976	341			
Materials and Resources						
Q21	Between Groups	1.48333333	1	.741666667	0.89	0.4202
	Within Groups	30.9166667	340	.835585586		
	Total	32.4	341			
Q29	Between Groups	1.08206518	1	.54103259	0.60	0.5518
	Within Groups	34.039886	340	.895786475		
	Total	35.1219512	341			
Q37	Between Groups	.300925926	1	.150462963	0.21	0.8087
	Within Groups	26.0740741	339	.704704705		
	Total	26.375	340			
Q41	Between Groups	3.81203704	1	1.90601852	2.14	0.1321
	Within Groups	32.962963	340	.890890891		
	Total	36.775	341			
Indoor Environmental Quality						
Q23	Between Groups	1.98425926	1	.99212963	0.72	0.4935
	Within Groups	50.9907407	340	1.37812813		
	Total	52.975	341			

Table 4.8

(Cont.)

		Sum of Squares	*df*	Mean Square	*F*	Sig. (*p*)
Indoor Environmental Quality (Cont.)						
Q31	Between Groups	.353808354	1	.176904177	0.17	0.8417
	Within Groups	34.7272727	340	1.02139037		
	Total	35.0810811	341			
Q39	Between Groups	.3937183	1	1.19685915	3.14	0.0547
	Within Groups	14.4843305	340	.381166592		
	Total	16.8780488	341			

4.2.3.2 One-way ANOVA based on respondent sector of occupation. The one-way ANOVA test on ‘sector of occupation’ was performed on four groups of respondents, public sector; private sector; education and/or training; and other non-governmental organization (see Figure 4.2). The output of SPSS presented in Table 4.9 indicates that:

1. There was no statistically significant difference in perceived importance of ‘sustainable sites’ green building rating attributes among differing sectors of occupation.

2. There was no statistically significant difference in perceived importance of ‘water efficiency’ green building rating attributes among differing sectors of occupation.

3. There was no statistically significant difference in perceived importance of ‘energy and atmosphere’ green building rating attributes among differing sectors of occupation.

4. There was no statistically significant difference in perceived importance of ‘materials and resources’ green building rating attributes among differing sectors of occupation.

5. There was no statistically significant difference in perceived importance of ‘indoor environmental quality’ green building rating attributes among differing sectors of occupation.

Table 4.9

One-way ANOVA for Perceived Importance of Green Building Rating Attributes Among Kenyan Building Professionals with Differing 'Sectors of Occupation'

		Sum of Squares	*df*	Mean Square	*F*	Sig. (*p*)
Sustainable Sites						
Q16	Between Groups	1.83717254	3	.612390846	0.85	0.4746
	Within Groups	26.6018519	340	.718968969		
	Total	28.4390244	343			
Q18	Between Groups	1.63256549	3	.544188497	0.84	0.4790
	Within Groups	23.8796296	340	.645395395		
	Total	25.5121951	343			
Q20	Between Groups	2.01923077	3	.673076923	1.04	0.3889
	Within Groups	22.75	339	.65		
	Total	24.7692308	342			
Q22	Between Groups	2.10440798	3	.701469326	0.75	0.5310
	Within Groups	30.922619	338	.937049062		
	Total	33.027027	341			
Q24	Between Groups	3.18368421	3	1.06122807	0.75	0.5315
	Within Groups	48.29	340	1.42029412		
	Total	51.4736842	343			
Q26	Between Groups	3.51930894	3	1.17310298	1.14	0.3453
	Within Groups	38.0416667	337	1.02815315		
	Total	41.5609756	340			
Q28	Between Groups	5.61257904	3	1.87085968	1.72	0.1788
	Within Groups	40.1435185	340	1.08495996		
	Total	45.7560976	343			
Q30	Between Groups	2.76230804	3	.920769346	0.81	0.4970
	Within Groups	42.1157407	340	1.13826326		
	Total	44.8780488	343			
Q32	Between Groups	4.9824359	3	1.66081197	2.01	0.1304
	Within Groups	28.915	340	.826142857		
	Total	33.8974359	343			
Q34	Between Groups	1.74595142	3	.581983806	0.88	0.4633
	Within Groups	22.5961538	339	.66459276		
	Total	24.3421053	342			
Q36	Between Groups	2.29285714	3	.764285714	0.91	0.4439
	Within Groups	30.1071429	340	.836309524		
	Total	32.4	343			
Q38	Between Groups	2.71153846	3	.903846154	1.13	0.3498
	Within Groups	28.7884615	339	.799679487		
	Total	31.5	342			

Table 4.9

(Cont.)

		Sum of Squares	df	Mean Square	F	Sig. (p)
Sustainable Sites (Cont.)						
Q40	Between Groups	1.74615385	3	.582051282	0.78	0.5155
	Within Groups	27.0288462	340	.750801282		
	Total	28.775	343			
Water Efficiency						
Q17	Between Groups	3.68653846	3	1.22884615	1.85	0.1556
	Within Groups	23.9134615	339	.664262821		
	Total	27.6	342			
Q25	Between Groups	.909358974	3	.303119658	0.75	0.5273
	Within Groups	14.065	339	.401857143		
	Total	14.974359	342			
Q33	Between Groups	.825993677	3	.275331226	0.98	0.4126
	Within Groups	10.3935185	340	.280905906		
	Total	11.2195122	343			
Energy and Atmosphere						
Q19	Between Groups	.223577236	3	.074525745	0.66	0.5808
	Within Groups	4.16666667	340	.112612613		
	Total	4.3902439	343			
Q27	Between Groups	.618676603	3	.206225534	0.59	0.6243
	Within Groups	12.8935185	340	.348473473		
	Total	13.5121951	343			
Q35	Between Groups	1.75146793	3	.583822644	0.68	0.4119
	Within Groups	22.0046296	340	.59471972		
	Total	23.7560976	343			
Materials & Resources						
Q21	Between Groups	3.39038462	3	1.13012821	1.40	0.2579
	Within Groups	29.0096154	340	.80582265		
	Total	32.4	343			
Q29	Between Groups	.922877145	3	.307625715	0.33	0.8016
	Within Groups	34.1990741	340	.924299299		
	Total	35.1219512	343			
Q37	Between Groups	.733465608	3	.244488536	0.34	0.7942
	Within Groups	25.6415344	339	.712264844		
	Total	26.375	342			
Q41	Between Groups	3.95886243	3	1.31962081	1.45	0.2451
	Within Groups	32.8161376	340	.911559377		
	Total	36.775	343			

Table 4.9

(Cont.)

		Sum of Squares	df	Mean Square	F	Sig. (p)
Indoor Environmental Quality						
Q23	Between Groups	5.76346154	3	1.92115385	1.46	0.2404
	Within Groups	47.2115385	340	1.31143162		
	Total	52.975	343			
Q31	Between Groups	1.11368978	3	.371229926	0.36	0.7818
	Within Groups	33.9673913	340	1.02931489		
	Total	35.0810811	343			
Q39	Between Groups	.317863595	3	.105954532	0.24	0.8702
	Within Groups	16.5601852	340	.447572573		
	Total	16.8780488	343			

4.2.3.3 One-way ANOVA based on respondent years of experience. The one-way ANOVA test on ‘years of experience’ was performed on four groups of respondents, 5 or less; 6-10; 11-15; and more than 15 (see Figure 4.3). The output of SPSS presented in Table 4.10 indicates that:

1. There was statistically significant difference in perceived importance of Q28 *(provide secure bicycle storage space for building occupants)* among Kenyan building professionals with differing years of experience (p = 0.0151). Also, there was statistically significant difference on perceived importance of Q30 *(encourage building occupants to use vehicles that are fuel-efficient and emit lesser pollutants)* among Kenyan building professionals with differing years of experience (p = 0.0483). However, there was no statistically significant difference in perceived importance of the other ‘sustainable sites’ green building rating attributes among Kenyan building professionals with differing years of experience.

2. There was no statistically significant difference in perceived importance of ‘water efficiency’ green building rating attributes among Kenyan building professionals with differing years of experience.
3. There was no statistically significant difference in perceived importance of ‘energy and atmosphere’ green building rating attributes among Kenyan building professionals with differing years of experience.
4. There was no statistically significant difference in perceived importance of ‘materials and resources’ green building rating attributes among Kenyan building professionals with differing years of experience.
5. There was no statistically significant difference in perceived importance of ‘indoor environmental quality’ green building rating attributes among Kenyan building professionals with differing years of experience.

Table 4.10

One-Way ANOVA for Perceived Importance of Green Building Rating Attributes among Kenyan Building Professionals with Differing ‘Years of Experience’

		Sum of Squares	*df*	Mean Square	*F*	Sig. (*p*)
Sustainable Sites						
Q16	Between Groups	1.4234909	3	.474496968	0.65	0.5881
	Within Groups	27.0155335	340	.730149554		
	Total	28.4390244	343			
Q18	Between Groups	2.58018595	3	.860061985		
	Within Groups	22.9320092	340	.619784032		
	Total	25.5121951	343			
Q20	Between Groups	4.25158371	3	1.41719457	2.42	0.0827
	Within Groups	20.5176471	339	.586218487		
	Total	24.7692308	342			
Q22	Between Groups	.284169884	3	.094723295	0.10	0.9620
	Within Groups	32.7428571	338	.992207792		
	Total	33.027027	341			

Table 4.10

(Cont.)

		Sum of Squares	*df*	Mean Square	*F*	Sig. (*p*)
Sustainable Sites (Cont.)						
Q24	Between Groups	1.10285088	3	.367616959	0.25	0.8621
	Within Groups	50.3708333	340	1.4814951		
	Total	51.4736842	343			
Q26	Between Groups	4.045882409	3	1.34860803	1.33	0.2793
	Within Groups	37.5151515	340	1.01392301		
	Total	41.5609756	343			
Q28	Between Groups	11.1342488	3	3.71141627	3.97	**0.0151**
	Within Groups	34.6218487	340	.935725642		
	Total	45.7560976	343			
Q30	Between Groups	8.52090592	3	2.84030197	2.89	**0.0483**
	Within Groups	36.3571429	340	.982625483		
	Total	44.8780488	343			
Q32	Between Groups	5.28174962	3	1.76058321	2.15	0.1111
	Within Groups	28.6156863	340	.817591036		
	Total	33.8974359	343			
Q34	Between Groups	2.4802005	3	.8267335	1.29	0.2950
	Within Groups	21.8619048	339	.642997199		
	Total	24.3421053	342			
Q36	Between Groups	5.28983957	3	1.76327986	2.34	0.0895
	Within Groups	27.1101604	340	.753060012		
	Total	32.4	343			
Q38	Between Groups	2.75897632	3	.919658773	1.15	0.3415
	Within Groups	28.7410237	339	.768361769		
	Total	31.5	342			
Q40	Between Groups	.500490196	3	.166830065	0.21	0.8871
	Within Groups	28.2745098	340	.78540305		
	Total	28.775	343			
Water Efficiency						
Q17	Between Groups	2.43137255	3	.810457516	1.16	0.3387
	Within Groups	25.1686275	339	.69912854		
	Total	27.6	342			
Q25	Between Groups	.499569058	3	.166523019	0.40	0.7520
	Within Groups	14.4747899	339	.413565426		
	Total	14.974359	342			
Q33	Between Groups	.200922941	3	.066974314	.0.22	0.8785
	Within Groups	11.0185893	340	.29779971		
	Total	11.2195122	343			

Table 4.10

(Cont.)

		Sum of Squares	*df*	Mean Square	*F*	Sig. (*p*)
Energy and Atmosphere						
Q19	Between Groups	.283292031	3	.094430677	0.85	0.4751
	Within Groups	4.10695187	340	.110998699		
	Total	4.3902439	343			
Q27	Between Groups	.493605868	3	.164535289	0.47	07066
	Within Groups	13.0185893	340	.351853764		
	Total	13.5121951	343			
Q35	Between Groups	.64430739	3	.21476913	0.34	0.7938
	Within Groups	23.1117902	340	.624642978		
	Total	23.7560976	343			
Materials & Resources						
Q21	Between Groups	1.42717087	3	.475723623	0.55	0.6495
	Within Groups	30.9728291	340	.860356365		
	Total	32.4	343			
Q29	Between Groups	3.26302583	3	1.08767528	1.26	0.3011
	Within Groups	31.8589254	340	.861052038		
	Total	35.1219512	343			
Q37	Between Groups	3.3379329	3	1.1126443	1.74	0.1764
	Within Groups	23.0370671	339	.639918531		
	Total	26.375	342			
Q41	Between Groups	.510660173	3	.170220058	0.17	0.9166
	Within Groups	36.2643398	340	1.00734277		
	Total	36.775	343			
Indoor Environmental Quality						
Q23	Between Groups	4.18172269	3	1.39390756	1.03	0.3915
	Within Groups	48.7932773	340	1.35536881		
	Total	52.975	343			
Q31	Between Groups	1.43108108	3	.477027027	0.47	0.7067
	Within Groups	33.65	340	1.01969697		
	Total	35.0810811	343			
Q39	Between Groups	2.3334855	3	.7778285	1.98	0.1340
	Within Groups	14.5445633	340	.393096305		
	Total	16.8780488	343			

4.2.4 Research Question 4. *What are the barriers to adoption of green building practices in Kenya and what is their level of importance, as perceived by Kenyan building professionals?*

Descriptive statistics were utilized to answer this research question. The analysis was conducted on survey items Q4-Q14. After exporting the data from the Survey Monkey to SPSS 20, each green building adoption barrier corresponding to the survey items was identified with one of the following categories of barriers: 'technical and awareness,' 'institutional,' 'regulatory and policy,' and 'socio-economic.' The following formula was then used to calculate and rank the importance of each barrier and corresponding category:

Mean rating = $\frac{\sum_{i=1}^{5} W * F_i}{n}$, where,

W = weight assigned or scale value of respondent's response for the specified survey item (variable): W=1, 2, 3, 4 and 5;

F_i = frequency of the i^{th} response;

n = total number of respondents to the survey item (variable); and

i = response scale value = 1,2,3,4 and 5 for no opinion/do not know, disagree, somewhat agree, agree, and strongly agree, respectively.

For the purpose of this analysis, responses with variable means above 4.0 were considered low/not important/not severe, those between 3.5 and 4.0 were considered moderate, those between 3.0 and 3.5 were considered moderately high, while those below 3.0 were considered highly important. The results of data analysis for each category of green building adoption barrier are presented in Tables 4.11, 4.12, 4.13, and 4.14.

Table 4.11

Mean Ratings for Responses on 'Socio-economic' Barriers to Green Building Adoption

Survey Item	Item Description	Response Count	Mean Rating
Q13	There are individuals who have taken initiatives to develop a green building rating system	342	2.74
Q12	A green building is more expensive to build than a non-green building	343	3.16
Q14	It is important to adopt green building practices in Kenya	343	4.67

Overall Rating Average: 3.52

Table 4.12

Mean Ratings for Responses on 'Technical and Awareness' Barriers to Green Building Adoption

Survey Item	Item Description	Response Count	Mean Rating
Q6	There is at least one 'green' building council in Kenya	343	2.02
Q4	There are individuals in Kenya who belong to an organization that promotes green building practices	344	3.55
Q5	There is at least one building in Kenya that is certified as 'green' by an organization promoting 'green' building practices	342	3.64

Overall Rating Average: 3.07

Table 4.13

Mean Ratings for Responses on 'Institutional' Barriers to Green Building Adoption

Survey Item	Item Description	Response Count	Mean Rating
Q7	There is at least one public organization or institution in Kenya that has taken initiatives to develop a 'green' building rating system	343	2.19
Q8	There is at least one private organization or institution in Kenya that has taken initiatives to develop a green building rating system	342	2.55
Q9	There is at least one non-governmental or other organization/institution in Kenya that has taken initiatives to develop a green building rating system	341	2.66

Overall Rating Average: 2.47

Table 4.14

Mean Ratings for Responses on 'Regulatory and Policy' Barriers to Green Building Adoption

Survey Item	Item Description	Response Count	Mean Rating
Q10	There are building codes, standards, and/or regulations to promote green building practices in Kenya	340	2.58
Q11	There are government policies, mandates, or incentives to promote green building practices in Kenya	343	2.70

Overall Rating Average: 2.64

The descriptive data analyses in Tables 4.11, 4.12, 4.13, and 4.14 were further compiled and ranked according to mean rating, as shown in Table 4.15. The outcome of this analysis indicates that all three factors identified as 'institutional' barriers were ranked as highly important. They were: Q7 *(there is at least one public organization or institution in Kenya that has taken initiatives to develop a 'green' building rating system)* which was ranked 2nd overall with a mean rating of 2.19; Q8 *(there is at least one private organization or institution in Kenya that has taken initiatives to develop a green building rating system)* which was ranked 3rd overall with a mean rating of 2.55; and Q9 *(there is at least one non-governmental or other organization/institution in Kenya that has taken initiatives to develop a green building rating system)* which was ranked 5th overall with a mean rating of 2.66.

The two factors identified as 'regulatory and policy' barriers were also ranked as highly important. They were: Q10 *(there are building codes, standards, and/or regulations to promote green building practices in Kenya)* which was ranked 4th overall with a mean rating of 2.58; and Item Q11 *(there are government policies, mandates, or incentives to promote green building practices in Kenya)* which was ranked 6th overall with a mean rating of 2.70.

Out of the three factors identified as 'technical and awareness barriers,' Q6 *(there is at least one 'green' building council in Kenya)* was perceived to be of highest importance/severity in the entire list with a mean rating of 2.02. The other two factors were: Q4 *(there are individuals in Kenya who belong to an organization that promotes green building practices)* which was ranked 9th overall with a mean rating of 3.56; and Q5 *(there is at least one building in Kenya that is certified as 'green' by an organization promoting 'green' building practices)* which was ranked 10th overall with a mean rating of 3.64. Both Q4 and Q5 were considered to be of moderate importance.

Out of the three factors that were identified as 'socio-economic' barriers, Q13 *(there are individuals who have taken initiatives to develop a green building rating system in Kenya)* was ranked 7th overall with a mean rating of 2.74; and Q12 *(a green building is more expensive than a non-green building)* was ranked 8th overall with a mean rating of 3.16. Q13 was considered to be of high importance whereas Q12 was considered to be of moderate importance.

Table 4.15

Comparative Ranking for Green Building Adoption Barriers in Order of Importance/Severity

Survey Item	Item Description	Category*	Mean Rating	Rank
Q6	There is at least one 'green' building council in Kenya	TA	2.02	1
Q7	There is at least one public organization or institution in Kenya that has taken initiatives to develop a 'green' building rating system	IT	2.19	2
Q8	There is at least one private organization or institution in Kenya that has taken initiatives to develop a green building rating system	IT	2.55	3
Q10	There are building codes, standards, and/or regulations to promote green building practices in Kenya	RP	2.58	4
Q9	There is at least one non-governmental or other organization/institution in Kenya that has taken initiatives to develop a green building rating system	IT	2.66	5
Q11	There are government policies, mandates, or incentives to promote green building practices in Kenya	RP	2.70	6

Table 4.15

(Cont.)

Survey Item	Item Description	Category*	Mean Rating	Rank
Q13	There are individuals who have taken initiatives to develop a green building rating system	SE	2.74	7
Q12	A green building is more expensive to build than a non-green building	SE	3.16	8
Q4	There are individuals in Kenya who belong to an organization that promotes green building practices	TA	3.56	9
Q5	There is at least one building in Kenya that is certified as ‘green’ by an organization promoting ‘green’ building practices	TA	3.64	10
Q14	It is important to adopt green building practices in Kenya	SE	4.67	**

* Categories of barriers include ‘Socio-economic (SE),’ ‘Technical and Awareness (TA),’ ‘Institutional (IT),’ and ‘Regulatory and Policy (RP)’
** Q14 (it is important to adopt green building practices in Kenya) had a mean rating of 4.67 but was not ranked with the rest of the survey items because it was constructed differently. However, it was taken into consideration in subsequent analyses.

4.2.5 Research Question 5. *Are there any statistically significant differences in perceived importance/severity of barriers to adoption of green building practices and rating system among Kenyan building professionals with differing primary occupations, sectors of occupation, and years of experience?*

One-way ANOVA was used to test for significant differences in perceived importance/severity of barriers to green building adoption among Kenyan building professionals with differing primary occupations, sectors of occupation, and years of experience. The analysis was conducted on survey items Q4-Q14. After exporting the data from the Survey Monkey to SPSS 20, each green building adoption barrier corresponding to the survey items was identified with one of the following categories of barriers: ‘technical and awareness,’ ‘institutional,’ ‘regulatory and policy,’ and ‘socio-economic.’ Since respondents skipped some questions, the sample size (n) and degree of freedom (df) was not the same in all questions. It was therefore necessary to perform the tests on individual questions instead of individual categories. The results were, however, reported according to the five green building rating categories.

4.2.5.1 One-way ANOVA based on respondent primary occupation. The one-way ANOVA test on 'primary occupation' was performed on three groups of respondents, Architect/Designer; Quantity Surveyor; and Other (see Figure 4.1). Only one respondent indicated "other" and was therefore not included in this analysis since the corresponding n-1 value would equal zero. The output of SPSS presented in Table 4.16 indicates that:

1. There was no statistically significant difference in perceived importance of 'technical and awareness' barriers among Kenyan building professionals with differing primary occupations.
2. There was no statistically significant difference in perceived importance of 'institutional' barriers among Kenyan building professionals with differing primary occupations.
3. There was no statistically significant difference in perceived importance of 'regulatory and policy' barriers among Kenyan building professionals with differing primary occupations.
4. There was statistically significant difference in perceived importance of Q14 *(it is important to adopt green building practices in Kenya)* among Kenyan building professionals with differing primary occupations (p = 0.0153). However, there was no statistically significant difference in perceived importance of the other 'socio-economic' barriers among Kenyan building professionals with differing primary occupations.

Table 4.16

One-Way ANOVA for Perceived Importance/Severity of Green Building Adoption Barriers among Kenyan Building Professionals with Differing 'Primary Occupations'

		Sum of Squares	*df*	Mean Square	*F*	Sig. (*p*)
Technical and Awareness						
Q4	Between Groups	.848780488	1	.424390244	0.59	0.5578
	Within Groups	27.2	343	.715789474		
	Total	28.0487805	344			
Q5	Between Groups	1.43846154	1	.719230769	1.08	0.3497
	Within Groups	22.5615385	341	.663574661		
	Total	24	342			
Q6	Between Groups	1.94447658	1	1.94447658	2.99	0.0965
	Within Groups	15.593985	342	.649749373		
	Total	17.5384615	343			
Institutional						
Q7	Between Groups	.31492192	1	.31492192	0.31	0.5849
	Within Groups	24.6466165	342	1.02694236		
	Total	24.9615385	343			
Q8	Between Groups	2.70899471	1	2.70899471	3.11	0.0903
	Within Groups	21.8095238	341	.872380952		
	Total	24.5185185	342			
Q9	Between Groups	.007017544	1	.007017544	0.01	0.9330
	Within Groups	21.3263158	340	.96937799		
	Total	21.3333333	341			
Regulatory and Policy						
Q10	Between Groups	3.36648352	1	1.68324176	3.05	0.0597
	Within Groups	19.8642857	339	.551785714		
	Total	23.2307692	340			
Q11	Between Groups	2.42435065	1	1.21217532	1.92	0.1608
	Within Groups	23.3506494	342	.631098631		
	Total	25.775	343			
Socio-economic						
Q12	Between Groups	.706486043	1	.353243021	0.33	0.7243
	Within Groups	42.3649425	342	1.08628058		
	Total	43.0714286	343			
Q13	Between Groups	.297619048	1	.297619048	0.35	0.5616
	Within Groups	22.3809524	341	.860805861		
	Total	22.6785714	342			

Table 4.16

(Cont.)

		Sum of Squares	*df*	Mean Square	*F*	Sig. (*p*)
Technical and Awareness						
Q14	Between Groups	2.53469866	1	1.26734933	4.65	**0.0153**
	Within Groups	10.9071618	342	.272679045		
	Total	13.4418605	343			

4.2.5.2 One-way ANOVA based on respondent sector of occupation. The one-way ANOVA test on 'sector of occupation' was performed on four groups of respondents, public sector; private sector; education and/or training; and other non-governmental organization (see Figure 4.2). The output of SPSS presented in Table 4.17 indicates that:

1. There was no statistically significant difference in perceived importance of 'technical and awareness' barriers among Kenyan building professionals with differing sectors of occupation.
2. There was statistically significant difference in perceived importance of Q9 *(there is at least one non-governmental or other organization/institution in Kenya that has taken initiatives to develop a green building rating system)* among Kenyan building professionals with differing sector of occupation (p = 0.0310). However, there was no statistically significant difference in perceived importance of the other 'institutional' barriers among Kenyan building professionals with differing sectors of occupation.
3. There was no statistically significant difference in perceived importance of 'regulatory and policy' barriers among Kenyan building professionals with differing sectors of occupation.
4. There was statistically significant difference in perceived importance of Q12 *(there is at least one non-governmental or other organization/institution in Kenya that has taken*

initiatives to develop a green building rating system) among Kenyan building professionals with differing sectors of occupation (*p* = 0.0454). However, there was no statistically significant difference in perceived importance of the other 'socio-economic' barriers among Kenyan building professionals with differing sectors of occupation.

Table 4.17

One-Way ANOVA for Perceived Importance/Severity of Barriers to Green Building Adoption Barriers among Kenyan Building Professionals with Differing 'Sectors of Occupation'

		Sum of Squares	df	Mean Square	F	Sig. (p)
Technical and Awareness						
Q4	Between Groups	.204763394	3	.068254465	0.09	09647
	Within Groups	27.8440171	343	.752541003		
	Total	28.0487805	346			
Q5	Between Groups	2.54891304	3	.849637681	1.31	0.2886
	Within Groups	21.451087	341	.650032938		
	Total	24	344			
Q6	Between Groups	2.03846154	3	.679487179	0.96	0.4271
	Within Groups	15.5	342	.704545455		
	Total	17.5384615	345			
Institutional						
Q7	Between Groups	4.38034188	3	1.46011396	1.56	0.2272
	Within Groups	20.5811966	342	.935508936		
	Total	24.9615385	345			
Q8	Between Groups	4.25185185	3	1.41728395	1.61	0.2148
	Within Groups	20.2666667	341	.88115942		
	Total	24.5185185	344			
Q9	Between Groups	7.5047619	3	2.5015873	3.62	**0.0310**
	Within Groups	13.8285714	340	.691428571		
	Total	21.3333333	343			
Regulatory and Policy						
Q10	Between Groups	2.24038462	3	.746794872	1.25	0.3081
	Within Groups	20.9903846	339	.599725275		
	Total	23.2307692	342			
Q11	Between Groups	.915	3	.305	0.44	0.7246
	Within Groups	24.86	342	.690555556		
	Total	25.775	345			

Table 4.17

(Cont.)

		Sum of Squares	df	Mean Square	F	Sig. (p)
Socio-economic						
Q12	Between Groups	8.10989011	3	2.7032967	2.94	**0.0454**
	Within Groups	34.9615385	342	.920040486		
	Total	43.0714286	345			
Q13	Between Groups	.859022556	3	.286340852	0.31	0.8144
	Within Groups	21.8195489	341	.90914787		
	Total	22.6785714	344			
Q14	Between Groups	1.41223084	3	.470743612	1.53	0.2229
	Within Groups	12.0296296	342	.308452042		
	Total	13.4418605	345			

4.2.5.3 One-way ANOVA based on respondent years of experience. The one-way ANOVA test on 'years of experience' was performed on four groups of respondents, 5 or less; 6-10; 11-15; and more than 15 (see Figure 4.3). The output of SPSS presented in Table 4.18 indicates that:

1. There was no statistically significant difference in perceived importance of 'technical and awareness' barriers among Kenyan building professionals with differing years of experience.
2. There was statistically significant difference in perceived importance of Q8 *(there is at least one private organization or institution in Kenya that has taken initiatives to develop a green building rating system)* among Kenyan building professionals with differing years of experience (p = 0.0337). Also, there was statistically significant difference in perceived importance of Q9 *(there is at least one non-governmental or other organization/institution in Kenya that has taken initiatives to develop a green building rating system)* among Kenyan building professionals with differing years of experience (p = 0. 0394). However, there was no statistically significant difference in perceived

importance of the other 'institutional' barriers among Kenyan building professionals with differing years of experience.

3. There was no statistically significant difference in perceived importance of 'regulatory and policy' barriers among Kenyan building professionals with differing years of experience.
4. There was no statistically significant difference in perceived importance of 'socio-economic' barriers among Kenyan building professionals with differing years of experience.

Table 4.18

One-Way ANOVA for Perceived Importance/Severity of Barriers to Green Building Adoption Barriers among Kenyan Building Professionals with Differing 'Years of Experience'

		Sum of Squares	*df*	Mean Square	*F*	Sig. (*p*)
Technical and Awareness						
Q4	Between Groups	.207427104	3	0.691422368	0.09	0.9641
	Within Groups	27.8413534	343	.75246901		
	Total	28.0487805	346			
Q5	Between Groups	1.6460084	3	.548669468	0.81	0.4975
	Within Groups	22.3539916	341	.677393685		
	Total	24	344			
Q6	Between Groups	3.49084249	3	1.16361416	1.82	0.1726
	Within Groups	14.047619	342	.638528139		
	Total	17.5384615	345			
Institutional						
Q7	Between Groups	5.06272894	3	1.68757631	1.87	0.1649
	Within Groups	19.8988095	342	.904491342		
	Total	24.9615385	345			
Q8	Between Groups	7.58518519	3	2.52839506	3.43	**0.0337**
	Within Groups	16.9333333	341	.736231884		
	Total	24.5185185	344			
Q9	Between Groups	7.14285714	3	2.38095238	3.36	**0.0394**
	Within Groups	14.1904762	340	.70952381		
	Total	21.3333333	343			

Table 4.18

(Cont.)

		Sum of Squares	*df*	Mean Square	*F*	Sig. (*p*)
Regulatory and Policy						
Q10	Between Groups	.624390316	3	.208130105	0.32	0.8092
	Within Groups	22.6063789	339	.64589654		
	Total	23.2307692	342			
Q11	Between Groups	.849162679	3	.283054226	0.41	0.7476
	Within Groups	24.9258373	342	.69238437		
	Total	25.775	345			
Socio-economic						
Q12	Between Groups	5.08802309	3	1.6960077	1.70	0.1840
	Within Groups	37.9834055	342	.999563302		
	Total	43.0714286	345			
Q13	Between Groups	2.26684982	3	.755616606	0.89	0.4612
	Within Groups	20.4117216	341	.8504884		
	Total	22.6785714	344			
Q14	Between Groups	.6732234354	3	.224411451	0.69	0.5664
	Within Groups	12.7686261	342	.32740067		
	Total	13.4418605	345			

4.2.6 Secondary Research Question. *What sources of information are potentially useful for promoting awareness of green building in Kenya?*

This secondary research question was tackled using survey item Q15 of the questionnaire. Descriptive analysis was conducted to understand how certain sources of information were useful in increasing, or promoting, societal awareness of green building in Kenya. Results from this analysis would add rigor to the overall findings in regard to barriers that impact adoption of green building practices and green building rating system in Kenya.

The total response rate to this question was 343. Out of the 9 potential sources, print media had the highest response count of 271 (79.0%). This was followed by a combination of workshop, seminar, conference, or other meeting, with a response count of 224 (65.3%). In third place was website with a response count of 216 (63.0%), and fourth were international standards or policies, which had a response count of 208 (60.6%).

Other potential sources of information had less than 50% response count. These included school/college curriculum, which was ranked fifth overall with a response count of 127 (37.0%); broadcast media, which ranked sixth overall with a response count of 119 (34.3%); direct participation, which ranked seventh overall with a response count of 112 (32.7%); and demonstration, which ranked eighth overall with a response count of 96 (28.0%). Only 72 (21.0%) indicated that advertisement had played a role in increasing their awareness of green building and/or green building rating system. A summary of this ranking including response counts for each source is presented in Figure 4.4.

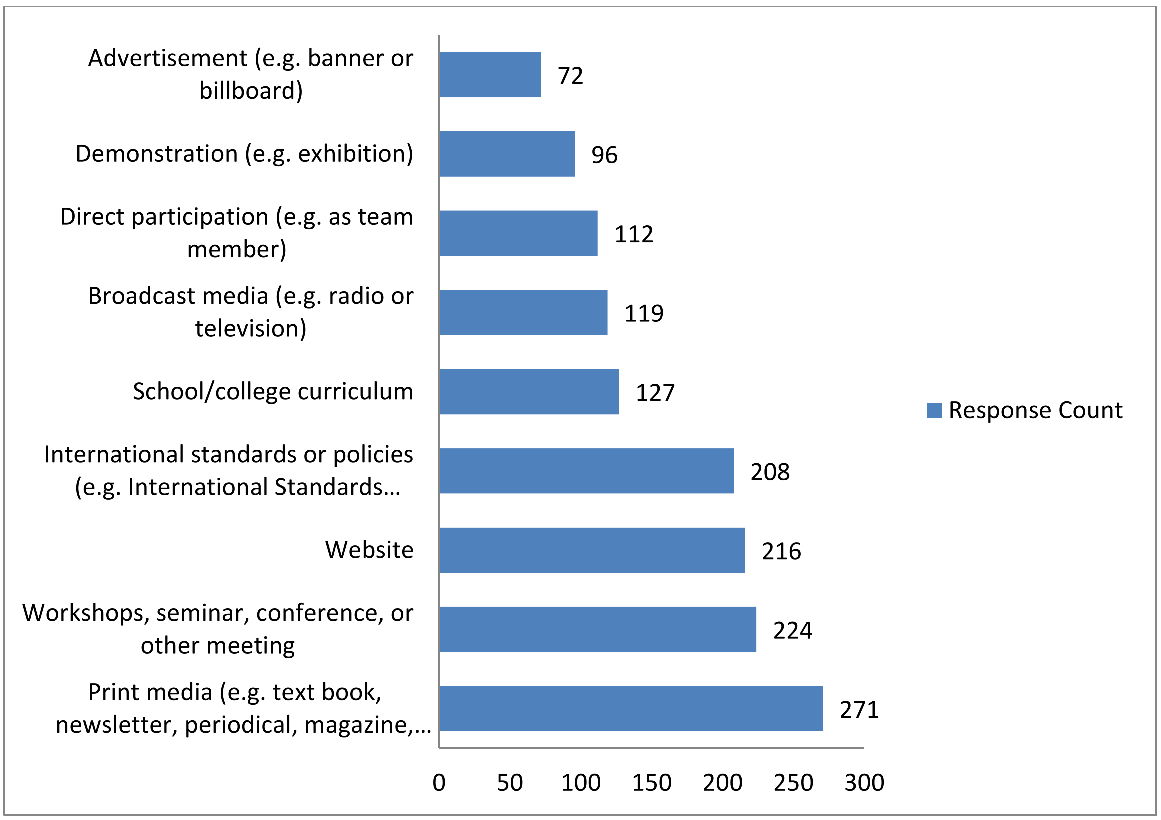

Figure 4.4. Summary of how various sources of information have been useful in increasing respondents' awareness of green building and green building rating system.

4.2.7 Content analysis for open-ended question. Survey item Q42 of the questionnaire instrument asked subjects to provide any additional information about the survey. The open-ended question had a response count of 61. Content analysis was then conducted on all responses and some of them were discarded for lack of clarity or relevance to the objectives of the study. Also, responses that had similar contents were treated as one comment. Overall, the review process yielded the following 28 statements which were deemed relevant to the objectives of the study:

Statements pertaining to the importance of green building adoption in Kenya:

1. “This is a very important survey. We need more of such studies to help the Kenyan building industry become green.”
2. “We humans are the worst pollutant of mother earth; we are therefore bound to create solutions for a sustainable future. I hope that is the issue this study is trying to address.”
3. “This subject has not been adequately addressed in Kenya. Much more needs to be done.”
4. “Green architecture is good for the country.”
5. “This is a great initiative, Peter. It is important that we adopt green building technology to minimize negative environmental emissions to our God-given atmosphere.”
6. “Green building is good for healthy environment. The problem is where to start from.”
7. “Thank you; this is a good, fundamental research that could help to change our building culture. I wish to participate fully.”

Statements pertaining to the importance of ‘institutions’ in green building adoption in Kenya:

1. “The new offices of the UN Environment Programme and the UN Human Settlements Programme, is a good example of green architecture setting a precedent in Kenya.”

Statements pertaining to the importance of 'regulatory and policy' tools in green building adoption in Kenya:

1. "Clients see no value to bother with going the extra mile to do a green building. If there were some sort of proper incentive it might help. Awards for green buildings also need to be developed."
2. "The government and local authorities in Kenya are to blame for not helping the public to build green."
3. "The government of Kenya should be at the forefront in putting together regulatory mechanisms to promote and foster green building."
4. "Green building is important to me as an individual and my team, but we do not have the legislation or mechanisms in place yet to pursue the way forward."
5. "I think there are other priorities than green building at this point in Kenya. For example, let us first deal with quacks (i.e., unlicensed practitioners) in the building industry caused by lack of legal enforcement."

Statements pertaining to the importance of 'socio-economic' factors in green building adoption in Kenya:

1. "Socio-economic factors, such as high levels of poverty in Kenya are a major barrier to green building adoption. People merely build for the sake of having shelter or a place to earn a living."
2. "Introducing green building in Kenya is simply a way of bringing unnecessary politics into our industry."
3. "We do not need green building in Kenya. This is another colonial influence from the western countries."

Statements pertaining to the importance of 'technical and awareness' tools in green building adoption in Kenya:

1. "Kenyans first need to establish a local green building council and a customized green building rating system."
2. "Green building is very important in Kenya. However, initial implementation is a major challenge due to lack of consensus."
3. "Green building will merely cause the cost of construction to go up."
4. "The concept of green building in Kenya is taking root now and will take time as developers and clients embrace it."
5. "Green Building is a new concept in Kenya. A lot of education needs to be conducted for it to gain currency and be properly adopted."
6. "More sensitization and analysis of the benefits of green building is needed in Kenya."
7. "Awareness is very crucial to initiating green building in Kenya."
8. "We need more professional training in Kenya on green building."
9. "The key barrier to green building in Kenya is lack of developed standards to guide the building industry toward embracing green practices. We need environmental experts to lobby for joint efforts among all relevant institutions to develop a strategy of promoting a green building standard. Also, we can use green building rating standards of other countries as a template to create our own. Therefore, this study is important at this time."
10. "Green building is but a myth. It makes no sense."
11. "You can get more information from UN Habitat's Urban Energy Unit. They are currently running a project on Promoting Energy Efficiency in Buildings in East Africa."
12. "Kenyan universities need to start teaching courses on green building."

4.3 Chapter Summary

In this chapter, various statistical techniques were employed to analyze data. These included descriptive statistics, ANOVA, and content analysis. The results were then interpreted and discussed according to the prescribed research questions.

Results for Research Question 1 indicate that there are at least 26 green building rating attributes which can be potentially adopted for Kenyan building industry (Section 4.3.1). In other words, the identified and validated green building rating attributes can – without modification – be used to frame a green building rating system that makes sense to the context of building practices in Kenya.

The analysis for Research Question 2 utilized descriptive statistics to compute the mean ratings of each attribute according to its level of importance, as perceived by industry stakeholders in Kenya. The mean ratings were then ranked according to their weighted importance, followed by a comparative analysis of the results.

The analysis for Research Question 3 built upon the foregoing analyses and employed ANOVA technique to investigate if there were any statistically significant differences in perceived importance of the 26 green building rating attributes among the responses based on respondents' 'primary occupation,' 'sectors of occupation,' and 'years of experience.'

The survey instrument contained 12 measures for green building adoption barriers. Responses to these measures were analyzed in Research Question 4 using descriptive statistics to determine mean ratings based on their perceived levels of importance. The mean ratings were then ranked according to their weighted importance, followed by a comparative analysis of the results.

The ANOVA analysis for Research Question 5 was employed to investigate if there were any statistically significant differences in perceived importance of the 12 green building adoption barriers among the responses based on respondents' 'primary occupation,' 'sectors of occupation,' and 'years of experience.'

The secondary research question in Section 4.3.6 was analyzed using descriptive analysis in an attempt to understand the extent to which different sources were useful in disseminating information on green building to Kenyan stakeholders. Lastly, all responses to the open-ended question (Q42) were examined using content analysis and the findings were integrated into the conclusion for the study.

CHAPTER 5

Findings, Discussions, and Recommendations

This chapter concludes the research study by presenting the (a) summary, (b) restatement of research questions and findings, (c) implications and further discussions, and (d) limitations and recommendations for future research directions.

5.1 Summary of the Study

The overarching theme of this research study was to investigate 1) green building rating attributes that could be adopted for Kenya, and 2) barriers to initial adoption of green building practices and a green building rating system in Kenya. The study was primarily built on the premise of select rating and adoption attributes of existing green building standards, especially Leadership in Energy and Environmental Design (LEED). Also, the study was built upon findings of a pilot survey which revealed that (a) despite the interest to transition from conventional to green building practices in Kenya, lack of tools for defining and measuring green building goals was a key impediment, and (b) certain attributes in existing green building rating systems could potentially be adopted to develop meaningful green building guidelines in Kenya.

The pilot findings formed the basis of a questionnaire that was utilized to survey a convenience sample of 608 building professionals that were registered with the Kenyan Board of Registration of Architects and Quantity Surveyors (BORAQS) with a view of understanding their awareness and perspectives towards adopting green building practices and a green building rating system. End-line data was interpreted using a combination of descriptive statistics, content analysis, and analysis of variance.

5.2. Restatement of Research Questions and Findings

The following questions guided the study toward achieving its objectives:

Research Question 1: What green building rating attributes are applicable to Kenyan building industry, as identified and validated in this research?

This study identified and validated 26 green building rating attributes that were deemed relevant for framing a green building rating system that makes sense to the Kenyan building industry. These attributes belong to the categories of 'sustainable sites' (13), 'water efficiency' (3), 'energy and atmosphere' (3), 'materials and resources' (4), and 'indoor environmental quality' (3) (see Table 4.1). In essence, these green building attributes are potential low-hanging fruits that could – without modification – be adopted to frame a green building rating system for Kenya.

Research Question 2: What is the likelihood of adopting certain green building rating attributes and what is their level of importance, as perceived by Kenyan building professionals?

This question guided the study to rank the green building rating attributes identified in Research Question 1 according to the order of their importance, as perceived by Kenyan building professionals (Table 4.7). The rank-order revealed that the attributes which belong to 'energy and atmosphere' are generally rated highest in regard to likelihood, or potential, for adoption in Kenya. This means that, among other green building attributes, Kenyan building professionals perceive 'energy and atmosphere' green building attributes to be of topmost importance. 'Water efficiency' attributes were ranked second while 'indoor environmental quality' were ranked third overall. In fourth place were 'materials and resources' while 'sustainable sites' attributes were ranked fifth. This rank order of potential green building attributes in order of their perceived importance is an invaluable foundation, or baseline, for framing a green building rating standard that is contextual to Kenya.

Research Question 3: Are there any statistically significant differences in perceived importance of certain green building rating attributes among Kenyan building professionals with differing primary occupations, sectors of occupation, and years of experience?

This test was performed to investigate if there were any statistically significant differences in perceived importance of the 26 green building rating attributes (in reference to Research Questions 1 & 2) among Kenyan building professionals with differing primary occupations, sectors of occupation, and years of experience. The findings revealed that:

1. There was no statistically significant difference in perceived importance of ‘energy and atmosphere’ green building rating attributes among Kenyan building professionals with differing primary occupations.
2. There was no statistically significant difference in perceived importance of ‘materials and resources’ green building rating attributes among Kenyan building professionals with differing primary occupations.
3. There was no statistically significant difference in perceived importance of ‘indoor environmental quality’ green building rating attributes among Kenyan building professionals with differing primary occupations.
4. There was no statistically significant difference in perceived importance of ‘sustainable sites’ green building rating attributes among differing sectors of occupation.
5. There was no statistically significant difference in perceived importance of ‘water efficiency’ green building rating attributes among differing sectors of occupation.

6. There was no statistically significant difference in perceived importance of 'energy and atmosphere' green building rating attributes among differing sectors of occupation.
7. There was no statistically significant difference in perceived importance of 'materials and resources' green building rating attributes among differing sectors of occupation.
8. There was no statistically significant difference in perceived importance of 'indoor environmental quality' green building rating attributes among differing sectors of occupation.
9. There was no statistically significant difference in perceived importance of 'water efficiency' green building rating attributes among Kenyan building professionals with differing years of experience.
10. There was no statistically significant difference in perceived importance of 'energy and atmosphere' green building rating attributes among Kenyan building professionals with differing years of experience.
11. There was no statistically significant difference in perceived importance of 'materials and resources' green building rating attributes among Kenyan building professionals with differing years of experience.
12. There was no statistically significant difference in perceived importance of 'indoor environmental quality' green building rating attributes among Kenyan building professionals with differing years of experience.
13. There was statistically significant difference in perceived importance of Q36 *(control the quantity of storm water runoff from the building/site)* among Kenyan building professionals with differing primary occupations. However, there was no statistically significant difference in perceived importance of other 'sustainable sites' green building

rating attributes among Kenyan building professionals with differing primary occupations.

14. There was statistically significant difference in perceived importance of Q25 *(treat and re-use waste water in the building)* among Kenyan building professionals with differing primary occupations. However, there was no statistically significant difference in perceived importance of other 'water efficiency' green building rating attributes among Kenyan building professionals with differing primary occupations.
15. There was statistically significant difference in perceived importance of Q28 *(provide secure bicycle storage space for building occupants)* among Kenyan building professionals with differing years of experience. Also, there was statistically significant difference on perceived importance of Q30 *(encourage building occupants to use vehicles that are fuel-efficient and emit lesser pollutants)* among Kenyan building professionals with differing years of experience. However, there was no statistically significant difference in perceived importance of other 'sustainable sites' green building rating attributes among Kenyan building professionals with differing years of experience.

<u>Research Question 4:</u> What are the barriers to adoption of green building practices in Kenya and what is their level of importance, as perceived by Kenyan building professionals?

This question guided the study to identify and validate at least 12 barriers to initial adoption of green building practices and green building rating system in Kenya. Further, the barriers were ranked according to the order of their importance, or severity, as perceived by Kenyan building professionals (Table 4.15). The ranking revealed that lack of 'institutional' support was perceived to be the greatest barrier to adoption of green building in Kenya. This was followed by lack of ‘regulatory and policy’ framework, ‘socio-economic’ factors, and inadequate ‘technical and awareness,’ in that order of overall ranking.

Research Question 5: Are there any statistically significant differences in perceived importance/severity of barriers to adoption of green building practices and rating system among Kenyan building professionals with differing primary occupations, sectors of occupation, and years of experience?

This test was performed to investigate if there were any statistically significant differences in perceived importance of the 12 green building adoption barriers (identified in Research Question 4) among Kenyan building professionals with differing primary occupations, sectors of occupation, and years of experience. The findings revealed that:

1. There was no statistically significant difference in perceived importance of ‘technical and awareness’ barriers among Kenyan building professionals with differing primary occupations.
2. There was no statistically significant difference in perceived importance of ‘institutional’ barriers among Kenyan building professionals with differing primary occupations.
3. There was no statistically significant difference in perceived importance of ‘regulatory and policy’ barriers among Kenyan building professionals with differing primary occupations.
4. There was no statistically significant difference in perceived importance of ‘technical and awareness’ barriers among Kenyan building professionals with differing sectors of occupation.

5. There was no statistically significant difference in perceived importance of ‘regulatory and policy’ barriers among Kenyan building professionals with differing sectors of occupation.
6. There was no statistically significant difference in perceived importance of ‘technical and awareness’ barriers among Kenyan building professionals with differing years of experience.
7. There was no statistically significant difference in perceived importance of ‘regulatory and policy’ barriers among Kenyan building professionals with differing years of experience.
8. There was no statistically significant difference in perceived importance of ‘socio-economic’ barriers among Kenyan building professionals with differing years of experience.

On the other hand, the study found that:

9. There was statistically significant difference in perceived importance of Q14 (it is important to adopt green building practices in Kenya) among Kenyan building professionals with differing primary occupations. However, there was no statistically significant difference in perceived importance of the other ‘socio-economic’ barriers among Kenyan building professionals with differing primary occupations.
10. There was statistically significant difference in perceived importance of Q9 *(there is at least one non-governmental or other organization/institution in Kenya that has taken initiatives to develop a green building rating system)* among Kenyan building professionals with differing sector of occupation. However, there was no statistically

significant difference in perceived importance of the other 'institutional' barriers among Kenyan building professionals with differing sectors of occupation.

11. There was statistically significant difference in perceived importance of Q12 *(there is at least one non-governmental or other organization/institution in Kenya that has taken initiatives to develop a green building rating system)* among Kenyan building professionals with differing sectors of occupation. However, there was no statistically significant difference in perceived importance of the other 'socio-economic' barriers among Kenyan building professionals with differing sectors of occupation.
12. There was statistically significant difference in perceived importance of Q8 *(there is at least one private organization or institution in Kenya that has taken initiatives to develop a green building rating system)* among Kenyan building professionals with differing years of experience. Also, there was statistically significant difference in perceived importance of Q9 *(there is at least one non-governmental or other organization/institution in Kenya that has taken initiatives to develop a green building rating system)* among Kenyan building professionals with differing years of experience. However, there was no statistically significant difference in perceived importance of the other 'institutional' barriers among Kenyan building professionals with differing years of experience.

<u>Secondary Research Question:</u> What sources of information are potentially useful for promoting awareness of green building in Kenya?

This secondary research question was formulated to guide the study in investigating what sources of information were potentially useful for promoting awareness on green building and green building rating system among Kenyan building professionals. The findings, presented in

Figure 4.4, indicated that print media (e.g., text books, newsletters, periodicals, magazines, and research articles) was ranked top-most with a cumulative response count of 79.0%. In other words, print media is considered to be the most potentially useful source of information for increasing or promoting awareness on green building in Kenya. Other three potential sources of information that scored a cumulative response count of at least 50% were:

- Workshops, seminars, conferences, or other meetings (65.3%)
- Website (63.0%)
- International standards/policies (60.6%).

These findings on various potential sources of green building information could be helpful in overall plans to sensitize the Kenyan society about green building. This would, in turn, accelerate adoption of green building in the country.

5.3 Implications and Further Discussion

The implications of this study has been alluded to in previous sections of this paper, but to sum it up, the main implication is that there is neither green building standard nor green building practices in Kenya. However, the findings of this study would provide a preliminary platform for framing a green building rating system that is applicable to the Kenyan building industry. Also, the findings would inform the industry stakeholders on barriers that need to be overcome in order to achieve breakthrough in adoption of green building in Kenya. These barriers were broadly categorized as ‘institutional,’ ‘regulatory and policy,’ ‘socio-economic,’ and ‘technical and awareness.’ By ranking both potential green building attributes and adoption barriers in order of their perceived importance, the findings garnered from this study become an invaluable resource for developing best practices to enhance the adoption of green building in Kenya.

5.3.1 Institutional barriers to green building adoption in Kenya. Lessons learned in this study demonstrate that public, private and non-governmental institutions played a major role in the evolution and adoption of the LEED rating system. For instance, it took the USGBC – a non-governmental organization – to introduce the concept of green building to the U.S society. This was further enhanced by institutional efforts of EPA, GSA, DOE, etc. which became early adopters of green building concept into their building systems. For example, the design and construction of the pioneer green campus at Research Triangle Park in Durham, North Carolina (in 1997-2001), took a team effort of EPA (as "owner"), GSA (as "technical consultant and construction manager"), the Army Corps of Engineers (as primary design consultant"), and other partners (Greening Curve, 2009). In other words, the U.S. public sector was a front-runner in adopting green building.

Since its inception, LEED green building rating system has been increasingly adopted for use in other public, private, and non-governmental institutions. An example of this is the Proximity Hotel in Greensboro, North Carolina, which became the first hotel in the U.S. to achieve LEED Platinum (Proximity Hotel, 2010). The overall implication is that Kenyan institutions also need to become role models to the rest of the society in adoption of green building.

5.3.2 Regulatory and policy barriers to green building adoption in Kenya. Lack of relevant regulatory and policy framework is another factor that impedes the adoption of green building in Kenya. This includes building codes, standards, policies, mandates, and incentives. The LEED green building rating system, for example, is founded upon a variety of codes and standards such as: 1) the 2003 EPA Construction General Permit (CGP); 2) Local codes; 3) USDA standards; 4) FEMA standards; 5) US Fish & Wildlife Service; 6) ASTM; 7) California

Air Resource Board; 8) ACEEE; 9) ASHRAE; 10) IESNA; 11) EPAct 1992; 12) EPA Clean Air Act; 13) IPMVP; 14) Center for Resource Solutions (CRS); 15) Green-e Product Certification; 16) ASTME; 17) California 2001 Energy Efficiency Standards; 18) CIBSE Applications Manual; 19) EPA Compendium of Methods Determination of Indoor Air Pollutants in Indoor Air; 20) SCAQMD; and 21) Green Seal Standard. This study compiled a comprehensive summary of codes and standards and their application to the various LEED rating criteria, as presented in Appendix J.

In an effort to achieve high performance and sustainability goals in its building footprint, the U.S. Government has put in place various mandates and policies to guide individual federal agencies in design, construction, operation and management, maintenance, and deconstruction of their buildings. The guidelines, or sustainability performance plans, are outlined in Executive Order 13514 of October 5, 2009 – Federal Leadership in Environmental, Energy, and Economic Performance (EO, 13514). This study also compiled a comprehensive summary of the mandates and their reference to the LEED rating criteria, as presented in Appendix K.

Availability of incentives has also contributed to marketplace adoption of green building in the U.S. According to the American Institute of Architects (AIA), the jurisdictions across the U.S. offer a number of incentives to encourage the private development of green buildings (AIA, 2011). *Tax incentives* are one of the most robust and widely used forms of incentives to promote green building because the benefits come in form of corporate tax, gross receipts tax, income tax, property tax/ad valorem tax, sales tax, and local taxes. *Expedited permitting incentives* enable streamlining of the permitting process for building, plan, and site permits. This can save green developers substantial time and money. *Net metering incentives* allow owners of renewable energy facilities, such as wind or solar power instruments, to generate their own energy. *Grant* *incentive* programs enable recipients to offset some of the increased development costs that arise from a green building project. *Bonus density incentive* programs are usually in the form of height and floor/area ratio bonuses. These are particularly attractive to developers and owners in cities and counties that have floor space capacity shortfalls (AIA, 2011).

Some states and local authorities have *loan fund incentives* to be used specifically for green improvements. *Insurance incentives* are used to communicate the benefits of green buildings to owners. *Technical assistance/design assistance incentives* are provided by some states and local governments through training of planners, building inspectors, and other local officials in green building best practices. *Permit/zone fee reduction incentives* are almost exclusively for use by cities rather than states and counties to encourage green building. *Leasing assistance incentives* work by state and local jurisdictions leasing energy efficient equipment to businesses and residents so that the initial cost of purchasing and/or installing the equipment is passed on to the state or local government. *Rebates and discounts incentives* provide for discounts on environmental products. For example municipalities can purchase energy efficient appliances, such as Energy Star, in bulk and offer discounted prices to citizens (AIA, 2011).

During the course of this study, it was clear that there are no forms of regulatory, policy, or incentive tools to leverage adoption of green building in Kenya. It is therefore imperative for the Kenyan government, the 47 county governments, local authorities, and regulatory bodies to follow the example of the U.S. in order to address this barrier. This study learnt that due to lack of clearly defined and well enforced policies and regulations in the country’s construction sector, many operations are done by unlicensed individuals and firms (locally referred to as “quacks”), often leading to poor workmanship and dangerous buildings.

5.3.3 Socio-economic barriers to green building adoption in Kenya. Findings of this study imply that the Kenyan building industry generally views green building to be important for the country. On the other hand, the study unveils a variety of socio-economic barriers that must be removed in order to pave way for green building adoption in the country. First, there is a strong indication that very minimal initiative has been taken to develop a green building rating system. Second, there is a strong indication that most stakeholders are not sure of paybacks for going green as compared to keeping the current conventional building practices. This uncertainty of return on investment needs to be fully communicated to potential green building adopters in the country.

Another barrier that was noted among the survey responses for this study was in regard to resistance to culture change. Since Kenya was a British colony until almost 50 years ago, some stakeholders in the building industry still portray an attitude that green building could be merely another way of western countries attempting to colonize or manipulate the country's building practices. As a new concept, green building is likely to face resistance for stakeholders that are culturally averse.

This study also learnt that the high level of poverty in Kenya might pose a challenge to promoting green building in the country. On one hand, this is because some people cannot even afford the cost of a basic building. On the other hand, most of those that can afford to build do so for the mere purpose of having a structure to occupy. Consequently, introducing green building to such a society would be financially burdensome. Moreover, several green building monitoring and evaluation tools require software tools to measure their performance. For example, Building Automated Systems (BAS) are required for monitoring building performance for energy and indoor environmental quality. Purchase and maintenance of such tools and equipment may prove unaffordable to potential green building adopters in Kenya.

5.3.4 Technical and awareness barriers to green building adoption in Kenya. Although this study identified some ongoing green building initiatives in the country, there is neither a green building standard nor a green building council. Without a local green benchmark and green building guidelines, it is difficult to define and measure the green building efforts in the country. For instance, although this study ascertained that there are some building projects in Kenya that have been retrofitted with green building features, it is important for the stakeholders to understand that just having a solar panel on the roof does not make the building "green." Rather the solar panel should be part of an integral energy system that meets pre-determined criteria based on a green building rating standard.

As discussed elsewhere in this paper, the successful development and adoption of LEED is partly due to its member-driven and committee-based attributes. Also, it took consensus-focused and voluntary-based effort of green building champions to establish USGBC and LEED rating system. As a 501(c) (3) non-profit, voluntary organization, USGBC's member organizations include architectural firms, landscape designers, engineering firms, contractors, consultants, educators, financial, and various other institutions and firms interested in green building practices. However, this study did not come across any committee, team network, or a green building council that has been set up to champion the adoption of green building in the country. Lack of these attributes posits a challenge to the adoption process since such platforms are helpful in keeping the local society abreast of global trends in green building.

Another challenge that was identified by this study has to do with inadequate sources of information to foster societal awareness of green building. In particular, the study found that some potential sources of information on green building have barely been explored. These include school/college program; media broadcast (e.g., radio, television); direct participation (e.g., working team); demonstration (e.g., exhibition); and advertisement (e.g., banner, billboard) (see Figure 4.4). Inadequacy of such awareness interventions renders it difficult to implement and sensitize the society on the importance of green building.

5.4 Limitations of the Study and Recommendations for Future Research Directions

It would not be an overstatement to articulate that this research is one of the first studies that attempts to create a platform for adoption and uptake of green building practices and green building rating system in Kenya. However, the scope of this mixed method study was limited to the following boundaries:

- The target population consisted of 1,238 building professionals who were listed as members of the Board of Registration of Architects & Quantity Surveyors of Kenya (BORAQS) as of August 31, 2012. The sample size was, however, limited to only 608 professionals that had an email address on their registration profiles.
- Only 347 survey responses that were received by the data collection deadline of December 31, 2012, and usable, were analyzed.
- Due to the geographic dispersion of the study participants and desire to be as environmentally friendly as possible, data for the main phase of the study was collected by means of an electronic survey.
- The LEED reference was only based on the 2009 New Construction and Major Renovation guideline. Other LEED reference guidelines were not considered.
- The research instrument was developed upon the perspective of a model building in an urban area of Kenya, typically the city of Nairobi.

Depending on future needs, the following research ideas can be built off of this study:

1. This study took an exploratory approach in that it broadly identified barriers and potentials that exist to initial adoption of green building and rating system in Kenya. The study further examined the applicability of LEED rating criteria to the typical context of building design and construction in Kenya. It is possible for future researchers to build off of this study by looking at each of these areas separately but from a narrower perspective. For example, separate research topics can be built off each potential and/ barrier to adoption of green building and rating system in Kenya, as identified in this study.
2. As a way of broadening the body of knowledge, the contents of this research can be replicated, or extrapolated, to conduct related studies for other country contexts.
3. This study was delimited to LEED rating system. Future research can broaden the horizons by looking at other emergent green building rating standards as a baseline to pursue similar research.
4. Due to scope, time, and resource constraints, this study was delimited to identifying LEED green rating attributes that would be 'readily' adopted for the context of Kenyan building industry (i.e. "low-hanging fruits"). Future research can broaden the horizon by seeking to identify LEED green building rating attributes that can be modified, or adapted, to the context of Kenyan building industry. Ideally, the theme of the study would look like this: "Would LEED rating system work as a benchmark for sustainability in Kenya?"
5. Although rigorous reliability and validation checks were employed throughout the methodology for this study, it makes sense for future researchers to conduct a similar

study using different methodology, such as the Delphi method or panel technique. This would even help to validate the present findings further.

6. Apply Diffusion of Innovation theory model to project an appropriate roadmap for adoption and uptake of green building in Kenya. Diffusion of innovation (DOI) theory provides both quantitative and qualitative tools for assessing the likely rate of diffusion of a technology, and also identifies the factors that facilitate or hinder technology adaptation and implementation (Fichman, 1992). These factors include: characteristics of the technology, characteristics of adopters, and the means by which adopters can learn about and are persuaded to adopt the technology (Rogers, 1995). This theory has, however, been used by several researchers to study the adaptation of a variety of innovative technologies (Prescott, 1995). Since green building is both innovative and evolving, it would make sense for future researchers to apply the DOI theory to the findings of this study to identify which stakeholders in Kenya would potentially become 'innovators,' 'early adopters,' early majority,' 'late majority,' and 'laggards.' This understanding would help to accelerate green building adoption in Kenya.

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Appendix A

Map of Kenya

(Source: 2012-13 www.mapsofworld.com)

(Source: CIA, 2010)

Appendix B

LEED 2009 for New Construction and Major Renovation

LEED 2009 for New Construction and Major Renovation

Project Checklist

Project Name

Date

Sustainable Sites — Possible Points: 26

Y	N	?			
Y			Prereq 1	Construction Activity Pollution Prevention	
			Credit 1	Site Selection	1
			Credit 2	Development Density and Community Connectivity	5
			Credit 3	Brownfield Redevelopment	1
			Credit 4.1	Alternative Transportation—Public Transportation Access	6
			Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	1
			Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
			Credit 4.4	Alternative Transportation—Parking Capacity	2
			Credit 5.1	Site Development—Protect or Restore Habitat	1
			Credit 5.2	Site Development—Maximize Open Space	1
			Credit 6.1	Stormwater Design—Quantity Control	1
			Credit 6.2	Stormwater Design—Quality Control	1
			Credit 7.1	Heat Island Effect—Non-roof	1
			Credit 7.2	Heat Island Effect—Roof	1
			Credit 8	Light Pollution Reduction	1

Water Efficiency — Possible Points: 10

Y	N	?			
Y			Prereq 1	Water Use Reduction—20% Reduction	
			Credit 1	Water Efficient Landscaping	2 to 4
			Credit 2	Innovative Wastewater Technologies	2
			Credit 3	Water Use Reduction	2 to 4

Energy and Atmosphere — Possible Points: 35

Y	N	?			
Y			Prereq 1	Fundamental Commissioning of Building Energy Systems	
Y			Prereq 2	Minimum Energy Performance	
Y			Prereq 3	Fundamental Refrigerant Management	
			Credit 1	Optimize Energy Performance	1 to 19
			Credit 2	On-Site Renewable Energy	1 to 7
			Credit 3	Enhanced Commissioning	2
			Credit 4	Enhanced Refrigerant Management	2
			Credit 5	Measurement and Verification	3
			Credit 6	Green Power	2

Materials and Resources — Possible Points: 14

Y	N	?			
Y			Prereq 1	Storage and Collection of Recyclables	
			Credit 1.1	Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 3
			Credit 1.2	Building Reuse—Maintain 50% of Interior Non-Structural Elements	1
			Credit 2	Construction Waste Management	1 to 2
			Credit 3	Materials Reuse	1 to 2

Materials and Resources, Continued

Y	N	?			
			Credit 4	Recycled Content	1 to 2
			Credit 5	Regional Materials	1 to 2
			Credit 6	Rapidly Renewable Materials	1
			Credit 7	Certified Wood	1

Indoor Environmental Quality — Possible Points: 15

Y	N	?			
Y			Prereq 1	Minimum Indoor Air Quality Performance	
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
			Credit 1	Outdoor Air Delivery Monitoring	1
			Credit 2	Increased Ventilation	1
			Credit 3.1	Construction IAQ Management Plan—During Construction	1
			Credit 3.2	Construction IAQ Management Plan—Before Occupancy	1
			Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	1
			Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
			Credit 4.3	Low-Emitting Materials—Flooring Systems	1
			Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products	1
			Credit 5	Indoor Chemical and Pollutant Source Control	1
			Credit 6.1	Controllability of Systems—Lighting	1
			Credit 6.2	Controllability of Systems—Thermal Comfort	1
			Credit 7.1	Thermal Comfort—Design	1
			Credit 7.2	Thermal Comfort—Verification	1
			Credit 8.1	Daylight and Views—Daylight	1
			Credit 8.2	Daylight and Views—Views	1

Innovation and Design Process — Possible Points: 6

Y	N	?			
			Credit 1.1	Innovation in Design: Specific Title	1
			Credit 1.2	Innovation in Design: Specific Title	1
			Credit 1.3	Innovation in Design: Specific Title	1
			Credit 1.4	Innovation in Design: Specific Title	1
			Credit 1.5	Innovation in Design: Specific Title	1
			Credit 2	LEED Accredited Professional	1

Regional Priority Credits — Possible Points: 4

Y	N	?			
			Credit 1.1	Regional Priority: Specific Credit	1
			Credit 1.2	Regional Priority: Specific Credit	1
			Credit 1.3	Regional Priority: Specific Credit	1
			Credit 1.4	Regional Priority: Specific Credit	1

Total — Possible Points: 110

Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110

Appendix C

Permission to Borrow Sections of Thesis by Peter Ozolins

-----"Peter Ozolins" <peter@peterozolinsarchitect.com> wrote: -----

To: "'Peter B Khaemba'" <pbkhaemb@ncat.edu>

From: "Peter Ozolins" <peter@peterozolinsarchitect.com>

Date: 05/08/2012 08:54PM

Subject: RE: PERMISSION TO BORROW SECTIONS OF YOUR THESIS

Sure, Peter, you have my permission to borrow parts of my thesis. I think it's great if you can use my conclusions as a starting point for your research in Kenya. It would be good to see how those conclusions relate to the Kenyan context. Please keep me informed as things progress!

All the best,

Peter Ozolins, PhD AIA LEED AP

Peter Ozolins Architect, P.C.

4485 Mount Tabor Road

Blacksburg, Virginia 24060-0437 USA

office: 540 552 1700

mobile: 540 357 1701

peter@peterozolinsarchitect.com

www.peterozolinsarchitect.com

Appendix D

Permission to Adapt Varun Potbhare’s Research Ideas for This Study

To: Peter B Khaemba<pbkhaemb@ncat.edu>
From: "Prof. Matt Syal" <syalm@msu.edu>
Date: 03/21/2011 10:41AM
cc: varun.potbhare@gmail.com, "Prof. Matt Syal" <syalm@msu.edu>
Subject: Re: REQUEST FOR PERMISSION TO ADAPT VARUN POTBHARE’S RESEARCH IDEAS FOR PART OF MY STUDY

Dear Mr. Khaemba:
I am pleased to note that you are planning to do research similar to the one conducted by my student, Varun Potbhare. We would be pleased to have you adapt the research format and survey instrument from Varun's work with proper credit.

Thanks
Prof. Matt Syal

Matt Syal, Ph.D., LEED®AP
Professor, Construction Management
School of Planning, Design and Construction
MICHIGAN STATE UNIVERSITY
www.msu.edu/~syalm

Appendix E

Permission from Board of Registration of Architects and Quantity Surveyors of Kenya (BORAQS) To Use List of Registered Persons

To: pbkhaemb@ncat.edu
From: BORAQS <boraqs@gmail.com>
Date: 10/02/2012 11:05AM
Subject: LIST OF REGISTERED PERSONS

Dear Peter
Thank you for choosing BORAQS and its registered persons for your research studies.
The Board has approved use of the addresses by yourself for the purposes of your study.

Would you still require further assistant, please be free to contact us.

Yours

George Omondi
REGISTRAR

Board of Registration of Architects and Quantity Surveyors of Kenya (BORAQS)
P.O Box 40866-00100 Nairobi, Kenya.
Tel. +254 020 2728 444, 0726 243 005
Email: boraqs@gmail .com
Website: www.boraqs.or.ke
Transcom House Annex, Ngong Road, Opposite Milimani Law court

Vision Statement
"To Promote World Class Professionals in the Fields of Architecture and Quantity Surveying Towards a Sustainable Built and Natural Environment".
Mission Statement
"To regulate the professions of Architecture and Quantity Surveying through training, registration and enhancement of ethical practice.

Appendix F

Notice of Approval from North Carolina A&T State University Institutional Review Board (IRB)

NC A&T DIVISION OF RESEARCH AND ECONOMIC DEVELOPMENT
1601 East Market Street
Greensboro, NC 27411
(336) 334-7314
Web site: http://www.ncat.edu/~divofres/compliance/irb/index.php
Federalwide Assurance (FWA) #00000013

To: Peter Khaemba
School of Graduate Studies
120 Gibbs Hall

From: Behavioral IRB

Date: 10/05/2012

RE: Notice of IRB Exemption
Exemption Category:
Study #: 12-0031

Study Title: Adoption of Green Building Practices and Rating System in Kenya: Potentials and Barriers

This submission has been reviewed by the above IRB and was determined to be exempt from further review according to the regulatory category cited above under 45 CFR 46.101(b).

Investigator's Responsibilities:

If your study protocol changes in such a way that exempt status would no longer apply, you should contact the above IRB before making the changes. The IRB will maintain records for this study for three years, at which time you will be contacted about the status of the study. **If you are conducting research in a location other than North Carolina A&T State University, such as an agency, organization, or school, you must provide written approval from an authorized representative (for example, the superintendent's office for research conducted in a public school) prior to conducting your research.**

CC:
Musibau Shofoluwe, Built Environment Department

Appendix G

Pre-Notice to Potential Sample of Survey Participants

Subject: Research on Green Building and Green Building Rating System in Kenya
Dear Colleague,

I am requesting for your participation in a research survey to understand the status of "Green Building Practices and Rating System in Kenya." Your participation in this research is important because – as a member of the Board of Registration of Architects and Quantity surveyors (BORAQS) – you represent a stakeholder group that would play a key role toward embracing the emerging green building practices in Kenya's building sector.

The survey will be in form of an online questionnaire, and will not contain information that will personally identify you. Your participation is voluntary and there is no penalty if you do not participate.

If you are willing to participate in this research, please simply respond to this email within the next **fourteen (14)** days by indicating **"Yes."**

After receiving your response, I will email the survey to you.

I appreciate your time very much and look forward to your participation.

Thank you,

Peter Khaemba
Graduate Student, North Carolina Agricultural and Technical State University

Appendix H

First Follow-Up Notice to Sample of Survey Participants

Study Title: Adoption of Green Building Practices and Rating System in Kenya
Principle Investigator: Peter Khaemba
Faculty Advisor: Dr. Musibau Shofoluwe

Dear Respondent,

I hope this email finds you well. About two weeks ago, I invited you to participate in a research study on Adoption of Green Building Practices and Rating System in Kenya. Through your participation, I hope to understand your awareness and viewpoints on this subject.

If you have responded to the survey, please disregard this email and I highly appreciate your help. However, if you have not completed the survey, I just want you to know how important your response is to the success of this research study. I encourage you to take a few minutes from your busy schedule to complete the online survey.

Once again, I appreciate your time very much and look forward to your participation.

Sincerely,

Peter Khaemba
Graduate Student, North Carolina Agricultural and Technical State University

Appendix I

Survey Instrument

Adoption of Green Building Practices and Rating System in Kenya

INFORMED CONSENT TO PARTICIPATE

Study Title: Adoption of Green Building Practices and Rating System in Kenya
Principle Investigator: Peter Khaemba
Faculty Advisor: Dr. Musibau Shofoluwe

Dear Respondent,

I am inviting you to participate in a research study on 'Adoption of Green Building Practices and Rating System in Kenya.' You are being asked to participate because you are a valued stakeholder in the Kenyan building industry. The procedure involves completing an online survey that will take approximately 30 minutes. The survey questions will be about 42. Through your participation, I hope to understand your awareness and perspectives on this subject.

I will keep your information confidential. The survey will not contain information that will personally identify you and I will not ask for your name.

This study has been approved by the Institutional Review Board (IRB) at North Carolina A&T State University. Your participation is voluntary and there is no penalty if you do not participate. You may stop the survey at any time or skip any questions you do not wish to answer.

If you have any questions about completing the questionnaire or about being in this study, you may contact me at pbkhaemb@ncat.edu. You may also contact my research advisor at musibaus@ncat.edu. If you have any study-related concerns or any questions about your rights as a research study participant, you may contact the Office of Research Compliance and Ethics at North Carolina A&T State University at +1(336) 334-7995.

By completing this survey, you are indicating that you at least 18 years old, have read this document, have had any questions answered, and voluntarily agree to take part in this research study. You may keep this form for your records. I appreciate your time very much and look forward to your participation.
Sincerely,

Peter Khaemba
Graduate Student, North Carolina A&T State University

Section I: General Information

Please provide information about yourself by checking the most appropriate response.

1. Which of the following best describes your primary occupation category? (Select one)

- ◯ Architect/Designer
- ◯ Quantity Surveyor

Other (please specify)

____

2. Which of the following best describes your primary sector of occupation? (Select one)

- ◯ Public Sector (government, local authority, etc.)
- ◯ Private Sector (consultant, general contractor, material supplier, etc.)
- ◯ Education and/or Training (school, college, etc.)
- ◯ Other non-governmental organization (local, foreign, international, etc.)

Adoption of Green Building Practices and Rating System in Kenya

3. How long have you directly worked, or participated, in the Kenyan building industry?

- ◯ 5 years or less
- ◯ 6 to 10 years
- ◯ 11 to 15 years
- ◯ More than 15 years

Section II: Green Building Practices and Rating System in Kenya

Green building rating systems have been adopted in various countries as tools for defining and measuring green building goals. Based on your awareness, please indicate your level of agreement to each of the following statements.

4. There are individuals in Kenya who belong to an organization that promotes green building practices.
(Note: The organization can either be local or based in other country)

No opinion/Do not know	Disagree	Somewhat agree	Agree	Strongly agree
◯	◯	◯	◯	◯

5. There is at least one building in Kenya that is certified as 'green' by an organization promoting 'green' building practices. (Note: The certification or rating standard can either be local or developed in another country)

No opinion/Do not know	Disagree	Somewhat agree	Agree	Strongly agree
◯	◯	◯	◯	◯

6. There is at least one 'green' building council in Kenya.

No opinion/Do not know	Disagree	Somewhat agree	Agree	Strongly agree
◯	◯	◯	◯	◯

7. There is at least one public organization or institution in Kenya that has taken initiatives to develop a 'green' building rating system

No opinion/Do not know	Disagree	Somewhat agree	Agree	Strongly agree
◯	◯	◯	◯	◯

8. There is at least one private organization or institution in Kenya that has taken initiatives to develop a green building rating system.

No opinion/Do not know	Disagree	Somewhat agree	Agree	Strongly agree
◯	◯	◯	◯	◯

9. There is at least one non-governmental or other organization/institution in Kenya that has taken initiatives to develop a green building rating system. (Note: This can be local, foreign, or international)

No opinion/Do not know	Disagree	Somewhat agree	Agree	Strongly agree
◯	◯	◯	◯	◯

Adoption of Green Building Practices and Rating System in Kenya

10. There are building codes, standards, and/or regulations to promote green building practices in Kenya.

No opinion/Do not know	Disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○

11. There are government policies, mandates , or incentives to promote green building practices in Kenya.

No opinion/Do not know	Disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○

12. A green building is more expensive to build than a non-green building.

No opinion/Do not know	Disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○

13. There are individuals who have taken initiatives to develop a green building rating system in Kenya.

No opinion/Do not know	Disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○

14. It is important to adopt green building practices in Kenya.

No opinion/Do not know	Disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○

Section III: Sources of Information on Green Building and Green Building Ra...

Please indicate if any of the following sources has been useful in increasing your awareness of green building and/or green building rating system (check all that apply)

15. Please indicate if any of the following sources has been useful in increasing your awareness of green building and/or green building rating system (check all that apply).

- ☐ Print media (e.g. textbook, newsletter, periodical, magazine, research article)
- ☐ Workshop, seminar, conference, or other meeting
- ☐ Website
- ☐ Broadcast media (e.g. radio, television)
- ☐ Advertisement (e.g. banner, billboard)
- ☐ Direct participation (e.g. as team member)
- ☐ Demonstration (e.g. an exhibition)
- ☐ International standards or policies (e.g. International Standards Organization)
- ☐ School/college curriculum

Other ((please specify other source/s of information))

[ ]

Adoption of Green Building Practices and Rating System in Kenya

Section IV: Potential Green Building Attributes

A green building/project consists of various "green attributes." Assume that your team is building a public or private office within a typical urban location (municipality or city) in Kenya. In your perspective, please rate each of the following potential green attributes in terms of its relative importance to making this a green building/project.

16. Prevent construction activity from causing site and air pollution

No opinion/Do not know	Not Important	Somewhat Important	Important	Very Important
◯	◯	◯	◯	◯

17. Minimize the amount of water used in the building

No opinion/Do not know	Not Important	Somewhat Important	Important	Very Important
◯	◯	◯	◯	◯

18. Protect or restore the natural state of the building site in terms of ecosystem, agriculture, plants and animal habitat

No opinion/Do not know	Not Important	Somewhat Important	Important	Very Important
◯	◯	◯	◯	◯

19. Minimize the amount of energy used in the building

No opinion/Do not know	Not Important	Somewhat Important	Important	Very Important
◯	◯	◯	◯	◯

20. Build/construct on a previously developed site

No opinion/Do not know	Not Important	Somewhat Important	Important	Very Important
◯	◯	◯	◯	◯

21. Re-use an existing building structure instead of constructing a new one

No opinion/Do not know	Not Important	Somewhat Important	Important	Very Important
◯	◯	◯	◯	◯

22. Build/construct in a densely populated neighborhood

No opinion/Do not know	Not Important	Somewhat Important	Important	Very Important
◯	◯	◯	◯	◯

23. Prohibit smoking inside the building

No opinion/Do not know	Not Important	Somewhat Important	Important	Very Important
◯	◯	◯	◯	◯

24. Build/construct on a contaminated site (e.g. industrial site or brownfield)

No opinion/Do not know	Not Important	Somewhat Important	Important	Very Important
◯	◯	◯	◯	◯

25. Treat and re-use waste water in the building

No opinion/Do not know	Not Important	Somewhat Important	Important	Very Important
◯	◯	◯	◯	◯

Adoption of Green Building Practices and Rating System in Kenya

26. Build/construct near to existing transport and utilities infrastructure

No opinion/Do not know	Not Important	Somewhat Important	Important	Very Important
◯	◯	◯	◯	◯

27. Use renewable energy that is generated on the building site (e.g. solar or wind)

No opinion/Do not know	Not Important	Somewhat Important	Important	Very Important
◯	◯	◯	◯	◯

28. Provide secure bicycle storage space for building occupants

No opinion/Do not know	Not Important	Somewhat Important	Important	Very Important
◯	◯	◯	◯	◯

29. Build/construct using recycled or salvaged building materials

No opinion/Do not know	Not Important	Somewhat Important	Important	Very Important
◯	◯	◯	◯	◯

30. Encourage building occupants to use vehicles that are fuel-efficient and emit lesser pollutants

No opinion/Do not know	Not Important	Somewhat Important	Important	Very Important
◯	◯	◯	◯	◯

31. Provide walk-off mats, grills, or grates at building entries

No opinion/Do not know	Not Important	Somewhat Important	Important	Very Important
◯	◯	◯	◯	◯

32. Minimize the number of car parking spaces at the building premises/site

No opinion/Do not know	Not Important	Somewhat Important	Important	Very Important
◯	◯	◯	◯	◯

33. Collect rainwater for use in the building

No opinion/Do not know	Not Important	Somewhat Important	Important	Very Important
◯	◯	◯	◯	◯

34. Maximize open space at the building/site

No opinion/Do not know	Not Important	Somewhat Important	Important	Very Important
◯	◯	◯	◯	◯

35. Measure and verify energy use in the building

No opinion/Do not know	Not Important	Somewhat Important	Important	Very Important
◯	◯	◯	◯	◯

36. Control the quantity of storm water runoff from the building/site

No opinion/Do not know	Not Important	Somewhat Important	Important	Very Important
◯	◯	◯	◯	◯

Adoption of Green Building Practices and Rating System in Kenya

37. Use materials that are closely available to the building/site

No opinion/Do not know	Not important	Somewhat important	Important	Very important
○	○	○	○	○

38. Control the quality of storm water runoff from the building/site

No opinion/Do not know	Not important	Somewhat important	Important	Very important
○	○	○	○	○

39. Use strategies to achieve maximum daylight entering the building

No opinion/Do not know	Not important	Somewhat important	Important	Very important
○	○	○	○	○

40. Use roof and non-roof materials with higher heat reflection

No opinion/Do not know	Not important	Somewhat important	Important	Very important
○	○	○	○	○

41. Use building materials that can be renewed or replenished rapidly

No opinion/Do not know	Not important	Somewhat important	Important	Very important
○	○	○	○	○

Section V: Additional Information

42. Please provide any additional information about this survey.

Thank you for completing this survey!

Appendix J

Codes and Standards Referenced in LEED 2009 for New Construction and Major Renovation

LEED Prerequisite/Credit	Reference Code or Standard
SS Prerequisite 1: Construction Activity Pollution Prevention	2003 EPA Construction General Permit (CGP) or Local Code
SS Credit 1: Site Development	USDA; FEMA; Threatened/Endangered Species Lists (US Fish & Wildlife Service, National Marine Fisheries Service); US CFR
SS Credit 3: Brownfield Redevelopment	ASTM E1903-97- Phase II Environmental Site Assessment
SS Credit 4.3: Alternative Transportation – Low-emitting and Fuel Efficient Vehicles	California Air Resource Board; ACEEE
SS Credit 6.2: Stormwater Design – Quality Control	Guidance Specifying Management Measures for Sources of Non-Point Pollution in Coastal Waters, January 1993
SS Credit 7.1: Heat Island Effect - Nonroof	ASTM International Standards
SS Credit 7.2: Heat Island Effect - Roof	ASTM International Standards
SS Credit 8: Light Pollution Reduction	ASHRAE/IESNA 90.1-2007
WE Prerequisite 1: Water Use Reduction	EPAct 1992
WE Credit 2: Innovative Wastewater Technologies	EPAct 1992
EA Prerequisite 2: Minimum Energy Performance	ASHRAE 90.1-2007
EA Prerequisite 3: Fundamental Refrigerant Management	EPA Clean Air Act
EA Credit 1: Optimize Energy Performance	ASHRAE 90.1-2007
EA Credit 2: On-site Renewable Energy	ASHRAE 90.1-2007
EA Credit 5: Measurement & Verification	IPMVP
EA Credit 6: Green Power	Center for Resource Solutions (CRS); Green-e Product Certification
EQ Prerequisite 1: Minimum Indoor Air Quality Performance	ASHRAE 62.1-2007
EQ Prerequisite 2: Environmental Tobacco Smoke Control	ASTME-779-03; California 2001 Energy Efficiency Standards
EQ Credit 1: Outdoor Air Delivery Monitoring	ASHRAE 62.1-2007
EQ Credit 2: Increased Ventilation	ASHRAE 62.1-2007; CIBSE Applications Manual 10-2005
EQ Credit 3.1: Construction IAQ Management Plan – During Construction	SMACNA; ASHRAE 52.2-1999 (air filters)
EQ Credit 3.2: Construction IAQ Management Plan – Before Occupancy	EPA Compendium of Methods Determination of Indoor Air Pollutants in Indoor Air

LEED Prerequisite/Credit	Reference Code or Standard
EQ Credit 4.1: Low-emitting Materials – Adhesives & Sealants	SCAQMD #1168; Green Seal Standard 36
EQ Credit 4.2: Low-emitting Materials – Paints & Coatings	SCAQMD #1113; Green Seal Standard 3; Green Seal Standard 11;
EQ Credit 4.3: Low-emitting Materials – Flooring Systems	SCAQMD #1113; SCAQMD #1168; Carpet & Rug Institute Green Label Plus Testing Program
EQ Credit 5: Indoor Chemical and Pollutant Source Control	ASHRAE 52.2-1999 (air filters)
EQ Credit 6.2: Controllability of Systems – Thermal Comfort	ASHRAE 55-2007 (thermal comfort); ASHRAE 62.1-2007 (ventilation)
EQ Credit 7.1: Thermal Comfort – Design	ASHRAE 55-2004; CIBSE AM 10
EQ Credit 7.2: Thermal Comfort – Verification	ASHRAE 55-2004
EQ Credit 8.1: Daylighting & Views – Daylight	ASTM D1003-07e1, Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics

Compiled from: LEED 2009 FOR NEW CONSTRUCTION AND MAJOR RENOVATION

Appendix K

Guiding Principles for U.S. Federal Leadership in High Performance and Sustainable Building Referenced in LEED 2009 for New Construction and Major Renovation

LEED Credit Reference	U.S Government Policy Guidelines for High Performance Sustainable Building Goals
Sustainable Site (SS)	• EO 13514 section 10-14
SS Credit 4.3 - Alternative Transportation: Low-Emitting & Fuel Efficient Vehicles	• EO 13514 section 12 •
SS Credit 6.1 and SS Credit 6.2 - Stormwater Design: Quantity and Quality Control	• EO 13514 section 14; Also EISA (2007) section 437
WE Prerequisite 1 – Water Use Reduction, 20% Reduction; WE Credit 3 – Water Use Reduction	• EO 13514 section 2d,3
WE Credit 1 Water Efficient Landscaping	• EO 13514 section 2d, 3
Energy and Atmosphere (EA)	• EO 13514 section 2b-2g
EA Prerequisite 1 & EA Credit 3 - Fundamental Commissioning of the Building Energy Systems, Enhanced Commissioning	• EO 13514 section 2
EA Credit 5 - Measurement & Verification	• EO 13514 section 2
Materials and Resources (MR	• EO 13514 section 2e, 5
Indoor Environmental Quality (EQ)	• EO 13514 section 4
EQ Credit 2 – Increased Ventilation	• EO 13514 section 4
EQ Credit 3.1 – Construction IAQ Management Plan: During Construction; EQ Credit 3.2 – Construction IAQ Management Plan: Before Occupancy	• EO 13514 section 4
EQ Credit 7.2 – Thermal Comfort: Verification	• EO 13514 section 4

Compiled from: Executive Order 13514 of October 5, 2009 – Federal Leadership in Environmental, Energy, and Economic Performance (EO, 13514)