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Building designers' perception and the effect on sustainability in Malawi

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2016

Abstract

Building Designers' Perceptions and the Effect on Sustainability in Malawi

by

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MS, Loughborough University, 2009

MS, Brunel University, 2000

BS, University of Saskatchewan, 1980

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Environmental sustainability in buildings is an important part of preserving the environment and reducing climate change. The increasing amount of physical infrastructure systems in Malawi has not been accompanied by policy-makers clearly understanding perceptions and attitudinal behaviors of building designers to promote environmental sustainability. Some building designers in Malawi might not be practicing sustainability innovations adequately, requiring more research to understand their perceptions and behaviors. The purpose of this mixed methods sequential and explanatory study was to explore how building designers' behaviors relate to the implementation of sustainability innovations in Malawi. Ajzen's theory of planned behavior explaining how attitudinal behaviors relate to individual's actions, served as the conceptual framework. The central research question investigated perceptions and attitudinal behaviors building designers hold about sustainability, and how these behaviors connect with practicing sustainability innovations. Data collection used a Likert scale questionnaire to capture behavior items. A sample of 99 individuals working in building organizations completed the questionnaire. Multiple linear regression analysis showed attitude behavior influenced practicing sustainability more than the subjective and perceived control behaviors. Interviews with 24 participants supported the analytical finding. Government and policy-makers were the target audience. Knowledge about behaviors toward sustainability innovations enables government and policy-makers strategize and change stakeholders' mindset to increase sustainability practices thereby impacting societal change in the construction communities.

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Dedication

To my father the late Weldon John Ndau and late brother Harry Weldon Ndau; who as I was growing up in my early years at Limbe-Bangwe Catholic School, together with teachers, taught and inspired me to the skill and discipline of reading and self study and discover knowledge on my own. To my wife Sandra for her understanding, patience and support.

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To my wife Sandra and my children Kondwani, Hanke, Ian, Precious and daughter Lambirani-Rozaria for patience, understanding, and support throughout the years.

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Chapter 1: Introduction to the Study

This mixed-methods cross-sectional study explored the relationship between Malawian building designers' perceptions and attitudes, and sustainability practices in buildings and infrastructure systems. This study stems from previously published research showing that countries differ in how they practice sustainability, and that African countries in particular might not be fully practicing sustainability innovations (Duplessis, 2005). Although governments and other organizations advocate for sustainable development methods, they do not fully understand people's perceptions, attitudes, and feelings toward sustainable design approach in Africa (Duplessis, 2005). This research in Malawi, a country in Southern Africa, contributes to understanding building designers' perceptions and attitudes toward sustainable development practices. I targeted building designers as the key stakeholders in construction and the main influential factor in building design, construction methods, and material (Raimondi, Mikic, Kovacic, & Cekic, 2014). A lack of consciousness about energy efficiency and sustainability, and a tendency to maintain traditional methods among various stakeholders are among barriers to achieving sustainability of resources (Ahn, Pearce, & Wang, 2013; Environmental Affairs Department, 2012).

Governments and development organizations need to understand how perceptions and attitudinal behaviors of stakeholders affect the management of the environment and climate change to achieve sustainability goals (Ahn, et al., 2013; Duplessis, 2005; Rafinandi, et al. 2014). This study on Malawi, contributes to understanding the perceptions of various stakeholders toward sustainability approaches in buildings and the

associated infrastructure systems. Practicing sustainability contributes toward climate change adaptation to reduce environmental degradation, thereby safeguarding and improving the conditions of human livelihood (Wells, Pointing, & Peattie, 2011). The research results show how building designers and associated stakeholders behave toward sustainability will help the government and policy-makers to formulate suitable strategies to increase awareness about the practice of sustainability methods. Hence, my research contributes toward positive social change through increased awareness efforts by the Malawi government, the building designers, and other stakeholders to provide environmentally sustainable buildings and infrastructure systems. In this chapter, I provide the background to the study, the problem statement, research questions, hypotheses, theoretical framework, limitations, definitions, and assumptions of the study.

Background

Infrastructure development, including building construction, affects the environment and causes climate change, as demonstrated by research reported in the United Nations Framework Convention on Climate Change (UNFCC, 2012). For example, in building and infrastructure development, curing bricks using firewood has a deleterious effect on the environment, as it erodes considerable proportions of the forest cover (Abolore, 2012). Dwyer (2011) and Egbue and Long (2012) observed that facilities such as factories, homes, and public utility companies use coal, diesel, and other oil-based fuels for electricity and heating. These energy resources produce gases that negatively affect the environment, resulting in climate change, and damage the natural resources (Dwyer 2011; Egbue & Long, 2012).

The depletion of natural resources and environmental damage due to climate change has raised concerns among stakeholders, governments, and organizations such as the Intergovernmental Panel for Climate Change (IPCC).Concerned governments and organizations subsequently formulated strategic programs to conserve natural resources and the environment (McDonald, 2014). These concerns prompted the World Commission on Environment (WCE) to formulate sustainable development strategies to guide governments and organizations in implementing sustainable development programs (Bruntland, 1987). Ulhanner, Berrent-Braun, Jeurissen, and Wit (2011) adopted the WCE definition for sustainable development as activities that governments and other organizations plan and implement to satisfy present needs of people while not adversely affecting the resources, such as water, forestry, and land needed by future generations.

Researchers have studied sustainability phenomena in different contexts and social values such as in economics, health, energy, and the environment (Axsen & Kurani 2012). However, in this study, I focused mainly on environmental and energy sustainability in buildings and infrastructure systems. Rettie, Burchell, and Riley (2012) observed that governments and organizations were not adequately implementing sustainability approaches in buildings and that attitude and perceptions might be affecting their behaviors. Duplessis (2005) considered that rapid building construction activities in Africa warranted urgent studies to understand behaviors toward sustainability approaches in African countries where stakeholders do not understand these behaviors fully.

According to Abolore (2012), building designers' and developers' decisions in choosing materials and methods are important to achieving full sustainability innovations

in building construction. There is an urgent need to understand designers' and developers' perceptions, attitudes, and feelings and the effect of these behaviors on sustainability innovations. Although countries agree to apply sustainable development methods, researchers such as Abolore observed that countries differ in their degree of sustainability and most do not fully implement sustainability methods. Abolore suggested that perceptions and attitudes might be affecting policy-makers and developers to practice sustainability in their countries. Researchers have studied effects of perceptions on sustainable development strategies such as in Nigeria and Malaysia (Abolore, 2012; Lam, Chan, Chua, & Poon, 2011). Abolore (2012) and Lam et al. (2011) showed that countries differed in the way they perceived and practiced sustainability innovations, and suggested further studies in other countries. Hence, this research in Malawi fulfills partly the need to understand how different countries perceive sustainability.

Problem Statement

Certain technologies and methods applied in buildings and infrastructure systems affect the environment and cause climate change. According to Lai (2014), each country needs to reduce these deleterious effects by employing sustainable materials and methods to conserve and sustain natural resources and reduce climate change. Abolore (2012) and Lai demonstrated further the problem that in infrastructure development, perceptions, and attitudes toward sustainability approaches might be affecting the extent of sustainable methods that building designers apply in buildings. Abolore and Lai proposed that further research is necessary to understand this phenomenon in every country.

Duplessis (2005) pinpointed the problem of the effect of designers' perceptions and attitudes on sustainability approaches in African countries. Duplessis emphasized the urgency of studying this phenomena, due to rapid growth in building infrastructure systems in the African region. According to Duplessis, developers in Africa might not be ready for the dynamic shift from their traditional design practices. The problem addressed by this study was that, despite extensive research, there is a lack of scholarly research on perceptions and attitudes toward sustainability innovations in African countries. As a result, governments and policy-makers do not understand fully perceptions and attitudes that designers and developers hold toward sustainability innovations in each country.

Purpose Statement

The purpose of this mixed methods study was to explore building designers' and developers' perceptions and attitudinal behaviors. The main purpose was to understand how these behaviors might be affecting sustainability innovations in buildings and infrastructure systems in Malawi. The intent of my study was also to explore the perceptions of Malawian building designers and to demonstrate the relationship between their attitudes and the degree to which they practice sustainability innovations in their work.

Nature of the Study

In this a mixed methods study, I analyzed how building designers' attitudinal behavior related to sustainability, and explored what attitudinal behaviors and perceptions the designers had about sustainability approaches that could explain their behaviors. The quantitative component consisted of analyzing how attitudes and related behaviors relate

to performing sustainability practices. The qualitative component consisted of exploring participants' feelings, perceptions, and beliefs. I used the mixed methods approach since the study involved descriptive analysis of participants' behaviors toward sustainability and the degree of sustainability they perform. I used questionnaires, interviews, and observational methods to collect data from participants. Data comprised participants' indication of sustainability they practice, attitudinal behavior scales, and beliefs about sustainability practices. Participants included architects, engineers, contractors, surveyors, and other relevant players in design and development of buildings and infrastructure systems.

In the quantitative data analysis, I evaluated the relationship between attitudinal behaviors of participants measured on a Likert scale survey and the extent to which participants practice sustainability approaches. I applied multiple linear regression (MLR) to analyze relationships among variables. I used the Statistical Package for Social Sciences (SPSS) as the software tool for the analysis (Green & Salkind, 2011; Field, 2013). Attitudinal behavior with Likert-type scale values were the independent variable while the degree of sustainability practiced that participants report as percentage values was the dependent variable.

Research Questions

The primary question of my study was, to what extent could attitudes and related behaviors influence building designers to practice sustainability innovations in Malawi; and what experiences, feelings, and perceptions do the building designers hold that could explain the phenomena? In the qualitative study, I inquired about participants'

explanation about their perceptions, feelings, and experiences about sustainability approaches to develop and find thematic patterns of participants' thoughts. In the quantitative component, I analyzed the attitudes that emerge and explore the extent to which these behaviors are affecting their intentions or willingness and application of sustainability methods in their work. Both quantitative and qualitative research questions guided the study. I expressed the quantitative research questions as mathematical hypotheses in Chapter 3.

The secondary research questions for the study were as follows:

1. What is the correlation between building designers' attitudinal behaviors towards sustainability innovations and their intention to practice sustainability innovations?

2. To what extent do attitude, subjective norms, and control behaviors affect building designers' intention to practice sustainability innovations?

3. To what extent do attitudinal behaviors differ across age in affecting building designers' intention to practice sustainability innovations?

4. What experiences, feelings, beliefs, and perceptions do building designers and similar experts have to explain about sustainability innovations?

Conceptual Framework

This study on how building designers' perceptions correlate with the application of sustainability innovations relied on the theory of planned behavior (TPB) (Ajzen, 1991). According to Ajzen (1991), the TPB explains how perceptions, attitudes, related behaviors, or interpretations as the planned conscious impact on individuals to act in

particular ways toward other individuals, processes, or phenomena. The TPB states that three types of beliefs guide human thinking before performing a behavior. The first is the belief about what consequences result from the behavior, and this behavioral belief produces favorable or unfavorable attitudes toward the behavior. The second is the normative belief and concerns the person's ideas about what people regard as normal behavior for him or her to perform. The normative belief is a social pressure or subjective norm that compels individuals toward or against a behavior. The third consideration is about the factors or conditions that a person believes impedes or facilitates performance of the behavior. This belief regulates a person's final steps toward performing a behavior as the perceived behavior control.

Ajzen (1991) stated that the combination of the behavioral beliefs results in intentions and actual performance of a behavior action. Ajzen observed that in general when behavioral beliefs are favorable, they result in influencing strong intentions to perform the action. Figure 1 shows the TPB diagram illustrating the relationships between the behavior constructs and actual behavior.
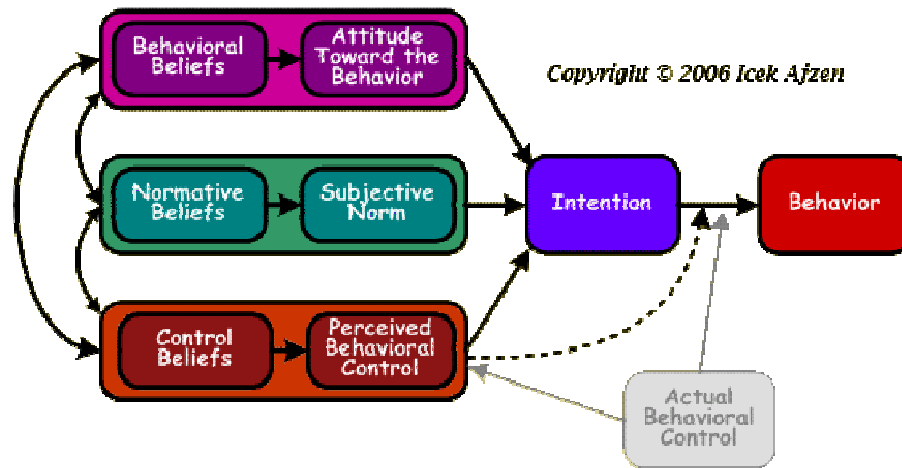
Figure 1. *Diagram of the theory of planned behavior*. Adapted from "The theory of planned behavior" by I Ajzen, 2006a. Retrieved from people.umass.edu/aizen/tpb.diag.html. Public domain (Ajzen, 2006b).

Ajzen's (1991) TPB was useful as my study evaluated attitudes and the related behavior constructs of building designers to understand how these behavioral constructs related to actual sustainability practices. Researchers have applied the TPB in social-technical studies to predict user intentions of technologies or processes. For example, Lo, Breukelen, and Kok (2014) included the TPB in a study to understand the motivation to use teleconference technologies among workers in the Netherlands and their behaviors toward the technologies. Luzon, Garcia-Martinez, and Calvo-Solguero (2012) used Ajzen's TPB to analyze attitudes, subjective behavior norms, and perceived behavior control to understand waste recycling behaviors among Spanish housewives. Similarly, Sanchez-Medina, Romero-Quintero, and Sosa-Cabrera (2014) used the TPB to understand the behaviors and intentions of managers towards the environmental management of small and medium enterprises in the Canary Islands.

The application of Ajzen's (1991) TPB in these studies was useful and relevant. It was similar in application to the study of perceptions and attitude of building designers. Perceptions and attitudes guide the designers to form planned behaviors that could be affecting their intentions and willingness to implement sustainability methods. The application of the TPB was relevant and guided this study.

Definitions

In the study of the effect of designers' perceptions and attitudes about sustainability practices, the following are the explanations and definitions of the key terms:

Sustainable development: Development activities that present generations undertake to satisfy their current demands safely and rationally while minimizing the effect on resources for future generations (Bruntland, 1987; Lourenco, Jones, & Jawarna 2012).

Sustainability: The efficient management of resources for future generations to also benefit (Swaim, Maloni, Napshin, & Henley, 2014)

Global warming and *climate change*: Global warming refers to the increase in average earth temperature arising from excessive man made greenhouse gases such as carbon dioxide and other phenomena. Climate change refers to the effects of global warming phenomena that raises earth temperatures and alters weather patterns (Lai, 2014).

Sustainable technologies or innovations: Technologies or innovations that present generations could use to achieve sustainable development goals and conserve

resources needed by future generations. Sustainable technologies or innovations are renewable energy systems, such as photovoltaic solar electricity generation and wind power generation, as these innovations do not adversely affect the environment (Zuo, Zillante, Wilson, Davidson, & Pullen, 2012).

Infrastructure: Physical facilities and systems for the functioning of societies and communities, such as buildings, transport, power, water, and gas systems (Cidell & Cope, 2013).

Assumptions

Duplessis (2005) observed that the construction industry affects environmental sustainability with unsuitable materials and construction methods. Based on Duplessis's observation, I considered building designers such as architects and engineers as the major decision-makers in the construction industry whose attitudes and perceptions about sustainability need exploring. I assumed that these population groups provided more effective information than the public, because of their influence in construction. Therefore, I targeted building designers as the study population.

Another assumption was about lack of personnel and resources to enforce environmental bylaws. The Malawi government was not policing and enforcing environment bylaws fully, as Chizimba (2013) observed in a study of donor-funded agriculture sustainability programs in Malawi. As Chizimba stated, bylaws alone might not fully achieve sustainability goals, but policy-makers also need to understand attitudes of stakeholders to plan for their behavior change. In this study, I assumed to be correct

Chizimba's suggestion for behavior change of stakeholders to supplement the environmental bylaws.

I also assumed that participants were open and honest when responding to survey and interview questionnaires. I assumed that participants expressed personal beliefs and feelings about their perceptions and attitudes with their consciences. I assumed that employers, superiors in the line of work, and other entities did not influence the participants. Where necessary, the participants limited their disclosure of information in conformity with ethical research procedures. After an assessment by the an expert panel, I assumed that my instrument measured the true reflection of participants' responses of the Malawian environment. This assumption was important since it would have jeopardized the internal validity of the study if I collected data that did not represent the true perceptions and attitudes of the participants.

Scope and Delimitations

The research problem was that there was insufficient understanding of how perceptions and attitudes affected building designers to practice sustainability approaches in Malawi. Therefore, I focused on building designers such as architects and engineers, even though other professionals such as lawyers could also influence policy and regulations of building and infrastructure development. The focus was on designers since unlike other professionals, building designers influence directly technical decisions about the development of buildings and infrastructures. The research process would have affected the internal validity of the findings if participants from the focus group were to generate bias, abscond, or drop out of the study. In the quantitative part using

questionnaires, data quality depended on the honesty and trustworthiness of the participants in responding to questionnaires as well as maintaining a presence without dropping out. According to Teddlie and Tashakkori (2009), confirming internal validity involves drawing the cause and effect from study samples correctly. Participants compromise internal validity if they drop out, or if either the researcher or if any of the participants bias data. If the researcher is not neutral, he or she may influence participants to provide biased responses.

I conducted my study in the Malawian cities of Lilongwe and Blantyre and excluded rural-based design professionals in the remote towns because of considerations of transport, communication, and timing of the study. The restrictive boundary of the study would jeopardize the external validity of the findings. According to Teddlie and Tashakkori (2009), achievement of external validity involves drawing study samples from large populations and different settings and situations.

The other restriction was the applicable theory for the study. The central theory was Ajzen's (1991) TPB as it drives perceptions and attitudes in persons to plan and behave or act in specific patterns, depending on their interpretations of surrounding factors. However, other theories, such as those concerning politics or governance, could also affect the behaviors and attitudes of the building-design professionals. In my study, I did not explore external factors of political or governance that could also be influencing building designers, but focused mainly on the personal attitudes and actions of these professionals.

Most building and infrastructure designers in Malawi are in the study area of the cities of Lilongwe and Blantyre (Nexus Strategic Partnership, 2014). Hence, the findings of the study in these two cities reflected a representative view of most of the professionals throughout Malawi. In the qualitative component, I used a purposeful sample of key professional designers who provided a truthful reflection of their feelings and perceptions. I assumed that they represented most of design professionals. Hence, qualitative study findings were transferrable and generalizeable to the entire building design professionals in Malawi.

Limitations

My study was within the Malawian geographical location—specifically in Lilongwe and Blantyre cities, where the major building designers in the government and the private sector organizations and firms operate (Nexus Strategic Partnership, 2014). In my study, I excluded rural areas, due to communication and transportation difficulties that would be costly and untimely for the proposed study. Another limitation was the proposed population study group, limited to the building designers only such as architects and engineers. The basis of this limitation was the assumption that building designers, rather than other professional groups such as economists and lawyers, have the immediate influence on decisions about building quality. Though my study focused on building design professionals, studies to include other professionals may be necessary for the future.

Significance

I explored the effects of building designers' perceptions and attitudes on sustainability approaches in Malawi. My research has a high potential to contribute to our knowledge about this phenomenon in different countries that researchers, such as Abolore (2012), found missing. According to Duplessis (2005), research in this area is both important and urgent in the unique environment of African countries. My research is urgent due to rapid infrastructure developments, as Duplessis observed and as the Malawian government (2009) stated, concerning rapid infrastructure development in Malawi. Hence, it is crucial to incorporate sustainability concepts now, as buildings and other infrastructure systems are growing, rather than wait until later when the infrastructure and building systems grow fully.

The Malawi government adopted the Millennium Development Goals (MDG), an ambitious project aiming to achieve continuous and long-term development for the country (Malawi Government, 2009). Among its aims, the MDG for Malawi includes sustainable development approaches. These sustainable approaches encourage the country to implement activities that do not affect the environment. Practicing the approaches safely satisfies present needs of society without affecting resources needed in the future, as the World Commission on Environment prescribed (Abolore, 2012). Although Malawi recognizes the significance of sustainable approaches, researchers such as Chizimba (2013) observed that human capacity other and resources within the Malawi government are not adequate to enforce regulations, including monitoring sustainability practices. As Chizimba observed, the growth in the application of sustainability practices,

like other developmental efforts, continue to depend on the efforts of individuals and interest groups. Hence, achieving sustainability requires the efforts of individuals and groups involved in the development of various sectors of the Malawian economy, such as the building and infrastructure development sector.

Malawi government development policies such as the MDG support sustainable development approaches. My research constitutes a significant contribution to Malawi's sustainability goals through understanding perceptions and attitudes of design professionals towards sustainability approaches. This knowledge on the behaviors of professional designers will assist the Malawi government and organizations to plan and formulate suitable frameworks to guide designers and developers in the self-monitoring of sustainability applications to their work. My research contributes significantly to Malawi government policies of meeting sustainability goals as part of the Millennium Development Goals.

This study unveils building designers' perceptions and attitudes toward sustainability innovations in Malawian buildings and infrastructure systems. The results are useful for policy-makers in government and development organizations. The understanding of the phenomenon among policy-makers provides information on how building designers in Malawi perceive sustainability. The findings of this study may assist the government and other organizations to formulate guides to change or improve the behaviors of building designers to implement sustainability approaches than. The change in building designers' behaviors would result in an increase in sustainable

buildings for society. Therefore, my research contributes toward social change through improved sustainable buildings and infrastructure systems.

Summary

The purpose of this study was to understand perceptions and attitudes of building design professionals in Malawi and the effects of these behaviors on sustainability practices in buildings and infrastructure systems. Sustainable development is activities that individuals, governments, or organizations undertake to satisfy safely present needs while safeguarding resources needed by future generations. Practicing sustainable approaches and innovations requires the use of materials and processes that do not adversely affect the environment to fulfill sustainability goals. Many countries have adopted the sustainable development goals, but research studies indicate degree to which countries practice sustainability varies and that most countries do not practice sustainability methods fully. These previous studies have highlighted the lack of understanding about the effects of perceptions and attitudes toward sustainability methods in different countries. This study in Malawi contributes to the understanding of the problem in African countries.

The central research question asked what behaviors building designers in Malawi hold towards sustainability issues and how these behaviors might be affecting the practicing of sustainability innovations. The research strategy employed a mixed methods research procedure. The mixed methods approach was appropriate in responding to the qualitative enquiry about perceptions as well as the quantitative enquiry regarding the extent of the effect of attitudes. Ajzen's (1991) TPB was appropriate to use in explaining

the research inquiry.TPB explains behaviors and actions that persons generate from interpreting perceptions and attitudes when they observe other persons or processes. The theory resonated with the research question since the aim in the study was to investigate the relationship between attitudinal behaviors and actions towards the sustainability phenomenon.

This research is important to Malawi because the understanding of perceptions and attitudes of professional designers enables the Malawi government and organizations to guide programs effectively. This enhances positive social change among communities and societies through improved and sustainable building and infrastructure systems. Chapter 2 comprises a review of recent peer-reviewed research articles. I elaborate further the scholarly research on attitudes and behaviors toward sustainability innovations. I also demonstrate the lack of knowledge about behaviors toward sustainability approaches in different countries.

Chapter 2: Literature Review

Previous studies showed the problem that buildings and infrastructure systems do not comply fully with sustainability goals. This problem continues although countries prescribe sustainability guidelines and frameworks aimed at reducing the effects of changes in climate (Abolore, 2012; Elmaulim, Valle, & Kwawu, 2012; Karahasanovic, Tatic, & Avdic 2012). The purpose of my study was to understand designers' behaviors concerning sustainability. According to Abolore (2012), various sustainability strategies are available for buildings. Abolore listed innovations such as natural ventilation, environmentally friendly materials, renewable energy systems including solar water heating, wind energy, photovoltaic systems, as well as efficient use of energy and natural resources. As African countries are at crossroads of development activities, it is imperative to understand how attitudinal behaviors and perceptions of building designers and similar stakeholders influence how these countries practice sustainability innovations (Duplessis, 2005). Duplessis and other researchers observed the lack of research to understand behaviors about sustainability innovations both globally and in African countries (Estevez & Janowiski, 2013; Evans, Whitehouse, & Gooch, 2012; Mogandas, Verdugo, & Ramanathan, 2013). My study in Malawi is relevant in increasing the understanding of perceptions and attitudes about sustainability innovations in African countries.

Chapter 2 comprises three sections, beginning with an explanation of concepts involving sustainability innovation in buildings and infrastructure systems. In the second section, I review the conceptual frameworks that explain the predictability of intentions

and actions toward innovations and technologies, in particular toward sustainability innovations. The major conceptual frameworks reviewed include Ajzen and Fishbein's (1975) theory of reasoned action (TRA), Ajzen's (1991) TPB, Davis's (1989) technology acceptance model (TAM). I also review other model frameworks relevant to explaining behaviors toward diffusion of technology and innovations into communities and societies. Reviewing similar studies of how researchers analyzed behaviors of communities or societies toward different innovations is relevant to the study of building designers' attitudes and perceptions toward sustainability approaches in Malawi. I present the summary of the literature review in the last section of this chapter.

To identify the current literature, I used online search strategies for peer-reviewed articles and dissertations published within the last 5 five years. The searches included the online databases in the Walden Library and online library resources of other institutions. In the online library searches, I focused mainly on the *EBSCO* database system, as it had search engines in many fields of specialization. I targeted selected specializations and found *Academic Search, Applied Science Complete*, and *Information Science and Technology* as appropriate databases in which to conduct my searches. Furthermore, I used Google and Google Scholar search engines to complement the search within the library. In the online search, I used search terms to find online literature. The search terms yielded a wide range of results from online search engines. However, the study narrowed down the terms and chose the relevant ones only. Examples of search terms included *attitude, perception, attitude-behavior theory*, and *technology acceptance*. These

searches resulted in the identification of applicable theoretical frameworks and research articles relevant to this study.

Sustainability Approaches in Buildings and Infrastructure Systems

Dwindling global economic resources, drought, and floods are results of climate change that scientists attribute largely to human development activities, including the construction of buildings and infrastructure systems that degrade the environment (Lai, 2014). Policy-makers and scientists recognize the need to preserve the environment and to sustain global resources such as water resources, agricultural resources, and land space by controlling human development activities. Bruntland (1987) described sustainable development as development that communities and societies could undertake cautiously to meet their needs while protecting resources that future communities and societies would need to fill their needs. Abolore (2012) highlighted similar explanations about sustainability and stated that it required a balance between meeting current needs and ensuring that future resources will be adequate to satisfy the needs of future generations. Sustainable development implies integrating social and economic development without contributing to declination of resources, as Abolore observed.

Several studies have observed that evaluating sustainability approaches can be difficult due to different activities and focus. For instance, Abolore (2012) explained that evaluating whether human activities are sustainable is a challenge. Abolore viewed this as a challenge since governments, organizations, or individuals aim at different impacts. They often use different scales to evaluate sustainability practices due to differences of sustainable development application. Abolore went on to explain the key concept of

satisfying human needs while safeguarding the environment and other resources is the main purpose of sustainable development agenda. Hence, one of the criteria for sustainability judgment was to evaluate the extent to which human economic and similar activities influence the environmental resources.

Shrinking environmental resources limits economic activities and hence, government and organizations recognize the importance of sustainability approaches (Abolore, 2012; Strengers & Maller, 2012; Thomas & Lamm, 2012). Axsen and Kurani (2012) argued that sustainability concepts were essential and linked them to humanistic values. Axsen and Kurani found that human activities exceeded the planet's biophysical limits and could result in an impoverished future society. Observation by Axsen and Kurani was similar to that of Thomas and Lamm (2012) in explaining that sustainability thinking considers that human activities take place within available limits of economic, environment, and social dimensions.

Most sustainability studies in buildings and physical infrastructure systems involved evaluation of environmental sustainability, even though buildings and infrastructure systems also affect social and economic conditions of the society, as Abolore (2012) observed. Abolore explained that sustainable building concepts related to environmental issues were important but understanding economic and social cultural indicators were also useful. Similarly, Lai (2012) observed that environmental challenges are the primary concern in sustainable construction. Therefore, evaluating environmental sustainability concepts in the study of building designers' perception about sustainability formed the major element of my evaluation criteria.

According to Abolore (2012), evaluating sustainability levels is complex, as measuring sustainability impacts and interpretations depends on the context of the study. Abolore's observations were similar to G4 sustainability reporting guidelines (GRI, 2013). The G4 guidelines highlighted the processes for governments and organizations to disclose how their activities adhere to the sustainability guideline procedures. Similar to Abolore, the guide incorporated the wider scope of economic, social, and environmental concerns and reflected the aspects of disclosing the context in which the reporting entity implemented the sustainability measures. Due to lack of uniformity in measuring sustainability, countries and regional bodies adopted different standards according to the context and aspects of sustainability. Governments and organizations recognize different standardizations for evaluating sustainability in buildings and infrastructure. The Building Research Establishment Environmental Assessment Method (BREEAM) and the Leadership in Energy and Environment (LEED) are notable standardizations governments recognize globally (Cidell & Cope, 2012; Hjorth & Madani, 2014; Rutkauskas, Stasytyte, & Michnevic, 2014).

Despite the significance of practicing sustainability measures and knowledge about guidelines such as the LEED and BREEAM, practicing sustainability approaches has not been adequate globally. Literature showed that attitudes and perception behaviors might be affecting persons including building design and construction professionals to practice sustainability approaches in different countries. For instance, Swaim, Maloni, Napshin, and Henley (2013) studied students' behaviors and intentions towards sustainability in the United States. Swaim et al. (2013) considered that prior education

was crucial for the new graduates to adopt sustainability behaviors in the work place. Swaim et al. observed that new graduates and other stakeholders challenged the legitimacy of sustainability and discredited its societal values. Swaim et al. therefore proposed that educational authorities incorporate strategies in the education system to change attitudes and increase the adoption of sustainability behaviors.

Lai (2012) studied stakeholders' opinion about greenhouse gas emission reporting in Hong Kong. Although most people supported the opinion for mandatory reporting of green house emissions, the stakeholders differed in the material to include when reporting. Lai observed that education, experience, and knowledge barriers influenced the differences in opinion. Lai reported that educated persons, energy experts, and experienced people were the only groups that supported the opinion for mandatory reporting. The author recommended the government to increase educating the stakeholders and the general population about sustainability to reduce the knowledge gap.

Abolore (2012) compared perceptions towards sustainability between Nigerian and Malaysian building professionals. Abolore found that in Nigeria perceptions about sustainability was lower than in Malaysia. Hence, Abolore recommended authorities to educate stakeholders to enhance sustainability adoption in the Nigerian construction industry. The study showed that perceptions about sustainability differ across countries.

Duplessis (2005) also observed insufficient studies about sustainability practices in different countries, but focused on the lack of similar studies in African countries. Duplessis highlighted the need to understand sustainability phenomena in Africa, due to unique cultures that affect sustainable development differently from those of developed

countries, where researchers had conducted their studies so far. Duplessis highlighted the urgency of studying perceptions of sustainable development in African countries as they actively began to undertake major infrastructure developmental projects. Duplessis suggested that developing countries ought to integrate sustainability methods in infrastructure systems immediately, as it would be impractical to integrate sustainability innovations after completion of the projects. In this study, I did not measure the actual sustainability elements that standards prescribe. Instead I evaluated sustainability behaviors of building professionals. I aimed at understanding how the behaviors might have affected individuals to practice sustainability in their work. I reviewed theoretical concepts that predict behaviors. The significance of reviewing the theoretical concepts was to understand constructs that predict behavior intentions of individuals or groups toward new approaches, objects, or phenomena such as sustainability approaches.

Approaches to Behavior Prediction

Sustainable building practices require designers and building teams to apply different types of technological and methodological innovations. Therefore, I explored theories and conceptual models that explain individual or group-perceived behaviors and attitudes toward phenomenon or innovation. Personal beliefs and attitudes that building designers hold influence behaviors toward sustainability practices at their work. Theoretical models exist that explain persons' behaviors, such as Ajzen's and Fishbein's (1975) TRA, Ajzen's (1991) TPB, and Davis's (1989) TAM. These conceptual models are relevant to the study of building designers' behaviors toward sustainability innovations. l reviewed theories and concepts associated with predicting the behavior of

individuals. I used these theories and concepts to explain how building designers'
attitudes and perceptions might have affected how they practice sustainability approaches
in their work.

Ajzen (1991) developed the TPB from the TRA originated by Fishbein and Ajzen
(1975). According to Fishbein and Ajzen, the TRA predicts a person's intention to
perform a behavior. The theory of reasoned action states that before performing a
behavior, a person has two beliefs about their behavior. The first is the belief the
particular behavior produces a favorable outcome; this is the person's attitudinal belief.
The second belief is the outcome of the person's behavior meets the expectation of their
peers. Fishbein and Ajzen referred to this second belief as a normative or subjective
belief. The TRA considers only two constructs guiding a person's action. The constructs
are the personal attitudes and subjective or normative beliefs about what others may feel
about the behavior. However, Ajzen modified the original TRA by adding the control
behavior as a third belief. In addition, he formed the TPB. The TPB has constructs similar
to those of TRA, but Ajzen included the control belief, which he attributed to the
person's self-assessment of success or failure. Hence, the TPB incorporated the perceived
behavior control as the third construct.

The TPB as modified from the TRA has a factor mitigating between a person's
intention to perform a behavior and the actual performance of that behavior (Ajzen,
1991). The TPB accounts for external and internal factors in a person that could reinforce
or weaken a person's intentions toward a perceived behavior. According to Ajzen,
intentions alone do not predict a person's final behavior, as he or she must balance or

mediate external and internal obstacles that interfere with the intent to perform a behavior. The perceived behavior control used in Ajzen's TPB is similar to the self-efficacy construct in the social cognitive theory. According to the social cognitive theory, self-efficacy is the belief that persons hold about themselves concerning their ability to perform particular tasks. The belief factor is what controls final behavior as considered in Ajzen's theory.

Ajzen's (1991) TPB is similar to the TRA in that both theories use attitude and normative factors as constructs for predicting behaviors. However, Ajzen's TPB is different from TRA since it includes the perceived behavior control as the third element. In his elaboration, Ajzen explained the three behavior constructs of the TPB as comprising one's attitude toward a specific behavior, subjective or normative behavior, and perceived behavior control. Therefore, according to Ajzen, the TPB stipulates that attitudes toward a behavior in question, subjective behavior, and behavior control are all useful in predicting a person's ultimate behavior. Ajzen suggested that when measuring attitudes, it is necessary to measure the subjective behaviors to account for personal beliefs controlling final decisions.

Davis (1989) developed the TAM similar to Fishbein's and Ajzen's (1975) TRA and Ajzen's (1991) TPB but focused on user behaviors towards technologies. The TAM explains the relationship between a person's intention to use a system or technology and their perceptions of its usefulness and ease of using the system or technology. According to Davis, the key constructs in the TAM model are the usefulness and the ease of use. However, as Ajzen observed, the intention to use a technology or system does not readily

result in actual usage. People are cautious in making final decisions, meaning the behavioral control mediates the actual implementation. According to Ajzen's observation, Davis's TAM focuses on technological systems, but the process of predicting behaviors is similar to that of the planned behavior theory. However, the TAM differs from Fishbein's and Ajzen's TRA in that it allows for an intermediate behavior that researchers can consider at the beginning before performing the behavior, which the TRA ignores.

Integrating Fishbein's and Ajzen's (1975) TRA, Ajzen's (1991) TPB, and Davis's (1989) TAM provides a useful framework. The framework elaborates how perceptions and attitudes guide behavior intentions of people toward accepting or rejecting technologies or innovations in different professional groups, societies, or communities. For instance, Wang and Lu (2011) integrated TAM with TPB to explore and understand users' acceptance of mobile communication biotechnology systems among consumers in China. According to Wang and Lu, improvement in technology acceptance due to its simplicity and ease of usage as well as its perceived usefulness in everyday life. Wang and Lu concluded that integrating the TPB with TAM was an effective methodology for understanding attitudes toward technology diffusion among communities or groups. In addition, Teo (2012) studied the intentions of preservice teachers to employ technology using the TAM and the TPB.

Similar to Wang and Lu (2011), Teo (2012) stated that perceived usefulness and ease of use leads to attitudes toward the technology or system, and this influences behavioral intention to use or reject the technology. Hence, it was possible to apply and

integrate the TPB and TAM to my study. A review of the literature demonstrated the extent of how researchers applied the TRA, TPB, and TAM frameworks to understand the effects of integrating new technologies and sustainability innovations into groups, communities, or societies.

The first group of studies in this literature review applied one theoretical model only among TRA, TPB, or TAM as single-behavior model studies. For these single-behavior prediction model studies, I examined the effectiveness of the constructs in each study and categorized them under attitudes, subjective behavior, or behavior control. The second group comprised of studies that applied multiple behavior models of TRA, TPB, and TAM in one study. I categorized these studies according to the number of combinations of TRA, TPB, and TAM researchers integrated.

Single-Behavior Prediction Models

I identified studies that used one form of theoretical or conceptual model of TRA, TPB, or TAM. I then compared how behavior constructs of attitudes, behavior control, and normative behavior affected intended or actual performance of activities. I demonstrate in the following section the effectiveness of behavior constructs that researchers used in their studies to predict behavior actions. The differences depended on the context in which researchers conducted the studies. To compare and contrast the studies, I grouped studies with similar constructs. Hence, in the following sections I reviewed articles by grouping them according to their key constructs of normative beliefs, attitudinal behavior, or perceived behavior control. I also grouped articles according to a combination of the behavior constructs.

Normative Beliefs

Normative beliefs are peer-driven or influenced by cultural beliefs. According to Ajzen (1991), normative beliefs influence individuals to behave in a manner that superiors, relations, friends, or society expects of them. Several studies analyzed the significance of normative behavior. A comparison of the studies showed similarity in that normative behavior influenced behavior intentions more than the other constructs did. Using Ajzen's TPB to study user behaviors toward protective information technologies was a demonstration of how normative cultural beliefs affected technology acceptance among communities or societies.

Lo, Breukelene, Peters, and Kok (2014) studied teleconference use as alternative to travel by using TPB to analyze travel behaviors among workers in the Netherlands. Lo et al. (2014) found habit and perceived norm to be effective in predicting intentions compared to attitudes and perceived behavior control. Lo et al. stated the workers' behavior norm to use teleconferencing was consistent with their habit of avoiding travel. Hence, applying TPB was useful in analyzing behavior as Lo et al. established that normative behavior was stronger than the attitudes and behavior control elements.

Using the TPB, Lee and Shepley (2012) studied how conditions in neighborhood environments affected the decisions of adults to perform leisure-time walking to improve their health. The hypothesis stated that differences existed between adults who performed leisure walking and adults who did not perform leisure-time walking depending on how they understood the significance of their neighborhood environments. Lee and Shepley also hypothesized that modeling the TPB into the study would assist in predicting

walking behaviors among participants. A cross-sectional survey applied a questionnaire to 424 Korean adults and found that participants who performed leisure–time walking appreciated the neighborhood environment. Lee and Shepley's constructs of the TPB had strong convergence between behavior control and intention to walk. However, the subjective norms strongly led to positive behaviors toward the environment. Although in a different context, this study found normative behavior to be the influential construct similar to Lo et al. (2014).

Uhlaner, Berett-Braun, Jeurissen, and Dewit (2012) explored factors that predicted the intentions of small to medium enterprises (SMEs) to practice environmental management in Netherlands. Uhlaner et al. (2012) analyzed a random sample of 689 SMEs and found that family influence and perceived financial benefits from energy savings were among factors that influenced Dutch SMEs to engage in environmental management practices. Uhlaner et al. used the TPB to construct relationships between behavior attitudes, subjective family norms, and perceived behavior control in the SMEs, and the resultant intentions to practice environmental management. Among other hypothesis testing, Uhlaner et al. confirmed the hypothesis that family concerns significantly influenced SMEs to engage in environmental management practices. This study was relevant in demonstrating the usefulness of the TPB, whose constructs are similar to my study of behaviors toward sustainability among infrastructure design professionals in Malawi. Uhlaner et al. found the normative behavior construct to be significant and similar to that discussed by Lo et al. (2014) and Lee and Shepley (2012).

Yang (2013) tested the effectiveness of the TPB to predict the behavior intentions to practice entrepreneurship among Chinese students. The study gave 1330 respondents a questionnaire that captured attitudes, subjective norms, and behavior control. The study found that gender and parents' entrepreneurial experience influenced significantly the attitudes, subjective norms, and behavior control of participants in developing entrepreneurial intentions. The findings confirmed what Yang aimed to explore, focusing on the usefulness and effectiveness of the TPB.

However, Yang (2013) observed few differences between the Chinese study and other similar studies, especially those conducted in western countries. According to Yang, most western studies observed that subjective norms were insignificant in influencing entrepreneurial intentions, whereas in Chinese environments, the subjective norms were the main drivers of entrepreneurial intentions. According to Yang, behavior control was insignificant in influencing Chinese entrepreneurship intentions compared to western studies, which showed behavior control as influencing intentions to practice entrepreneurship. Yang found normative behavior as significant in China. The effect of the construct was similar to that found by Lo et al. (2014), Lee and Shepley (2013), as well as Uhlaner et al. (2012), although in different environments. Yang (2013) attributed these differences to environmental and cultural effects. In western cultures, individualistic approaches encourage people toward independent decisions, whereas in Chinese collectivist cultures, group factors such as family or persons they admire often influenced individuals' behavior. Therefore, the subjective norms were high and individualistic behavior control for self-decisions was weak. The TPB was effective in

understanding and predicting behavior in China and would be useful to predict behavioral intentions in other cultures.

Attitudinal Behaviors

Other studies had similar findings showing that researchers identified that attitudinal behaviors were more influential than the other constructs. Thomas and Lamm (2012) focused on attitudes, observing that sustainability often involved operational practices in assessing sustainability processes, but giving little attention to understand attitudes. Thomas and Lamm suggested that attitudes could be influencing managerial decisions. Thomas and Lamm proposed a framework model to represent overall managerial attitudes that could legitimize the uptake of sustainability actions in organizations. Thomas and Lamm identified internally held attitudes, externally held attitudes or moral attitudes. Thomas and Lamm compared internal and external behaviors with attitudes, subjective norms, and behavior control of Ajzen's (1991) TPB. Thomas and Lamm constructed a legitimacy model using a framework diagram that mapped external and internal attitude elements and subjective moral norms. According to Thomas and Lamm, management could use mapping models to study attitudes toward sustainability measures of managers and staff members in their organizations. Thomas and Lamm observed the model, though not confirmed, was a useful foundation for quick decision-making for management before performing detailed analysis of sustainability measures.

Although the TPB was popular among researchers, other researchers preferred the TRA due to the context of the study. For instance, Coleman, Bahnan, Kelkar, and Curry

(2011) investigated the reasons that drive consumers to adopt green technologies. Coleman et al. (2011) used the TRA to develop and study how attitudes and beliefs among students and adults influenced their intentions to adopt green innovations. Coleman et al. observed that although the TPB was strong, since it includes the personal control element, Coleman et al. preferred to use the TRA, since attitudes were more predominant in the study than the effect of perceived control. Coleman et al. studied two samples consisting of 202 adults and 302 students in Northeastern United States communities and observed there were differences in response between the adult and student sample participants.

Coleman et al. (2011) developed several hypotheses to test these relationships; one of the key hypotheses was that attitudes toward green technologies and subjective norms influenced intentions to purchase green innovations. Coleman et al. found that both the student and nonstudent samples confirmed that attitudes influenced respondents positively toward green consumption behaviors and the main finding agreed with expectations from the TRA. The two participant samples were, however, different in that nonstudents attributed green consumption to the need to reduce environmental damage, which correlates more with attitudinal values than with subjective norms. Within the student sample, however, the subjective norm influenced their behaviors toward green consumption. Hence, Coleman et al. considered that green marketing could be a competitive strategy by using subjective norms to target students and using value marketing to target nonstudents to influence their attitudes.

As sustainability is applicable to different sectors, some studies explored behaviors toward environmental sustainability in the tourism sector. Hedland (2011) observed that tourism growth, although it signified positive economic development of countries, brought along negative impacts on the environment. Countries needed to balance between the negative and positive effects when practicing sustainable tourism. According to Hedlund, sustainable tourism was tourism that was economically beneficial and did not affect the environment negatively, and this tourism would be useful in future tourism. This meant that owners of tourist businesses needed to invest in economically sustainable tourism. The purpose of this study was to investigate whether environmental concerns and attitudes had an effect on tourists' behaviors of accepting economic sacrifice. Hence, this research developed several hypotheses, and one hypothesis predicted that environmental concerns or attitudes had an effect on the tourists' intentions favoring the choice of ecologically sustainable tourism. This study used 4444 web-based virtual participants and tested the relationships in pretest and posttest phases. Hedland found there was a statistically significant correlation in support of the hypothesis. Although the study showed the relevance of value, it did not examine the effect of behavior, and the author alluded to the need to include the impact of behaviors in future studies.

In another study, Razaei–Moghaddar and Salehi (2010) aimed to understand attitudes and intentions to adopt precision agricultural technologies among agriculturists in Iran. According to Razaei–Moghaddan and Salehi, agriculturists thought that traditional agriculture methods were degrading the environment and needed to change to

use softer and sustainable approaches. Razaei–Moghaddan and Salehi described precision agriculture as using technologies, machinery, tools, and chemicals profitably without degrading soils. Razaei–Moghaddan and Salehi reviewed the background to the TRA, TAM, and TPB and proposed to apply TAM as a derivative of the TPB. Razaei–Moghaddan and Salehi integrated the TAM with the innovation diffusion theory. According to Razaei–Moghaddan and Salehi, innovation diffusion theory stated that adoption of an innovation depended on individuals' perception of the innovation; Razaei–Moghaddan and Salehi thought that this theory was similar and complimentary to the TAM.

Razaei–Moghaddan and Salehi (2010) developed questionnaires by integrating constructs from the innovation diffusion theory and the TAM. Razaei–Moghaddan and Salehi administered the questionnaires to 705 agriculture specialist participants. Upon pilot testing and refinement, Razaei–Moghaddan and Salehi collected data that captured attitudes, perceptions, and possible intentions of the participants.

Among constructs Razaei–Moghaddan and Salehi evaluated was testability of innovation, which they described as being the ease of testing an innovation. Razaei–Moghaddan and Salehi referred to this as *triability.* Among other results, Razaei–Moghaddan and Salehi found that triability did not influence usefulness, though it positively influenced intentions to adopt the innovations. In their conclusion, Razaei–Moghaddan and Salehi observed that ease of use was among the key constructs that influenced attitudes and perceptions among agriculturalists to use precision agricultural innovations. Razaei–Moghaddan and Salehi also found that triability was important in

influencing intentions to adopt the innovations. Hence, Razaei–Moghaddan and Salehi recommended that Iran should recognize precision agriculture technologies to be a sustainability innovation approach. The study demonstrated the effectiveness of using the TAM when integrated with other models such as the innovations diffusion theory.

Ajzen, Joyce, Sheikh, and Cote (2011) explored the reasons people continue to behave in certain ways despite information advising them to behave in contrary directions. The purpose of the study was to demonstrate that providing accurate information was not adequate to effect behavior changes, but the information should incorporate behavioral beliefs that affect the study population. Ajzen et al. (2011) contended that for effective incentives to change peoples' behaviors, accurate information about the population was important. This should include identifying normative and control beliefs in the population. Full knowledge about the population was useful in challenging their beliefs and influencing behavior changes. Ajzen et al. described examples that showed that knowledge about a phenomenon alone was not a prerequisite for behavioral action, but that to influence behavior change effectively it should include full information about peoples' beliefs. In one example, Ajzen et al. described a study of 79 participants that showed that knowledge about the environment had no effect on energy conservation behaviors. Similarly, another study of 79 participants showed that there was no relationship between alcohol knowledge and drinking behavior.

However, when Ajzen et al. (2011) incorporated information of what beliefs participants held, they observed that knowledge influenced people's behavior. For

example, one study involving 85 participants incorporated beliefs and attitudes toward pro-Muslim behaviors in the test. In this study, Ajzen et al. showed there was a positive correlation between knowledge and behavior. According to Ajzen et al., the correlation was due to the knowledge-testing process that incorporated underlying participants' beliefs and attitudes about the religion. Therefore, Ajzen et al. recommended that researchers incorporate elements of attitudinal behaviors and beliefs. Ajzen et al. observed that using the TPB to incorporate peoples' behavior and beliefs into the knowledge or information dissemination was a strong strategy for seeking correlations to predict behavior actions.

Moons and Des-Pelsemacher (2012) sampled 1202 participants to study factors that determined usage intentions of electric cars in Belgium. Moons and Des-Pelsemacher applied the TPB to analyze emotion and attitude toward electric car driving and its general usage. Moons and Des-Pelsemacher found that emotions and attitudes correlated strongly with usage intentions. According to Moons and Des-Pelsemacher, emotions and attitudes had the strongest effect on intentions to use electric car; however, subjective norms and reflective behavior control were the least. When Moons and Pelsemacher studied different groups, and found that people with high concerns about the environment had strong intentions or inclinations to use an electric car once it became widely available. Moons and Despelsemacher observed that such characteristic factors were obvious in people with pro-environmental behaviors. Moons and Despelsemacher observed that people with less interest in the environment exhibited lesser emotion toward electric cars than the environmentally concerned group. Moon and

Despelsemacher demonstrated the TPB was effective in understanding emotions and attitudes toward electric car usage intentions.

Tan (2013) used the extended TPB modeling to measure the intention of homeowners to purchase sustainable homes in Malaysia. Tan found that attitudes toward green housing, perceived behavior control, and perceived self-identity influenced homeowners to generate behavior intentions to purchase green homes. However, the Tan observed that subjective norms, such as social references advocating green homes, did not affect purchase intentions significantly.

Tan considered that analyzing the relationships of the constructs of the TPB model were important in predicting purchase intentions. This study was another example of the usefulness of modeling the TPB to predict intentions. My study explored designers' behavior toward sustainability, using the TPB similar to Tan's approach.

Behavior Control

Greaves, Zibarras, and Stride (2013) explored behavior intentions of workers to preserve the environment in UK workplaces. Greaves et al. (2013) constructed questionnaires based on the constructs of the TPB, administered it to 449 participants, and captured their beliefs and intentions to preserve energy or the environment. Behavior control included such actions as switching off laptops when not in use recycling waste, or using videoconferencing to reduce the cost of transportation needed in face-to-face conferences. Greaves et al. established that they could predict the behaviors of up to 60% of the participants who intended to engage in the environmental and energy preservation behaviors.

Another study concerned attitudes toward plug-in cars as a sustainable energy technology. The aim of this study that Axsen and Kurani (2013), conducted was to establish what people valued about sustainability-oriented technologies such as hybrid plug-in electric vehicles. Axsen and Kurani used sociological and psychological concepts linking individual value and self-concept theories that influence behaviors in individuals. The study used the narrative approach, where individuals described personal experiences with plug-in hybrid vehicles that were a symbol of sustainable technology. The study grouped users according to their motivational factors. Axsen and Kurani formed a group whose members had no interest in sustainability, a group that expressed interest in electric vehicles, and a group that already practiced sustainability. Axsen and Kurani observed the second group adopted temporary behaviors favoring sustainability values. Incentives could move this group toward full adoption by strengthening their self-value concept. For example, owning or operating an electric vehicle. The study showed that using value addition could change self-concepts and influence the borderline individuals toward adopting sustainable technologies.

Behavior studies also included health environments. DeBebruin, Sheeran Prins, Hospers, and Van Breckelen (2012) observed a problem that showed a lack of correlation between intentions and actual behaviors of patients in health environments. The aim was to investigate whether self-regulatory processes or behavior control affected intentions and behavior actions. DeBebruin et al. (2012) conducted their study of HIV medication adherence and exercise behaviors. DeBebruin et al. utilized questionnaires to capture HIV adherence intervention behavioral data from 51 patients and from 499 participants to

obtain exercise adherence data. DeBruin et al. used elements of the TPB as one of the

frameworks to test and predict behaviors. DeBebruin et al. found that self-regulatory

processes and intentions predicted actual behaviors in both the HIV interventions and

exercise adherence studies. Hence, the study concluded that self-regulatory processes

mediated the intention–behavior relationships.

Other studies of behavior control included road safety behaviors. According to

Tavafian, Aghamodaei, Gregory, and Madani (2011), using seatbelts significantly

reduced injuries in car accidents. However, Tavafian et al. (2011) aimed to investigate

factors that predicted self-driven intentions or behavior control to use seatbelts among

drivers in Iran. Tavafian et al. designed questionnaires that captured constructs of the

TPB and belief model and administered it to 251 drivers to collect data. Using the SPSS

and the multiple regression method, Tavafian et al. found results that correlated the

constructs of the TPB. Tavafian et al. observed that attitudes, subjective norms, and

perceived behavior control influenced drivers' behaviors and significantly predicted the

use of seatbelts. Therefore, Tavafian et al. concluded that drivers were likely to use

seatbelts. Tavafian et al. predicted seat belt behaviors by integrating health beliefs with

attitudes, subjective norms, and perceived behavior control. The study demonstrated the

effectiveness of the TPB in predicting intentions to adopt and use innovations.

Prediction in Multiple Behavior Models

While single-method studies analyzed specific constructs to understand behavior

intentions, other researchers integrated several theoretical models or concepts to analyze

behaviors in one study. The TRA, TPB, and TAM were among the popular frameworks

that researchers combined and applied to their studies. The review of these studies

showed the effectiveness, usefulness, and problems associated with combining theoretical

frameworks in some studies.

Integrating TAM With TRA and TPB

In a study of behaviors toward Internet banking, Yousafzai, Foxall, and Pallister

(2010) used the TAM to explain user acceptance of new technologies. Yousafzai et al.

(2010) observed that previous assessments used financial expenditure and performance

levels of information technology (IT) systems. These were benchmarks for assessing user

acceptance in addition to behavior theories and models. Yousafzai et al. outlined the TRA

and the TPB as useful tools in predicting technology acceptance. Yousafzai et al. singled

out the TAM, an adaptation of the TPB, as the most effective tool in exploring behaviors

toward Internet banking compared to the other two theories. According to Yousafzai et

al., the TRA considers attitude behavior and belief about expected behaviors of

individuals as the subjective norm to explain behavior intentions. However, Yousafzai et

al. critically found the TRA as inconclusive, as it did not confirm real behavior intention,

because individuals could change intention at an ultimate stage.

In a similar approach to Ajzen's (1991), Yousafzai et al. (2010) considered the

inclusion of self-control behavior besides Ajzen's behavioral attitudes and subjective

norms in the TPB. However, Yousafzai et al. found that TPB in its form was not useful

for analyzing behaviors toward Internet banking technology, as measuring self-control

behavior in individuals was impractical. Therefore, Yousafzai et al. advocated for

applying the TAM that considered users' intentions to adopt a technology, as being

dependant on the users' personal beliefs about its usefulness and ease of use

Yousafzai et al. (2010) observed that although TPB was useful in explaining

behaviors, TAM was more effective in measuring and predicting behavior intention than

TPB alone. Hence, Yousafzai et al. suggested incorporating these two models in the study

of user behaviors toward Internet banking technology. Yousafzai et al. compared results

of the three models of Ajzen's and Fishbein's TRA, Ajzen's (1991) TPB, and Davis's

(1989) TAM used to explain behavioral intentions and actual use of Internet banking. The

comparison showed that TAM was superior in explaining behavioral intentions than TPB

and TRA. Furthermore, this study when using the TAM model found that perceived

usefulness significantly affected users' intentions to adopt internet banking more than did

the users' perceptions about its ease of use construct. Despite the differences, Yousafzai

et al. demonstrated the effectiveness of the TAM as a derivative of Ajzen's (1991) TPB.

Yousafzai et al. (2010) analyzed three frameworks in detail, showing exhaustive

findings using each model. Combining and comparing the three frameworks enhanced

research quality as one of the advantages, the disadvantage being the large amount of

analytical data resulting from the high number of construct variables. In contrast to the

studies that used three frameworks in one study, some other studies used only two

frameworks and were comparatively brief. Constructs generated from TAM and TPB, for

instance, were fewer than constructs generated from TRA, TPB, and TAM combinations.

Integrating TAM With TPB

Tsai, Wang, and Lu (2011) used the TAM to evaluate whether ease of use of

mobile communication had an impact on customers willingness to adopt mobile

communication technology in Taiwan. Tsai et al. (2011) observed that mobile

communication was increasing in Taiwan and was replacing other forms of

communication such as print media and television. Tsai et al. observed that a lack of

understanding by the public might be hindering the adoption of mobile

telecommunication and suggested further studies to explore user behavior and public

acceptance of mobile communication systems.

Similar to Yousofzai et al. (2010), Tsai et al. (2011) used Davis's (1989) TAM

and Ajzen's (1991) TPB to analyze behaviors and technology acceptance in

understanding users' intentions. The study initially conducted pretest questionnaires to

230 participants to test their technical knowledge. Participants viewed biotechnology

videos and other teaching materials concerning biotechnology systems, and then

completed research questionnaires. Tsai et al. designed the questionnaires based on the

TAM and TPB. Tsai et al. captured participants' perceptions about usefulness and ease of

use, attitudes and behavioral control, to assess participants' intentions. Tsai et al. found

that perceived usefulness, ease of use (Davis, 1989), and attitude, and behavior control

(Ajzen, 1991) directly correlated and affected behavioral intentions to use the technology.

The study reported reliabilities over 0.8 and Cronbach's alpha over 0.7. This study

concluded that using TAM and TPB was effective in analyzing and understanding users'

intentions toward mobile communication system.

Teo (2012) integrated TAM and TPB models to examine intentions to use technologies among pre-service teachers. Similar to Tsai et al. (2011) and Yousafzai et al. (2010), Teo explained the theoretical background of the models and considered the usefulness in analyzing behavior intentions of using both to compare the models. For instance, a hypothesis for TAM constructs stated that attitudes toward usage (ATU) of technology had a significant influence on behavior intentions to use (BIU) the technology. For the TBP construct, one of the hypotheses that Teo applied was the subjective norm (SN) had a significant influence on behavior intention to use (BIU) the technology. The study recruited 157 participants consisting of degree students and including both female and male participants who responded to a 5-scale Likert scale questionnaire.

When Teo (2012) tested the hypothesis, he found that TAM constructs yielded the most effective results. The constructs showed significant correlation between behavior intentions and attitude to use technologies other than TPB. This study concluded that teachers were likely to use technologies due to positive perceived usefulness and feeling that technologies are valuable. Teo highlighted limitations that included unreliable data on participants' self-report about their behaviors. According to the researchers, participants were likely to inflate the self-reporting data. Therefore, Teo proposed multi-method data collection as the solution to the problem. Teo recommended researchers to employ this strategy in future studies. Furthermore, Teo observed the need to test TAM and TPB in different groups and different contexts, as well as applying them in longitudinal studies to improve the effectiveness and validation of the method.

Teo's (2012) observation was similar to Yousafzai et al. (2010), who studied TAM and TPB in Internet banking, where Yousafzai et al. recommended further studies on effectiveness of TAM and TPB in different contexts. Although limitations in the study exist, Teo's research was important in demonstrating the effectiveness of integrating TAM and TPB in one study. Teo was similar to Tsai et al. (2011) in combining TPB and TAM. However, they were different in that Tsai et al. analyzed the integrated data from TPB and TAM constructs, while Teo separated the data and performed two studies to compare results of TPB and TAM constructs. Teo concluded that TAM was more effective than TPB, while Tsai et al. did not reach this conclusion.

Integrating TPB With TRA

Lin, Carsrud, Jagoda, and Shen (2013) used the TRA and TPB to explore determinants of entrepreneurial intentions in Sri Lanka. Lin et al. (2013) based their study on Ajzen's (1991) TPB and explained that attitudes, subjective beliefs, and behavior control were necessary to predict intentions and actual performance of entrepreneurship activities. However, they observed that TPB constructs were effective when predicting entrepreneurship intentions in western cultures due to the perceived behavior control that strengthen behavior beliefs. Lin et al. observed that perceived behavior control beliefs strengthen individuals to form personal decisions in western cultures. However, from their study in Sri Lanka, Lin et al. observed weaker behavior control beliefs in Asian cultures than in western cultures. Instead, they found that attitudes and subjective or normative beliefs were strong due to family and cultural values. Hence, Lin et al. observed the two-construct approach used in TRA was sufficient in Sri Lanka since only

attitudinal behavior constructs and subjective or normative behavior constructs were important. However, to study the behaviors fully, Lin et al. combined the TRA and TPB to account for both cultural context and western influences among Sri Lankan society. Lin et al.'s questionnaire measured both TPB and TRA constructs, and Lin et al. used students as participants in the survey. The results showed that perceived behavior control beliefs were weak among the Sri Lankan students and Lin et al. observed lack of confidence when students expressed their entrepreneurship intentions. Lin et al. contrasted the students' behaviors with Western context where, according to Lin et al., entrepreneurship intentions were strong. Lin et al. concluded that combining TRA and TPB accounted for cultural contexts and was an effective strategy for cross-cultural research.

Hackman and Knowlden (2014) reviewed studies concerned with dietary interventions among youths in selected locations in the United Kingdom. Hackman and Knowlden targeted research that applied the TPB and TRA as strategies for analyzing and planning behavior changes. Harkman and Kowlden explained that TRA assumes that a person has attitudes and a subjective behavior constructs only when forming their decision to act. Thus, TRA excludes the third construct of perceived behavior self control construct and has two constructs only whereas the TPB includes the perceived behavior control as the third construct. Harkman and Knowlden analyzed each research article to understand behaviors change that researchers reported.

Harkman and Knowlden (2014) observed that researchers used TPB combined with TRA in their research than TRA alone. Out of the 11 studies examined, 10 used TPB

combined with TRA as the basis for evaluating behavior while only one study exclusively used the TRA alone. Harkman and Knowlden observed that where researchers combined TRA and TPB in one study, TPB behavior constructs were important for analyzing and effecting behavior change. Therefore, Harkman and Kowlden demonstrated the effectiveness of combing TRA and TPB in behavior studies.

Integrating TPB With Other Frameworks

Researchers have applied the TPB in combination with different types of framework due to flexibility of its constructs. TPB allows integrating variables in different contexts. Depending on the context, studies showed that TPB was more effective and popular among researchers than the other frameworks.

Some studies integrated the TPB with social identity theory. In Nigeria, Ayobani and Ismail (2013) studied the effect of volunteer tourism on local residents. The aim was to understand livelihood and sustainability of the local residences in Abuja, Nigeria. The study recruited 150 villagers as participants and applied questionnaires developed from the constraints of the TPBs and integrated with social identity theory. This qualitative study found that residents firstly recognized perceived benefits from volunteerism, and in general, the study observed that cultural beliefs assisted them to support tourism when it did not conflict with their traditional beliefs. Residents with good national scenery and environment also supported tourism because of the economic benefits. The application of the TPB recognized the significance of social identity where the social identity instrument incorporated and integrated in the social parameters in the Nigerian context.

The TPB was useful and effective in understanding attitudes and perception behaviors, especially as integrated with the social identity theory.

In another approach involving multiple frameworks, researchers combined the TRA, TPB, and the TAM and applied them in one study. This was in the study of postpurchase behavior where Averdug and Wagenfulhreir (2011) observed that majority of studies did not acknowledge the importance of understanding postpurchase behaviors of sustainable innovation products. Averdug and Wagenfulhreir investigated consumer characteristics, consumer attitudes toward ecological products, and consumers' intended behavior. Averdug and Wagenfulhreir wanted to understand post-purchase behaviors among consumers. Upon comparing and analyzing major qualitative and complimentary factors such as consumers' willingness to pay and word of mouth, Averdug and Wagenfulhreir found that word of mouth was critical in supporting environmental behaviors in the post-purchase phase. The importance of word of mouth in the study showed the TPB, through its normative belief construct, was more useful and effective than the other frameworks integrated in the study.

Similar to the Averdug and Wagenhulhrer (2011) integrative study, Ozaki (2011) also integrated three frameworks in one study. Ozaki investigated what qualities and processes attract consumers toward adopting green electricity in the United Kingdom (UK). Ozaki observed that adopting innovations depended on many factors, but highlighted the value of the innovation, subjective norms of the users and their personal identity as being among the important factors. Ozaki explained the attributes of the TPB as the foundation for the study. Ozaki also integrated these theories with other models,

such as the environmental paradigm that emphasize the need to observe natural limits to preserve and to balance its resources.

Using the theories of planned behavior, reasoned action, environmental paradigm, and other models, Ozaki (2011) developed questionnaires based on the constructs that explained reasons for adopting sustainability and energy innovations. The reasons included perceived benefits, compatibility with existing processes, following what others were doing to preserve and cope with innovation (behavior control because of innovation), and foresee or predict risks associated with innovation. In this study, 103 respondents participated and contributed to the qualitative survey. This study found that respondents had positive attitudes toward green electricity and that this led to intentions to continue with the sustainability approaches. According to Ozaki, respondents had the strong belief that renewable energy was beneficial. Although consumers expressed negative sentiments about the method of accessing green tariffs, Ozaki concluded that it was the personal benefit, social identity, and other social norms that pushed users to adopt green electricity. This study showed the effectiveness of the normative constructs drawn from the TPB.

Bezzina and Dimech (2011) demonstrated the effectiveness of the TPB in their study where Bezzina and Dimech investigated recycling behaviors among Maltese residents. The aim was to determine which factors significantly influenced the residents' behaviors. Bezzina and Dimech used a sample of 400 randomly selected participants and used the TPB integrated with an altruism behavior model to construct questionnaires. Bezzina and Dimech found that personal attributes, subjective norms, and skills were the

highest factors that significantly influenced behaviors; the three factors were in tandem with constructs expected from the TPB.

Shih and Fan (2014) studied how behaviors affected the adoption of instant messaging technology among tourist and travel agents in Taiwan. Shih and Fan used the constructs in TPB to define variables and designed the survey questionnaire based on TPB. Their aim was to identify behavior factors that influence the adoption of instant messaging. Shih and Fan applied the questionnaire to 188 participants and found that optimism lead to positive attitudes towards adopting instant messaging. Shih and Fan recommended travel and tourism agencies to adopt instant messaging technologies. The study demonstrated the usefulness of TPB in technology intervention studies.

Alomari, Woods, and Sandhu (2012) also integrated theoretical frameworks in one study. Alomari et al. (2012) investigated factors that influenced and predicted citizens to adopt e-government in a study that used web Internet interactions. Alomari et al. integrated the TPB, TAM, and the diffusion of innovation to identify constructs and develop questionnaires. Alomari et al. administered and analyzed Internet-based survey questionnaires for 400 participants. Alomari et al. found that trust in government, beliefs, and perceived usefulness of the technology were among the most significant factors influencing citizens to adopt e-government. Alomani et al. combined TPB with constructs Alomari et al. identified from other frameworks, such as TAM. The strategy was unlike Shih's and Fan's (2014) that used constructs from one framework.

Summary

Integrating several frameworks enhances the quality of research. Researchers can compare and choose the most effective constructs from the theoretical frameworks that describe the behaviors of the study population compared to studies that use one framework. However, the researchers analyzed more constructs than studies involving a single theoretical framework that focused on fewer constructs. TAM was useful due to its ease-of-use construct, but applied mostly to technological innovations or contexts such as in IT environments. Most studies used the TPB, as it also included constructs from the TRA. In addition, researchers integrated TPB with other frameworks in different studies and contexts, showing its popularity among researchers. I therefore applied TPB to my study to address the research questions.

In Chapter 2, I explored sustainability approaches in buildings and the importance of investigating attitudinal behaviors and perceptions in persons or communities. These behaviors explain building designers' attitudes that might influence them when implementing sustainability innovations in their work. In the literature study, I explored the theoretical frameworks that explain how individuals develop behavior intentions. The TRA, the TPB, and TAM were among the frameworks that explained theoretical constructs used in predicting behavior intentions. The predictive frameworks led to an understanding of how individuals, groups, or societies acted toward innovations or technologies. Therefore, the frameworks could be useful in exploring behaviors that might affect the building designers' behavior and attitudes to implement sustainability approaches fully.

In the literature review, I compared and contrasted selected research studies to examine how researchers applied and implemented the theoretical models to explain behavioral intentions of individuals or groups toward different phenomena. Comparing and contrasting the different research literature showed that researchers evaluated similar constructs that consisted of attitudes, behavior control, and normative beliefs. The degree to which the constructs predicted behavior differed among these studies according to the context of the investigation. A comparison of the studies showed that those that used a single theoretical model were more specific in identifying the predictive constructs than studies that used several theoretical models. The literature review showed how researchers examined key constructs that affect behavior intentions. Although the TAM was effective in analyzing technological innovations, most the studies applied the TPB and in much wider contexts than the other frameworks, including TAM.

Knowledge about perceptions and attitudinal behaviors of building designers and similar experts toward sustainability practices is insufficient, and the study aims to analyze and explore the behaviors. Analyzing behavior constructs based on the TPB is among the effective methods to study behavior intentions. Therefore, my research used this approach. Chapter 3 follows, explaining the research methodology, including survey instruments and tools for measuring and analyzing behavior constructs that relate to behavior intentions of building designers toward sustainability approaches in Malawi.

Chapter 3: Research Method

The literature review in Chapter 2 showed that knowledge about perceptions and attitudes about sustainability approaches are not adequate in many countries. Duplessis (2005) recommended further studies in African countries. The purpose of this sequential explanatory mixed methods research was to study how attitudes and other behaviors affect building designers' to practice sustainability innovations in Malawi. The study explored participants' feelings, perceptions, and beliefs to explain their behaviors.

In Chapter 3, I explain the rationale for the research design, role of the researcher, research methodology, participant selection, instrumentation, data collection, and analysis for both quantitative and qualitative elements. In the final section, I explain threats to research validity, trustworthiness, and ethical procedures.

The primary question of my study was, to what extent could attitudes and related behaviors influence building designers to practice sustainability innovations in Malawi; and what experiences, feelings, and perceptions do the building designers hold that could explain the phenomena? The secondary research questions were as follows:

1. What is the correlation between building designers' attitudinal behaviors towards sustainability innovations and their intention to practice sustainability innovations?

2. To what extent do attitude, subjective norms, and control behaviors affect building designers' intention to practice sustainability innovations?

3. To what extent do attitudinal behaviors differ across age in affecting building designers' intention to practice sustainability innovations?

4. What experiences, feelings, beliefs, and perceptions do building designers and similar experts have to explain about sustainability innovations?

Rationale for the Research Design

I examined the extent to which perceived behaviors and attitudes affect how building designers and similar experts practice sustainability innovations. I also explored how their beliefs and perceptions explained their actions toward sustainability innovations. I used Ajzen's (1991) TPB as the central concept since it explains relationship between attitudinal behaviors, intentions and actual performance of an activity. The primary research question is in two parts suggesting the need to examine two strands of inquiry. The first inquiry was to evaluate attitudes and similar behaviors to understand how the behaviors affect sustainability actions among building designers. The second strand was to describe in detail what feelings, beliefs, and perceptions building designers and similar experts were holding that would explain their actions.

The sequential, explanatory, and mixed methods design was suitable for this inquiry, since this study addressed the two parts of the primary research question. The initial, quantitative part addressed the relationship between behavior intentions and actions, the second, qualitative part explained the reasons for the behaviors to complement and clarify the response to the initial inquiry. According to Teddlie and Tashakkori (2009), sequential explanatory mixed methods designs use multiple phases with the final study complimenting the initial study. The second phase was qualitative and explored explanations from selected participants to understand their perceptions, feelings, and beliefs. This second phase of the study confirmed results of the first phase.

Using the survey, I collected data on participants' attitudes, the other behavior constructs, and the actual sustainability activities participants practice or perform in their work. I analyzed the participants' behaviors using Ajzen's (1991) TPB. Ajzen's TPB states that internally mediated behavior constructs predict a person's final intentions and actions. The behavior constructs comprise a person's attitude toward a phenomenon, a person's subjective behavior, and behavior control (Ajzen, 1991). In my research, I examined attitudes, subjective behaviors, and behavior control of participants and examined how these behaviors were affecting participants' actual performance of sustainability innovations.

The first part was a quantitative study with a cross-sectional survey design, involving survey data and I used a Likert scale to measure participant behaviors. I collected data regarding the behavior constructs of attitudes, subjective norms, behavior control, intentions, and actual sustainability innovations performed. The literature search showed many available sustainability methods and practices in constructing buildings (Abolore, 2012; Bal, Bryde, Fearon, & Ochieng, 2013; Konig, Dimbek, & Stankoviski, 2013). The methods and practices included efficiency in energy and water usage, incorporating photovoltaic systems to supplement electricity supply, solar water heating, natural cooling or ventilation methods. The methods also included using environmentally friendly material or methods that minimize damage to the environment.

Participants indicated the level to which they perform sustainability innovations in the survey questionnaire. Upon analyzing data, I determined what relationships existed between behavior constructs and actual sustainability innovations that participants

perform. In my analysis, I confirmed the existence of such a relationship. According to Teddlie and Tashakkori (2009), the subsequent phase of a mixed methods design provides additional perspective for deeper understanding of a phenomenon compared to a single-method study. Therefore, it was necessary to continue in the subsequent phase to explore the reasons for the results to understand the phenomenon.

Thus, the second part of my study was a qualitative inquiry exploring data through interviews. The aim was to understand feelings, beliefs, and perceptions about sustainability approaches among participants, and to collaborate or contradict the quantitative findings. The second part of my study was designed to improve the validity of the research by explaining what participants described in detail about their feelings and beliefs about sustainability innovations. By this approach, participants clarified and confirmed their behaviors toward sustainability innovations.

In the interviews, I explored perceptions, feelings, and related beliefs of purposefully selected individuals involved in designing, planning, and construction of buildings to understand further, how the behaviors might be affecting the sustainability approaches as Frankfort-Nachmias and Nachmias (2008) as well as Monette and Sullivan (2008) recommended to gain further understanding. Frankfort-Nachmias and Nachmiasas well as Monette and Sullivan stated that cross-section survey designs accomplish a wide collection of data to understand the scale of variability and impact across the population. Furthermore, qualitative explorations achieve deeper understanding of the phenomenon in the population (Frankfort-Nachmias & Nachmiasas, 2008; Monette & Sullivan, 2008) .

Hence, the sequential explanatory mixed methods approach with a cross-sectional survey design achieved a better understanding of sustainability perceptions than other designs.

I used the sequential explanatory design that was appropriate because it required fewer resources than the simultaneous designs. The simultaneous designs, such as the parallel, concurrent, or embedded designs require two teams to collect data simultaneously–thus, they need more resources than the sequential designs. Unlike the designs that require simultaneous approaches, I used two methods at separate times for the sequential design. Hence, parallel, concurrent, and embedded designs were not suitable for my study since these designs involve simultaneous data collection processes for quantitative and qualitative analysis (Teddlie & Tashakkori, 2009). However, when analyzing the behaviors in the quantitative part, I identified important constructs and key participants for further exploration later in the qualitative part. I identified participants during the quantitative phase but it was impractical to interview the participants and perform qualitative study simultaneously.

In my study, I used a nonrandom purposeful sample of key participants for the second part. This was a subset of the participants in the first phase of the study, similar to Teddlie and Tashakkori (2009). Teddlie and Tashakkori stated that in sequential mixed methods, designs sampling from the first part often informs the methodology in the subsequent part. Hence, although the quantitative and qualitative data collection was at different phases, in the analysis and explanatory process I integrated and harmonized the quantitative and qualitative findings. Thus, in the second phase of my study I used the results from the first study, in alignment with Teddlie and Tashakkori.

Variables

In my study of building designers' perceptions and their effect on sustainability

innovations, the key independent variables were building designers and planners'

attitudes, normative or subjective behaviors, and perceived behavior control. The

dependent variable was building designers and planners' *behavior intentions or actual*

implementation of sustainability innovations. It was the self-reported degree of frequency

that participants perform sustainability innovations. I used a Likert scale questionnaire to

obtain data about the variables and transformed the data into numerical indices for each

of the variables. The value of any variable was the mean of the responses for the subset of

questions for that variable..

Instrumentation and Data Collection Methods

The literature review in Chapter 2 demonstrated that the TRA, the TPB, and the

TAM were useful theories researchers used in developing instruments to measure

behavior intentions. I used the behavior constructs to understand participants' intentions

or actions about sustainability innovations. In particular, Ajzen's TPB was appropriate, as

it considers up to three behavior constructs, compared to two constructs in the TRA and

TAM (Hackman & Knowlden, 2014). Furthermore, TPB addresses behaviors toward

different types of phenomena, while the TAM focuses on usage behaviors toward specific

technologies such as mobile communication (Tsai, Wang, & Lu, 2011). The TPB was

appropriate for my study of perceptions and behaviors toward sustainability innovations.

TPB generates three constructs that addressed the study questions fully, compared to the

other theoretical frameworks of TRA and TAM that generate two principle constructs.

As I observed in the literature, researchers used the TPB in multiple studies to generate constructs and questionnaire instruments. The researchers found the instruments to be effective and consistent in their studies (Tsai, Wang, & Lu, 2011; Hackman & Knowlden, 2014. The effectiveness of the questionnaire instruments in studies used Cronbach's alpha to measure the instruments' internal consistency and reliability (Frankfort-Nachmias & Nachmias, 2008). For instance, Lee and Shepley (2012) studied the effects of neighborhood environmental perceptions and attitudes on leisure-time walking among Koreans. Lee and Shepley reported Cronbach's alphas of 0.789 for attitudes toward walking, 0.701 for subjective norms, 0.862 for perceived behavior control, and 0.783 for behavior intention.

The other example was Greaves, Zobarras, and Strude (2013), who studied environmental behavior intentions at workplaces in London, United Kingdom. Greaves, Zobarras, and Strude tested their questionnaire instrument and found the instrument to be reliable in measuring constructs of the TPB. Greaves, Zobarras, and Strude recorded Cronbach's alpha of 0.88 for a construct measuring attitudes toward turning off laptops to conserve energy, 0.77 for subjective norm, 0.81 for perceived behavior control, and 0.87 for behavior intentions.

The examples showed that questionnaire instruments based on the TPB were consistent and reliable in measuring behaviors. Cronbach's alpha indicates the reliability and consistency of measuring instruments and shows correlation among items in the instrument. Frankfort-Nachmias and Nachmias (2008) recommended Cronbach's alpha levels of 0.7 or above as meeting acceptable reliability (p. 425). The effectiveness of the

instruments demonstrated in these studies supported the choice of using the same

approach for this study of building designers' perceptions and the effect on sustainability

innovations in Malawi. Therefore, in my study I used instruments from constructs based

on Ajzen's (1991) TPB similar to the examples.

Ajzen (2006c) provided methodology for developing questionnaire instruments

from the TPB. Researchers have used this methodology to construct instruments to suit

their studies. According to Ajzen, the researcher translates to numerical values the TPB

constructs of attitudes, subjective norms, and behavior control. Researchers collect

participants' scores using a questionnaire instrument that captures the TPB behavior

constructs.

I used a Likert scale questionnaire to collect data. The data reflected participants'

attitudes, subjective behaviors, behavior control, and performance of sustainability

actions. Participants responded to the 5-point Likert scale questionnaire statements by

scoring numerical values corresponding to the extent to which they agreed or disagreed

with the statements similar to Ajzen (2006c). A score of five corresponded to *strongly*

agree, four was *agree*, three was *neutral* (neither agree nor disagree), two was *disagree*,

and one was *strongly disagree*. The participants' self-reporting scores were numerical

data suitable for analyzing behaviors similar to Ajzen.

I constructed my questionnaire instrument following Ajzen's (2006c) guide to

constructing a TPB questionnaire. The guide is in public domain and I did not need to

obtain permission from the author as Ajzen (2006b) indicates in his responses to

frequently asked question. According to Ajzen, researchers collect data using score sheets

where participants respond to Likert scale statements of the questionnaire. I designed my

questionnaire to collect participants' scores measuring their attitudes, subjective

behaviors, and their behavior control about practicing sustainability innovations.

Participants' attitudes, subjective norms, and behavior control beliefs about sustainability

innovations were the independent variables. Participants also scored actual degree of

performing sustainability activities that was the dependent variable. I tested successfully

the questionnaire instrument in the pilot study involving 20 participants independent from

the main sample. I did not adjust the instrument as it was successful in the pilot study. I

have shown the details of my questionnaire instrument in the Appendix.

The dependent variable was from a self-reporting score sheet measuring the

frequency that participants performed the sustainability actions. I used the sustainability

actions the US Green Building Council (USGBC) recommend in their leadership in

energy and environment design (LEED) guidelines (USGBC, 2014). I used five

sustainability actions that comprised site selection, water efficiency, energy efficiency,

indoor environmental quality, and sustainable material. I requested participants to

complete the self-reporting questionnaire score sheet to indicate the frequency they

implemented the sustainability actions. Participants scored the sustainability actions

depending on the frequency they performed them. The scores were as follows: Five

points for very high frequency, four points for high frequency, three points for moderate

frequency, two points for low frequency, and one point for very low frequency or no

performance. Appendix F shows the sustainability implementation score sheet. Thus, I

used the self-reporting score sheet to measure the dependant variable. It was a five-item

self-reporting score sheet with 25 maximum points for a 100% score. Appendices A to F show the questionnaire instrument.

A qualitative part of my research was necessary to explain the quantitative relationships further (Teddlie & Tashakkori, 2009). Thus, to obtain a clear understanding of building designers' attitudinal behaviors and perceptions about sustainability approaches, a qualitative study followed the quantitative phase. The qualitative instrument was a list of interview questions that I formed for selected participants. I used the qualitative phase to collect descriptive data about participant's feelings and experiences to understand their overall perceptions about sustainability practices within their environment (Janesick, 2011). I developed interview questions as the instrument for collecting qualitative data from participants and I consulted experts to confirm suitability and improve validity of my instrument (Patton, 2002). I included follow-up questions during interviews. Follow-up questions improved understanding the contexts within which participants performed their activities and added insight to their explanations as Patton recommended.

Participants did not write responses to questions but I used voice recordings when conducting interviews. I returned to some participants to conduct follow-up interviews. Follow-up interviews enhanced data quality since participants verified their responses as a member-checking process as Janesick (2011) recommended. I coded and analyzed interview transcripts to find themes from participants' narrative descriptions about their behaviors toward sustainability approaches. The aim of analyzing themes was to examine how participants' narrative descriptions correlated with how they practiced sustainability

to explain the quantitative findings. Using both the survey instrument in the quantitative phase and the interview for the qualitative phase provided sufficient data for analyzing the research problem and responding to the research questions.

Pilot Study

I tested the survey instrument in a pilot study to confirm its effectiveness. Pretesting instruments and tools in pilot studies confirms effectiveness and validity of the tools (Frankfort-Nachmias & Nachmias, 2008). Adopting instruments that researchers used in similar studies is beneficial. However, it is necessary to check the effectiveness in pilot studies. This is important, especially when modifying and adapting them to other situations to ascertain quality, as Frankfort-Nachmias and Nachmias observed. The purpose of the pilot phase was to test the instrument and the research process and resembled the main study as Frankfort-Nachmias and Nachmias recommended.

In the pilot study, I tested the questionnaire survey instrument on 20 participants. I drew the participants from firms and organizations different from the main study population. They were remote from those intended for the main study. In the qualitative strand, I drew 12 participants to test the interview questions and followed procedures that Janesick (2011) recommended. The qualitative part comprised four major interview questions, but during the interview session, other sub-questions arose. The qualitative interview questions were:

Q1: What are your experiences about sustainability innovations?

Q2: What feeling do you have about practicing sustainability?

Q3: What are your beliefs about sustainability innovations?

Q4: What are your perceptions about sustainability innovations in Malawi?

The quality of the research outcome from the analytical tools depended on data accuracy, and I ensured data were clean and correct. Monette et al. (2008) emphasized the importance of using correct data, and stressed the entire study would be invalid if it uses questionable data. Screening and cleaning data involved physical examination of numerical values to check for errors made, especially during data entry. Checking for numerical outliers on data streams and misplaced or misspelled script was among strategies to clean data before analysis. Monette et al. as well as Frankfort-Nachmias and Nachmias (2008), explained manipulation techniques that researchers often use to screen data. Arranging figures in ascending order is one example. Presenting names in alphabetical order to reveal inconsistencies or omissions in the data sets is another example. I used the data validation technique in SPSS software to clean the data.

Data Analysis

This mixed methods sequential explanatory study had primarily a quantitative focus, and the qualitative phase was complementary to the quantitative component. Quantitative data analysis involved statistical methods to test hypotheses about relationships among variables and reported on the consequences of the relationships. I designed the questionnaire instrument to collect data about the participants' behaviors toward sustainability innovations comprising attitudes, normative or subjective behaviors, perceived behavior control, and actions or intentions to perform sustainability innovations.

The questionnaire instrument using Likert scale responses to questionnaire items captured numerical data about participant behaviors toward sustainability innovations. The data, when analyzed through hypothesis testing, showed what relationships exist between independent and dependent variables.TBP questionnaire data reflected attitudes, subjective behaviors, behavior control, and age as independent variables. It also showed data for actual practice of sustainability methods as the dependent variable, similar to Ajzen's (1991) TPB. I applied MLR to analyze relationships among variables through testing the hypotheses, as I explain later under hypotheses testing. The SPSS was the main analytical tool for my study and I obtained and interpreted key output data from this tool (Green & Salkind, 2011; Field, 2013). Qualitative analysis involved examining participants' responses to interview questions and describing contexts and experiences of participants. I used the NVivo software to analyze the qualitative data. This involved coding participants' narrative data and using the NVivo software to compare the coded data to find patterns and themes in the participants' explanations (Hoover & Koerber, 2011).

Quantitative Analysis

Frankfort-Nachmias and Nachmias (2008) explained that correlation information alone merely reports the existence of a relationship among variables but does not explain the cause-and-effect relationship between independent variables and dependent variables. Hence, Frankfort-Nachmias and Nachmias emphasized the need for researchers to apply additional techniques to analyze how variables affect each other. I analyzed four independent variables. The three behavior variables of attitudes, subjective norms, and

behavior control, and one demographic variable of age. The dependent variable was the extent that designers practice sustainability. I used MLR to evaluate the relationship between independent and dependent variables for the quantitative portion of the research to investigate the cause-and-effect relationships among the variables as Frankfort-Nachmias and Nachmias explained. My analysis showed which of the independent variables had the most significant influence on the dependent variable as well as showing how participants' age influenced the participants' behavior toward sustainability innovations. Understanding how behaviors affect sustainability performance according to the age demographic categories will assist policy-makers to plan necessary interventions by targeting specific categories of the workforce to improve sustainability innovations.

Analyzing the relationships among independent and dependent variables through a single mathematical expression was the key rationale for using the MLR model for my study. The terms in the MLR equation represent the mathematical relationship between dependent and independent variables. Thus, I obtained coefficients from the MLR model, reflecting the relationship between the dependent variable and each independent variable (Monette, Sullivan, & DeJong, 2008).

Frankfort-Nachmias and Nachmias (2008), as well as Gravetter and Wallnau (2008) explain the MLR modeling technique. Frankfort-Nachmias and Nachmias and Gravetter and Wallnau explain that MLR model is for analyzing the relationship of independent variables (x_i) with dependent variable (y) while controlling for the effect of other variables. Frankfort-Nachmias and Nachmias presented the following expression for the technique using the generalized model

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 \ldots + \beta_j x_j + \varepsilon$$

where β_0 is the value of the dependent variable when all independent variables

equal zero. β_i is a coefficient reflecting the change in dependent variable y due to a unit

change in independent variable x_i, and ε represents the error term. The standardized or

true model includes the error term while the predictive model ignores the error term. My

analysis used the predictive model:

$$\hat{Y}_{ACT} = \beta_O + \beta_{ATT} X_{ATT} + \beta_{SN} X_{SN} + \beta_{BC} X_{BC} + \beta_{AG} X_{AG}$$

I obtained data on the variables of attitudes (X_{ATT}), subjective norms (X_{SN}),

behavior control (X_{BC}), and age (X_{AG}) as independent variables, and actual behavior

action (Y_{ACT}) as dependent variable. I analyzed the variables by testing hypotheses to

establish the relationship between the independent variables and the dependent variable.

$\beta_{ATT}, \beta_{SN}, \beta_{BC},$ and β_{AG} are the respective regression coefficients showing the

mathematical relationship between each independent variable and the dependent variable

$\hat{Y}_{ACT.}$

Hypothesis Testing

Frankfort-Nachmias and Nachmias (2008) stated that hypotheses are tentative

responses to research problems that confirm or reject existence of relationships among

variables. Frankfort-Nachmias and Nachmias explained that a null hypothesis describes

the absence of a relationship or nonexistence of impact among variables in population

samples. On the other hand, a research or alternative hypothesis test indicates that a

relationship exists. According to Park (2010), testing hypotheses in MLR involves

analyzing regression coefficients. My study of building designers and planners'

perceptions about sustainability innovations in Malawi involved hypothesis testing in an MLR procedure. This procedure determined the relationship between attitudinal behaviors and age as the independent variables, and building designers' intentions to practice sustainability as the dependent variable.

Using hypothesis testing I determined what relationship exists between the independent variables and the dependent variable by evaluating the standardized coefficients (β) associated with each independent variable (X) in the regression analysis (Park, 2010). I applied the F-test to test the significance of the regression model. This is an overall test to determine existence of a relationship between the dependent variable $\hat{Y}_{ACT}$ and a subset of independent variables X_{ATT}, X_{SN}, X_{BC}, and X_{AG} of the regression model. According to Park, researchers use the t-test to assess the significance of each coefficient in the regression model, in to determine the effect of each variable. I applied the t-test to analyze the relationship between each independent variable and the dependent variable by testing the hypothesis of each relationship. When testing the hypothesis I used significance (alpha) of 0.05. According to Monette, Sullivan, and DeJong (2008), the criterion for selecting alpha depends upon the strictness against committing type I errors for the type of study. A value of .05 is moderate, .01 stringent, and .001 very stringent (Monette, Sullivan, & DeJong, 2008). Hence, using the moderate alpha of .05 the null and alternative hypotheses were as follows:

Null hypothesis H_0. The independent variables, attitudes (X_{ATT}), subjective norms (X_{SN}), behavior control (X_{BC}), and age variables (X_{AG}) do not have a relationship with the dependent variable, actual sustainability practice ($\hat{Y}_{ACT}$).

$$H_0: \beta_{ATT} = \beta_{SN} = \beta_{BC} = \beta_{AG} = 0$$

Alternate hypothesis H_a. At least one of the independent variables, attitudes (X_{ATT}), subjective norms (X_{SN}), and behavior control (X_{BC}), and age variables (X_{AG}) has a relationship with the dependent variable, actual sustainability practice ($\hat{Y}_{ACT}$).

Ha: At least one $\beta \neq 0$

Qualitative Analysis

I followed-up the quantitative part with a qualitative analysis by investigating participants' feelings, beliefs, and perceptions that might explain their behavior towards sustainability innovations among building designers. I collected and translated qualitative data into narrative explanations of what participants describe as their perceptions, beliefs, and feelings about sustainability approaches. I also included observations during interviews (Janesick, 2011). The procedure typically comprised organizing narrative transcripts and reducing textual data into themes using a coding process. Then interpreting the trend of the themes.

I analyzed analyze qualitative data by examining responses to questionnaires and face-to-face interview questions and grouped the coded responses into explanations that have similar themes. My research involved examining information about the condition of participants and the physical environment, as well as what thoughts participants might hold during interviews. Explaining the contextual information assists readers in interpreting and evaluating the soundness of the findings (Patton, 2002). As textual data was excessive to analyze manually, I used NVivo version 11 software to perform the analysis. The qualitative data comprised explanations, experiences, and thoughts about

sustainability innovations that participants expressed. As I interviewed 24 participants, their responses resulted in extensive qualitative data and it was not efficient to analyze it manually. Hence, I used the NVivo software since it is suitable for analyzing multiple variables and extensive data (Leech & Onwuegbuzie, 2011, Sotriadou, Brouwers, & Le, 2014). The aim of the qualitative analysis was to understand the feelings, beliefs, and perceptions about sustainability innovations. I examined qualitative data and compared it with quantitative data for similarities.

I used triangulation of data sources to strengthen validity of results. Methodological triangulation or across methods triangulation involved comparing and reconciling quantitative and qualitative findings (Patton, 2002; Bhehet & Zausznieski, 2012). Triangulation of data sources was within method triangulation as Oleinik (2011) explained and involved checking and comparing data obtained at different times to validate data (Patton, 2002). I asked participants to describe their responses to open ended questions through telephone interviews or emails. As a member-checking process, I conducted interviews with participants as follow-up at another time to compare and validate data. Combining qualitative and quantitative findings strengthened the validity of the findings to expand our understanding of the behaviors of building designers and related experts toward sustainability approaches in Malawi.

Participant Sampling

I recruited participants from building design and construction firms and organizations practicing in Malawi. The firms and organizations were of architectural, engineering, surveying, construction firms, and related organizations. A population of

over 220 building and associated experts operate in Lilongwe and Blantyre cities from where I recruited the participants. Due to the small population, I solicited participation from 100% of the population to obtain the minimum sample size and account for 45% nonresponsive participants, as Young (2010) observed in a similar study. I referred to architects, engineers, and contractors as building designers, planners, or experts of building infrastructure systems; and they met the criteria to form the study population. Quantitative and qualitative sample sizes were different, as the qualitative sample size was smaller but drew participants from the quantitative sample that I have selected under the quantitative sample section.

Identifying participants and getting them to accept involvement are crucial steps toward the success of any social science study that depends upon participants (Patton, 2002). Participants completed the questionnaire indicating their professional and occupational status, and this was the criterion to establish their eligibility to participate. Participants had informed consent, as I explained to them during recruitment, the conditions such as freedom to exit from the study and confidentiality. As confirmation of acceptance and commitment to the research processes, the participants signed agreements with me as consent and commitment to participate in the study. My study used Walden University Institutional Review Board's (IRB) participant consent forms as the initial document for recruiting participants. In accordance with the IRB as well as Patton (2002), the forms outlined the purpose and nature of the study. This is important for participants to make informed decisions to accept or reject participation in the study.

I contacted potential participants by telephone conversation, electronic mail, and through face-to-face contact. During the initial contact, as the point of entry for interaction, it was important to establish rapport and a suitable atmosphere in which to conduct the study. I included an explanation of my proposed study, my contact details, follow-up procedures, and process for exiting the study before I notify the participants about the end of the study. As much as possible, I approached participants with care and respect to build confidence that I wanted to maintain throughout the research process, as Patton (2002) recommended. Official contact with participants was through electronic mail, mainly for distributing questionnaires and other documents, but I also hand-delivered mail in some occasions.

I focused on building and construction experts in the Lilongwe and Blantyre cities of Malawi. The setting in Malawi was suitable for the study. It is a developing economy with similar conditions in many African countries where the experts do not understand fully effects of perceptions on sustainability innovations, as Duplessis (2005) observed. Furthermore, the study locations of Lilongwe and Blantyre cities have positive attributes that include the growing building and infrastructure systems and as the major centers for building and construction organizations (Nexus Strategic Partnership, 2014). The research base was in Lilongwe city, but I also involved participants in Blantyre city, that is only about a four-hour drive from Lilongwe. Therefore, Lilongwe and Blantyre cities were convenient for this study, due to their proximity.

Quantitative Sample

Calculating sample size should employ power analysis to yield results within acceptable probabilities of type I and II errors appropriate for the study (Lakens, 2013). Park (2010) explained that sample size, effect size, statistical power, and significance (alpha) are crucial components for determining the effectiveness of the research. Knowing three of the four components enables the calculation of the fourth, unknown, component. Park advised that a statistical power of 0.8 and significance level alpha of 0.05 are satisfactory criteria in most studies. Hence, researchers often seek to determine values of the two remaining entities of effect size (also referred as Cohen's coefficient) and sample size to meet the power and significance level criteria. Park and Lakens advised that evaluating past research articles using statistical formulas or software programs can provide average effect size.

Research similar to my study, such as Ayobami and Ismail (2013), Averdung and Wagenfuehrer (2011), and Lee and Shepley (2012) were useful in determining the effect size for this research. I used the G*Power software tool to compute the effect size of each research article by setting statistical power and significance level to 0.8 and 0.05 respectively as reported in the articles (Park, 2010). Finally, setting sample sizes and statistical test reported in each article as inputs, I used G*Power to compute the effect sizes. The result was an average effect size of 0.265 for the five research articles.

In G*Power an effect size of 0.35 is large, 0.15 is medium, and 0.02 is small (Park, 2010). The 0.265 effect size I evaluated for similar studies is in the medium to large effect size in G* Power. Lakens (2013) explained that researcher's use 0.2 as small

to medium effect size, but in my study, I applied 0.15 effect size that was closer to

Lakens's observations. Furthermore, Lakens as well as Monette et al. (2008) explained

statistical power as a measure of rejecting the null hypothesis correctly and recommended

its minimum as 0.8 with a significance alpha of 0.05.

Table 1

Computed Sample Sizes Using G*Power for the Study of Building Designers' Perception
and the Effect on Sustainability Innovations in Malawi

Nominal Power	Effect Size	Actual alpha	Actual Power	Sample Size
(Low) 0.80	0.15	0.05	0.8014400	77
(Medium) 0.90	0.15	0.05	0.9015817	99
(High) 0.95	0.15	0.05	0.9508992	119

Lakens (2013) and Monette et al. (2008) regarded statistical power of 0.95 and

above to be high. Hence, I computed the statistical powers of 0.80 (minimum), 0.90

(medium), and 0.95 (high); significance level alpha of 0.05; and the sample sizes as

shown in Table 1. Therefore, working backwards and using 0.15 as the effect size for my

study, I computed a minimum sample size of 99 to use in my study. This corresponded to

a medium statistical power of 0.90.

Young (2010) achieved a response of 45% in a similar research survey. Hence,

assuming a 45% response rate, I needed to send out the questionnaire instrument to at

least 220 participants to achieve the 99 responses. The cities of Blantyre and Lilongwe

together have over 40 building and construction firms operating and employ an estimate

of over 300 building design and related experts (Nexus Strategic Partnership, 2014).

Hence, the study area had an adequate population from which I drew participants. I did

not receive the 99 responses the first time. However, I sent polite reminders to

nonresponsive participants and then obtained the 99 responses.

Qualitative Sample

I selected a nonrandom, purposeful sample of 24 participants for the qualitative

component from the quantitative component for this sequential explanatory research.

Obtaining qualitative participants from the quantitative component strengthened research

quality, consistent with the aim of explaining further the phenomenon within the same

population and as a triangulation strategy (Teddlie & Tashakkori, 2009). According to

Teddlie and Tashakkori, sample sizes in a sequential explanatory approach depend upon

what the inquirer needs to understand but, often the first phase drives what sample the

subsequent component might explore.

Hence, my qualitative component used individuals I selected purposefully from

the quantitative study to provide in-depth explanation about experiences, feelings, and

beliefs about sustainability innovations in Malawi. Waiting for quantitative survey results

to select participants for the qualitative phase was a major disadvantage of my sequential

explanatory design. To ensure availability of persons for the qualitative phase, I informed

all participants of the quantitative part of the possibility of their further involvement in

the subsequent qualitative phase. I informed participants the qualitative interviews would

be at their workplaces or at other convenient locations, and for short durations. In the

interview sessions, I also informed participants about the possibility of follow-up interviews should I need further information.

In the qualitative phase, I selected participants in three categories, consisting of gender, age, and years of experience. The age category comprised a group above 40 years and the group below 40 years old. The experience category comprised the group above 10 years experience, and the group below 10 years experience. I identified the participants for the qualitative phase from the quantitative component. The breakdown of the qualitative sample and the criteria I used for selecting participants was as follows:

I planned selection criteria for gender as 12 male and 12 female. Selection criteria for age group as 12 participants above 40 years old and 12 participants below 40 years old. I assumed participants' age group above 40 years favored conventional methods and view sustainability methods differently from younger age participants below the age of 40. Years of work experience: I planned selection criteria for experience as 12 participants with over 10 years of experience and 12 participants with below 10 years of experience. I also planned to recruit male and female participants according to the following eight combinations:

Male Participants. Above 40 years old and above 10 years experience three participants. Above 40 years old and below 10 years experience three participants. Below 40 years old and above 10 years experience three participants. Below 40 years old and below 10 years experience three participants.

Female Participants. Above 40 years old and above 10 years experience three participants. Above 40 years old and below 10 years experience three participants. Below

40 years old and above 10 years experience three participants. Below 40 years old and below 10 years experience three participants. Hence, total number of qualitative participants was 24.

Although I planned the above combination of participants, in reality I did not obtain the combinations fully. The number of male participants was higher than the female participants. I obtained 18 male participants and only 6 female participants for the interview. I observed in Malawi most of the planners or designers, such as engineers and architects were male. Hence female participants in this study were less than the male participants. When I completed collecting data, I thanked the participants and re-assured them about the confidentiality of this study as a debriefing process (Patton, 2002).

Research Validity and Trustworthiness

I reported results of data analysis for the quantitative component from the SPSS software output. The output included descriptive statistics that had values for reporting the relationship between the dependent and the independent variables (Green & Salkind, 2011). Following the procedure, I showed a summary table to show the values for variables and the regression coefficients of the MLR model. The results were for the overall relationship between the dependent variables and the independent variable. The results also included the report on the strength or significance of the relationship between the dependent variable and each of the independent variables in the MLR model. Themes resulting from the interviews were the main outcome for the qualitative component. In the study, after transcribing the interviews, I analyzed the interview data by coding

according themes. Presentation of the results of the qualitative analysis consisted of the narrative text describing overall themes I derived from the analysis.

The extent to which findings would be acceptable to the research community and beneficiaries would depend on the validity and credibility of the entire research process. This mixed methods research safeguarded against threats to validity during data collection, interpretation, and merging or connecting of the quantitative and qualitative components. Safeguarding external and internal validity is an important part of managing quality to achieve research reliability (Patton, 2002). Patton (2002) explained about collecting and analyzing credible data as being crucial in demonstrating the truthfulness and trustworthiness of research findings. Hence, I focused on safeguarding data quality by verifying and checking the credibility of data during collection and analysis to achieve research quality.

Participant selection is a possible threat to external validity that could affect research quality and the effect on external validity would occur if participant selection is inconsistent (Teddlie & Tashakkori 2009). According to Teddlie and Tashakkori (2009), selecting inappropriate participants in a multiphase-mixed methods design, where participants in one component are markedly different from the original population, might be a threat to external validity. I safeguarded external validity by using the qualitative sample drawn from the original quantitative population. Hence, the qualitative sample was a subset of the quantitative sample and was a triangulation strategy to enhance quality of the outcome.

Threats to internal validity were minimal in several dimensions. For instance, using an instrument tested and applied in similar studies with a 0.7 or above for the Cronbach's alpha reliability measure, enhances validity. Dropouts did not affect the participant population sample adversely, since the number of volunteer participants was large enough to compensate for dropouts. I minimized threats to construct validity due to statistical computations by applying suitable criteria for testing hypotheses such as the 0.05 significance that applies to research works similar to the current study. Furthermore, suitable statistical tools used in similar studies helped minimize threats to construct validity as Teddlie and Tashakkori (2009) explained. To strengthen credibility of data collection, I contacted participants more than once to verify data where necessary and engage participants long enough during interviews to obtain thick qualitative information. My strategy was to obtain thick qualitative data involved asking open-ended questions to generate in depth information as Patton (2002) advised.

Trustworthiness depended on truthfulness of the explanations in the qualitative component. Patton (2002) explained the essence of researchers to be "neutral, balanced and fair and report naturally, considering the multiple perspectives and interests of reality" (p. 75). This study about building designers' behaviors and perceptions of sustainability innovation involved describing processes, procedures, methods, and styles of how participants explained their beliefs, feelings, and perceptions. In this study, I did not influence participants. I listened and reflected only on what participants described. I reported narratives of participants fully and openly for readers to form their own conclusions (Patton, 2002).

Role of the Researcher

The role of researchers and their personal qualities influence how the intended audience ascertains the credibility of their findings either positively or negatively. Janesick (2011) recommended that researchers include personal and professional inclinations when reporting, as these characteristics might have an effect on the research process during data collection, analysis, and interpretation. Similarly, Patton (2002) highlighted the importance of the researcher's role in qualitative studies. Patton explained the researcher is the instrument collecting data through observation, interviewing participants, or participating in the activities.

Patton (2002) described factors with which the researcher might influence the quality of research. In experimental studies, the presence of the researcher within the environment or setting often compels participants to behave differently from their natural condition. The participants attempt to behave in a way they anticipate the expert researcher might want them to behave. Patton's explanation of participant reactivity was similar to the condition that Frankfort-Nachmias and Nachmias (2008) described as demand characteristics.

Patton (2002) also explained the influences of the researcher's selective bias during observation and interpreting activities. Patton also outlined lack of skill or preparation, as being among the major factors that might influence research quality. Furthermore, Frankfort-Nachmias and Nachmias (2008) explained other factors, such as the researcher's unintentional communication with participants such as facial or body expressions, as possible actions that might influence participants' responses.

Unlike with qualitative designs, quantitative data collection, and analysis processes do not consider the researcher as an instrument; instead, they use physical instruments to collect data. The role of the researcher is to design unbiased instruments for collecting data (Frankfort-Nachmias & Nachmias, 2008; Patton, 2002). As Frankfort-Nachmias and Nachmias (2008) explained, the design of questionnaire instruments should not list questions that lead to obvious and specific responses or influence participants to respond in a particular pattern.

As an observer and researcher, I acted alone, being responsible for data collection, analysis, and reporting. I also managed the activities to meet program timelines without compromising quality and validity of the research findings. However, as Patton (2002) observed, when the researcher is acting alone, the there are no internal member-checks or triangulation benefits. The researcher must institute their own measures to safeguard research quality. Therefore, as my study used a sole researcher, research quality depended upon my self-imposed strategies. The strategies included maintaining neutrality by avoiding bias when collecting and analyzing data and reporting the findings as Patton recommended.

Strategies to maintain neutrality and avoid bias in the quantitative phase and the qualitative phase were not the same. This is due to differences in the types of data as well as the methods for data collection and analysis (Teddlie & Tashakkori, 2009). During the quantitative strand, my role was to collect, record data, and present results of the analysis using instruments and analytical tools. Data collection instruments and analytical tools assisted in executing the research processes and provide results. Ascertaining data quality

involved the researcher to enter data manually and personally into appropriate software tools.

Although in the quantitative studies the researcher is almost independent from the analysis, Frankfort-Nachmias and Nachmias (2008) cautioned against researchers' actions that could influence validity of the quantitative findings. For instance, the questionnaire instrument design did not contain the possibility of leading respondents toward response patterns that might lead participants to choose to guess at the anticipated responses, rather than recording their true answers. Furthermore, as Frankfort-Nachmias recommended, I as the researcher should train adequately in the use of the instruments and analytical tools to interpret and present results objectively.

In the qualitative strand, I regarded myself as the researcher and the instrument Patton (2002). The implications were that my personal credibility affected how the research community and scholars would accept my findings. Therefore, following Patton's advice, I include an explanation of my personal and professional background as information that may influence how I collected, analyzed, and interpreted data. According to Patton, disclosure of researchers' background characteristics informs the audience of the researcher's experience and skills, and the audience understands clearly the context and quality of interpreting the participants' perceptions.

As the research instrument, I spent reasonable time with participants during the qualitative strand to build trust and rapport with participants, as Patton (2002) suggested. However, the time for engagement with the participants was not be too long, to avoid any influence on the participants. According to Patton, prolonged engagement with

participant might increase reactivity. In this condition, participants begin to view the researcher as part of the setting for activities. The reactivity could affect the quality of their reactions or responses. My knowledge and experience in the Malawian environment was a suitable background for my study.

Influence due to personal relationship with participants was minimal, thus allowing participants to express thoughts freely. The interview protocol and journal entries described any bias as part of the qualitative analysis (Janesick, 2011). In the quantitative component, bias in data collection was insignificant, since most participants were employees in organizations different from my workplace, and I did not influence their thoughts. Furthermore, there no employment or financial benefits for participants. I maintained neutrality in data collection, analysis, and reporting avoiding bias as much as possible. As Patton (2002) advised, my role as the researcher was to "describe and report what effect the research finds, and strive to avoid overestimating or underestimating the effects that the researcher observes" (p. 568).

Ethical Procedures

My study of how building designers and planners' perceptions might have a relationship with behaviors about sustainability innovations in Malawi involved interacting and interviewing persons. I complied with the research ethics and guidelines when interacting with participants. Firstly, my research involved obtaining official approval from the Walden University Institutional Review Board (IRB) before contacting participants Following the Walden University IRB's regulations, researchers must wait for formal approval before conducting research with participants. The approval from the

Walden University IRB was a crucial process to ensure participant protection. I disclosed possible risks to participants and also minimized them during my research. The Walden University IRB requires researchers to disclose expected risks to participants and measures for minimizing the risks. In this study, possible risks to participants would include loss of personal privacy, unintended disclosure of personal or other information, and other risks. I explained to participants the strategies for safekeeping of personal data, such as password protection for electronic data and locking up documents in safes or closed cabinets as safeguards. Periods for which I will secure data will comply with Walden University and IRB requirements.

Guidelines such as those outlined by Patton (2002) enhanced my understanding of the ethical research procedures about the study of human subjects. Therefore, my study complied with regulatory requirements of the IRB to fulfill ethical procedures. I will continue to treat all research data as confidential, participants will remain anonymous; and I will not disclose their names to protect personal integrity, opinions, and privacy of the participants. However, depending on the authority of Walden University, I will share results with participants interested in the outcome. I will also as disseminate the results to the interested academic or professional research groups.

Summary

In Chapter 3, I explained the research process and the rationale for choosing the mixed methods approach for my study. My research concerns the effects of attitudinal behaviors on building designers' willingness to practice sustainability innovations and I explored perceptions, feelings, and beliefs that could explain the behavior. The research

method involved a quantitative part to evaluate the effects of building designers'
attitudinal behaviors toward sustainability innovations and a qualitative part to explore
feelings and beliefs among designers. Therefore, a mixed methods approach was
appropriate. In particular, the two-part mixed methods research was the sequential and
explanatory design where the first part was quantitative and the second part was
qualitative to explain the findings further.

In Chapter 3, I also described variables, instruments, and tools for data collection
and analysis, and explained strategies for research quality and ethics. Research quality
and ethics involved mainly maintaining my neutrality in the research and protecting the
integrity of participants. I modified and used existing instruments but pretested the
instruments in a pilot study. Data about the variables was numerical measurements of
participants' responses using a questionnaire instrument. The instrument was a Likert-
scale designed to measure and transform responses to numerical values for quantitative
analysis. For the qualitative phase, I conducted interviews and observations, and data was
narrative descriptions about participants' perceptions, feelings, and beliefs. In Chapter 4,
I explain the data collection and analytical processes, and report the results.

Chapter 4: Results

The purpose of this sequential explanatory mixed methods study was to explore building designers' and developers' perceptions and attitudes towards sustainability innovations. I aimed to understand how these behaviors affected sustainability innovations in buildings and infrastructure systems in Malawi. The primary question of my study was, to what extent could attitudes and related behaviors influence building designers to practice sustainability innovations in Malawi; and what experiences, feelings, and perceptions do the building designers hold that could explain the phenomena? The secondary research questions were as follows:

1. What is the correlation between building designers' attitudinal behaviors towards sustainability innovations and their intention to practice sustainability innovations?

2. To what extent do attitude, subjective norms, and control behaviors affect building designers' intention to practice sustainability innovations?

3. To what extent do attitudinal behaviors differ across age in affecting building designers' intention to practice sustainability innovations?

4. What experiences, feelings, beliefs, and perceptions do building designers and similar experts explain about sustainability innovations?

I asked participants the following interview questions to illicit their experiences, feelings, beliefs, and perceptions about sustainability innovations:

- What are your experiences with sustainability innovations?

- What are your feelings about sustainability innovations?

- What are your beliefs about sustainability innovations?

- What are your perceptions about sustainability innovations in Malawi?

In the quantitative component, I evaluated the following hypotheses to analyze the relationships between four independent variables and one dependent variable:

Null hypothesis H_0. The independent variables, attitudes (X_{ATT}), subjective norms (X_{SN}), behavior control (X_{BC}), and age variables (X_{AG}) do not have a relationship with the dependent variable, actual sustainability practice ($\hat{Y}_{ACT}$).

$$H_0: \beta_{ATT} = \beta_{SN} = \beta_{BC} = \beta_{AG} = 0$$

Alternate hypothesis H_a. At least one of the independent variables, attitudes (X_{ATT}), subjective norms (X_{SN}), and behavior control (X_{BC}), and age variables (X_{AG}) has a relationship with the dependent variable, actual sustainability practice ($\hat{Y}_{ACT}$).

Ha: At least one $\beta \neq 0$

Chapter 4 starts with a description of the pilot study to test the survey instrument and assessed how well the interview questions complimented the survey. In the main study, I explain the sequential collecting of survey and interview data followed by the integration and analysis of the survey and interview data to understand the phenomena.

Pilot Study

I pretested the survey instrument and interview questions on 20 and 12 participants respectively before using them in the main study. The survey instrument was in the public domain and, therefore, did not require permission from Ajzen (2006b).

However, Ajzen recommended researchers test the instrument in specific settings before full application in their studies, and I did so..

The survey instrument I used is reproduced in Appendices A to F. I interviewed participants, analyzed the data, and compared the survey and interview results. In this mixed methods sequential explanatory design comparing and integrating survey results with interview outcomes strengthened the effectiveness of the survey instrument. The Cronbach's alpha measures how variables affect each other and researchers recommend values of .7 and above (Field, 2013). I evaluated the Cronbach's alpha value for the variables in my pilot study and the effectiveness of the survey instrument. I collected pilot survey data in 4 weeks and 3 weeks of follow-up interviews. I analyzed survey data using the SPSS software and resulted in the Cronbach's Alpha value of .701. The result showed that my survey instrument exceeded the recommended minimum of .7 and therefore I could use it in my study.

I also tested the interview questions in the pilot phase. The purpose of the follow-up qualitative interviews was to confirm or contradict findings that were emerging from the quantitative survey. The aim of the interview questions was to find explanations from participants about the same issues covered in the quantitative phase and concerned their experiences, attitudes, subjective behaviors, and perceived behavior control aligned the behavior questionnaire items in the quantitative survey with interview questions. The questionnaire items in the quantitative phase were the guiding themes for the interview.

In the follow-up interview, I tested the interview questions through audio-recorded interviews with 12 participants to find out how well participants narrated their

thoughts and experiences around the guiding themes. Upon transcribing the audio-recorded interviews I reviewed the transcripts with the participants. I examined the interview data around the guiding themes. I found the explanatory data added insight to the survey data about behaviors towards sustainability approaches. I also observed that participants responded easily and with enthusiasm to the question about their experiences. Therefore, I chose this question to be the opening question during the interview.

As my research was outside the U.S., it was necessary to apply for approval to conduct the research in my country in addition to the Walden IRB approval. Therefore, before conducting the study, I obtained permission to perform the study in Malawi by complying with the Malawian ethics authorities. The National Commission for Science and Technology (NCST) in Malawi granted permission for the study through their National Committee on Research in the Social Sciences and Humanities (NCRSH). The NCRSH assessed and accepted the proposal in the form as approved by Walden IRB and I started my research with the pilot study as planned.

In the pilot study to pretest the instruments, I found that participants understood their role and responded adequately to the questionnaire and interview questions as intended. The purpose of the pilot study was to pretest the instruments for adequacy and effectiveness to capture data. However, the pilot study would affect data quality if pilot and main study participants influenced each other (Teddlie & Tashakkori, 2009). To minimize this effect, I conducted the pilot study in the city of Mzuzu, which was geographically distant from the main study areas, the cities of Blantyre and Lilongwe cities. Hence, I minimized the impact of the pilot study on the main study data.

From a purposeful sample of 20 pilot participants, 12 completed the survey online and eight completed the paper-based questionnaire. Of the 12 interview participants, nine attended the face-to-face interviews and three took telephone interviews. The interview data in this pilot study also demonstrated the soundness of the questions. To confirm credibility and dependability of the interview questions, I engaged three independent experts who validated the interview questions as pertinent for the nature of the study. Based on the validations, the survey instrument and interview questions remained as planned. I proceeded to use them in the main study.

Setting

I focused my study on building and construction experts in the Lilongwe and Blantyre cities of Malawi. The setting in Malawi was suitable for the study because the country's developing economy has similar conditions to those in many other African countries. Duplessis (2005) observed that building design experts in these countries do not understand fully effects of perceptions on sustainability innovations.

Lilongwe and Blantyre cities also have positive attributes for this study including the growing building and infrastructure systems and being among the country's major centers for building and construction organizations (Nexus Strategic Partnership, 2014). My research base was in Lilongwe city, but I also travelled to Blantyre (a 4-hour drive away). Lilongwe and Blantyre cities were convenient settings for this study, due to their relative proximity.

Demographics

In the quantitative phase, I sent out 240 invitations and 99 participants responded representing a 45% response rate as expected. Male participants were the dominant gender where the sample comprised 84 males and 15 females. In the responses, 65 participants completed the paper-based questionnaires and 34 completed the online version The 99 participants were what I expected from my sample size computation.

In the qualitative phase, I interviewed 24 participants selected from the survey sample who agreed to participate in the interview. As anticipated from the composition of the survey sample, the male gender dominated the interview sample with 18 male participants compared to only 6 female participants. The data on gender were only for showing the demographic composition of the sample but did not affect the study since gender was not among the variables of interest.

The composition of the interviewees was as follows:

- below 30 years old: six;

- between 31 years and 50 years old: 10;

- between 51 years and 55 years old: four; and

- above 55 years old: four.

Quantitative Data Collection

In this sequential mixed methods study, the data collection process lasted for 9 weeks comprising 6 weeks for the survey followed by 3 weeks for the interviews. I recruited volunteer participants targeting those working in the construction industry which represented a purposeful sample from the population. Appendixes A to F show the

survey instrument for collecting the quantitative data. The variables were attitudes (*ATT*), subjective or normative behavior (*SN*), perceived behavior control (*BC*), and age (*AG*) as the independent variables. The practice of sustainability innovations was the dependent variable (*ACT*).

I used the survey instrument to collect data for the four variables of attitude, subjective norms, perceived behavior control, and actual practice of sustainability. Before the analysis, I grouped the questions according to the common behavior of interest. I summed up response scores so each group of questions measured the specific behavior as the variable of interest. Therefore, referring to the survey instrument at Appendix A to F, questions 1 to 4 captured the demographic data and questions 5 to 21 measured the independent variables.

Questions 5 to 21 measured the independent variables as follows: Survey questions 5 to 9 measured attitudes (*ATT*). Questions 10 to 15 measured subjective or normative behaviors (*SN*). Questions 16 to 21 measured perceived behavior control (*BC*), and question 4 measured age (*AG*). To measure the independent variables, participants responded to the 5-point Likert scale questionnaire statements in questions 5 to 21. Participants scored numerical values corresponding to the extent to which they agreed or disagreed with the statements. A score of five corresponded to strongly agree, four was agree, three was neutral (neither agree nor disagree), two was disagree, and one was strongly disagree. The participants' self-reporting scores were numerical data suitable for analyzing behaviors. The value for each variable was the mean response for the questions pertaining to that variable.

To measure the dependent variable *ACT,* participants responded to Question 22 and measured how often participants practiced sustainability actions. Participants responded to Question 22 by scoring against five sustainability actions comprising site selection, water efficiency, energy efficiency, indoor environmental quality, and sustainable materials (USGBC, 2014). Hence, the measurement for the dependent variable *ACT* as from participants' self-response sustainability score sheet indicating how often they practiced the five sustainability actions. The scores were as follow: Five points was for very high frequency, four points for high frequency, three points for moderate frequency, two points for low frequency, and one point for very low frequency or no performance. Thus, the dependent variable *ACT* was the average score for the five sustainability items. Therefore, the instrument at Appendix A to F measured all variables and comprised of the Likert scale type questions for measuring the independent variables and the 5-item score sheet for measuring the dependent variable (*ACT*).

Qualitative Data Collection

Interview sessions with participants followed sequentially after completing the survey. I interviewed 16 participants through telephone and 8 by face-to-face interview. The settings, either at the participant's workplace or remotely from a neutral workplace, did not affect the participants as they could express their knowledge and opinion about practicing sustainability freely. I conducted additional interviews as follow-ups and member checking to supplement the initial interviews.

When I compared the interview and survey data I found that interview responses supplemented the survey data. For instance, the attitudinal behavior variable (*ATT*) in the

survey instrument measured a positive coefficient suggesting that participants held positive views towards sustainability innovations. This corresponded with the interview question: What are your feelings about practicing sustainability innovations?

The interview response showed that participants enjoyed or liked practicing sustainability innovations. Thus, the interview responses complimented the survey data and provided explanatory attributes to the survey data.

Quantitative Analysis

Descriptive Statistics

Table 2 shows the descriptive statistics that characterize the study variables. The descriptive statistics in Table 2 show the independent variables comprising attitudes (*ATT*), subjective behavior (*SN*), perceived behavior control (*PBC*), and age (*AG*). The actual sustainability measure (*ACT*) was the dependent variable. From the descriptive statistics depicted in Table 2, I observed that attitudes were the strongest influence affecting the majority of participants to practice sustainability innovations.

Table 2

Descriptive Statistics for Variables

	Mean	Std. Deviation	N
ACT	17.5556	3.45591	99
ATT	4.2253	.65921	99
SN	3.6423	.70442	99
PBC	3.8525	.71761	99
AG	3.5051	1.01392	99

Statistical Assumptions

I evaluated the assumptions to confirm the relationships between independent and dependent variables were linear, errors or residuals followed the normal distribution, multicollinearity was minimal, and equality of variances using the Levene's test (Green & Salkind, 2011). Confirming the assumptions was necessary for applying the multiple linear regression (Field, 2013).

Linearity. Using the SPSS software, I constructed scatter plots of the data to show the relationships between actual sustainability measure (ACT) and attitudes *(ATT)*, subjective or normative behaviors (*SN*), perceived behavior control (*PBC*), age (*AG*)**.**
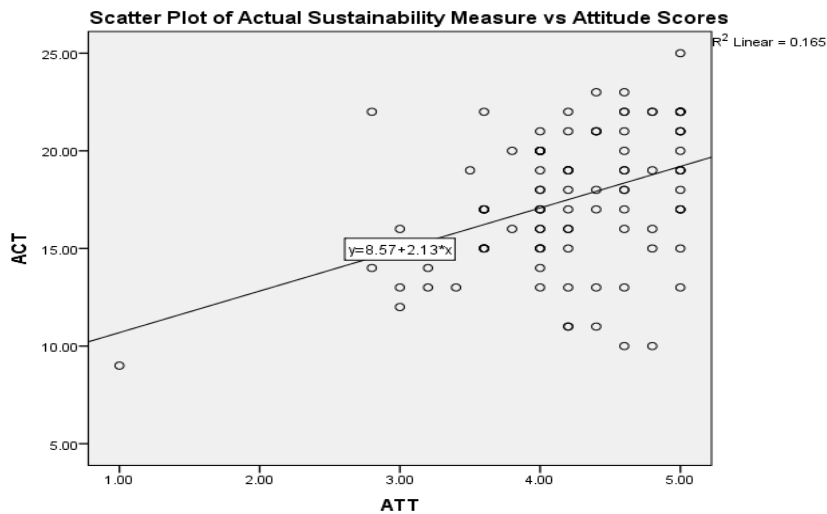
Figure 2. *Scatter plot of ACT and ATT.*
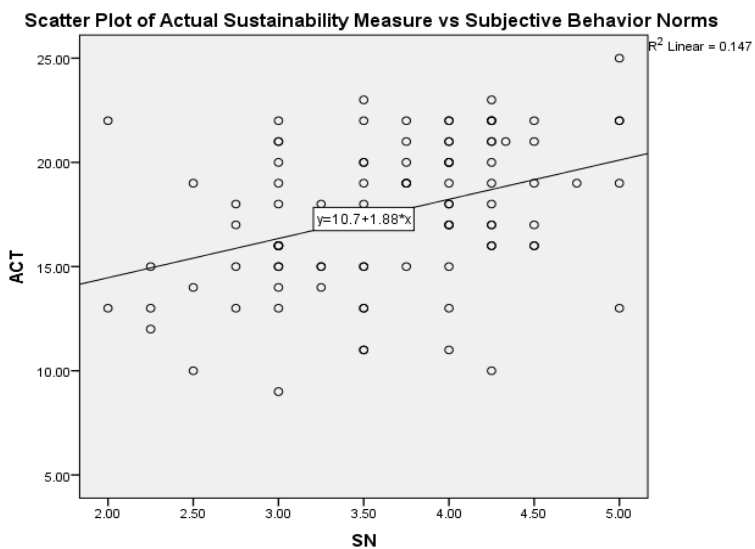
Figure 3. *Scatter plot of ACT and SN.*
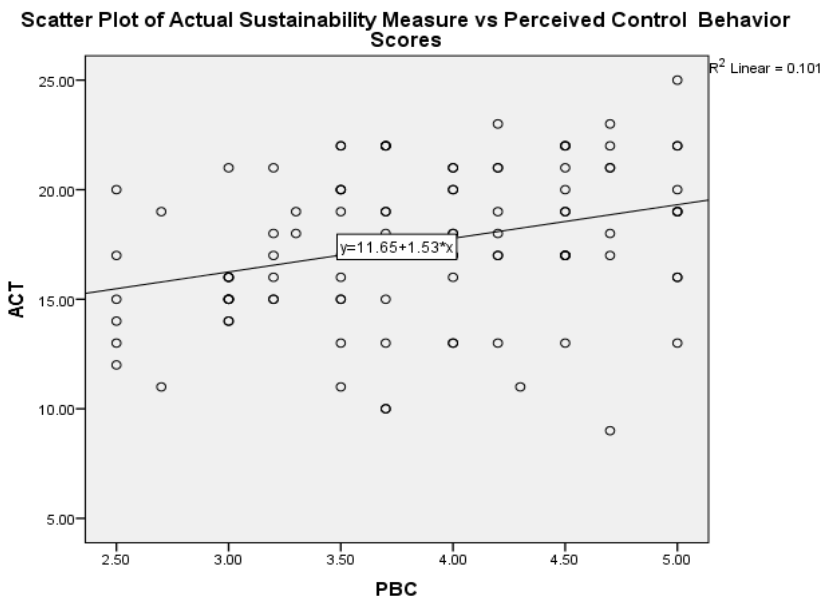
Figure 4. *Scatter plot of ACT and PBC.*
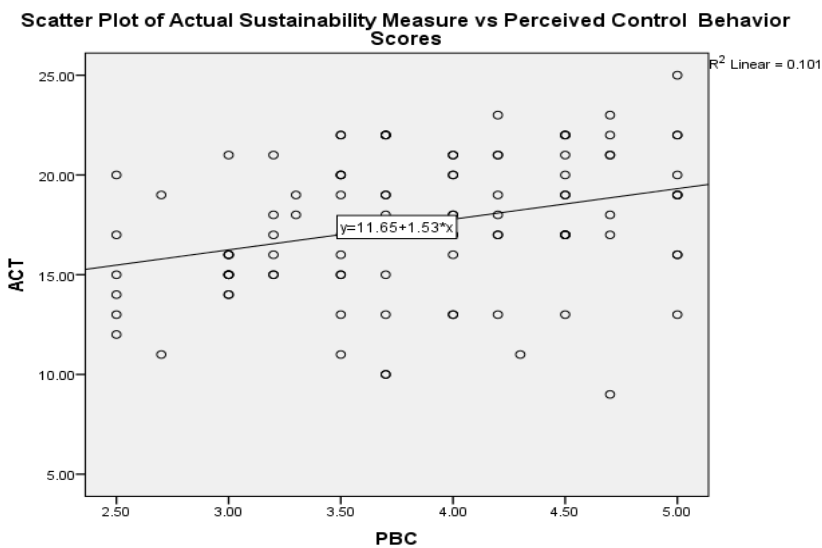
Figure 5. *Scatter plot of ACT and PBC.*

The scatter plots in Figures 2, 3, 4 and 5 showed no distinct pattern. There is no indication of a nonlinear relationship between the dependent variable and any of the independent variables.

Normal distribution of residuals. Another assumption for MLR is that the residuals are normally distributed. The normal probability plot of residuals to demonstrate normality as shown in Figure 6. The plot shows the residual deviations lie almost along the diagonal line and demonstrate the residuals are normally distributed (Field, 2013).
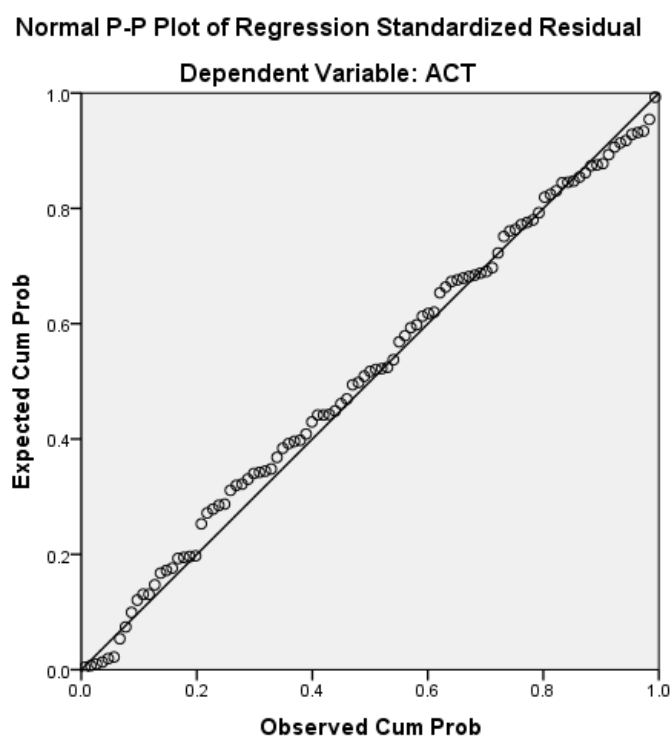
Figure 6: *Normality P-P plot*.

Multicollinearity. I evaluated the independent variables for multicollinearity—how they correlated with each other. The effect would be a distortion in the result if collinearity between independent variables was high. The recommended level for collinearity is .8 or below (Field, 2013). Table 3 shows the correlation coefficients among the variables I obtained after evaluating. The result confirmed that multicollinearity was minimal as the correlations were below .8 within the recommended levels.

Table 3.

Correlation Matrix Showing Multicollinearity of Variables

Variable	Attitude (ATT)	Subjective Behavior (SN)	Perceived Behavior Control (PBC)	Age (AG)	Actual Sustainability Behavior Measure (ACT)	N
Attitude (ATT)	1.000	.547	.331	.025	-.215	99
Subjective Norms (SN)	.547	1.000	.663	-.196	.319	99
Perceived Behavior Control (PBC)	.331	.663	1.000	-.221	.384	99
Age (AG)	.025	-.196	-.221	1.000	.406	99
Actual Sustainability Measure(ACT)	-.215	.319	.384	.406	1.000	99

Levene's test. I checked the homogeneity of variances among variables by using Levene's test (Green & Salkind, 2011). Researchers conduct Levene's test using the null hypothesis that the variance between two groups is the same (Field, 2013). From SPSS software, the evaluation of homogeneity of variance was as follows:

F (4,100) = .491, p = .742

Since $p \geq .05$, I did not reject the null hypothesis and concluded that the variances between the variable groups are equal.

Research Questions

To repeat from Chapter 1, the research questions for the study were as follows:

The primary question of my study was, to what extent could attitudes and related behaviors influence building designers to practice sustainability innovations in Malawi; and what experiences, feelings, and perceptions do the building designers hold that could explain the phenomena? The secondary research questions were as follows:

1. What is the correlation between building designers' attitudinal behaviors towards sustainability innovations and their intention to practice sustainability innovations?

2. To what extent do attitude, subjective norms, and control behaviors affect building designers' intention to practice sustainability innovations?

3. To what extent do attitudinal behaviors differ across age in affecting building designers' intention to practice sustainability innovations?

4. What experiences, feelings, beliefs, and perceptions do building designers and similar experts explain about sustainability innovations?

I asked participants the following interview questions to illicit their experiences, feelings, beliefs, and perceptions about sustainability innovations:

- What are your experiences with sustainability innovations?

- What are your feelings about sustainability innovations?

- What are your beliefs about sustainability innovations?

- What are your perceptions about sustainability innovations in Malawi?

Research Question 1

What is the correlation between building designers' attitudinal behaviors towards

sustainability innovations and their intention to practice the sustainability innovations?

To answer research question 1, I used SPSS to calculate the Pearson's correlations

between each independent variable and the dependent variable. I constructed Table 4 to

show the correlations.

Table 4

Matrix Showing Pearson's Correlation Between Independent Variables and Dependent
Variable

	Attitudes (ATT)	Subjective Norms (SN)	Perceived Behavior Control (PBC)	Age (AG)	N
Actual Sustainability Behavior (ACT)	.406	.391	.319	-.215	99

I interpreted the strengths of the correlations based on standard correlation

coefficient values researchers use. According to Green and Salkind (2011), researchers

interpret correlation coefficient values of .10 as small correlation, greater than .30 as

medium correlation, and .50 or greater as large correlation. In Table 4, correlation

between attitudes (*ATT)* and actual sustainability performance (*ACT*) showed medium

correlation. Correlation between subjective behavior norms *(SN)* and actual sustainability

performance *(ACT)* as well as correlation between perceived behavior control (*PBC*) and

actual sustainability performance (*ACT*) were also medium. Correlation between age

(*AG*) and actual sustainability performance (*ACT*) was small.

Research Questions 2 and 3

To respond to Research Questions 2 and 3, I conducted a MLR analysis to evaluate the relationships between the independent and dependent variables. I evaluated the overall MLR model using the F-test (and its associated p-value) to test the significance of the relationship between the entire set of independent variables and the dependent variable. Table 5 shows the results of the analysis. I rejected the null hypothesis and concluded that there was sufficient evidence of a relationship between the dependent variable and the entire set of independent variables was significant: $F(4, 94) = 8.023, p = .00 < .05.$

I then examined how well each independent variable predicted the dependent variable. Table 5 shows the results of the MLR analysis. Attitudes (ATT) were significantly related to actual sustainability behavior (ACT), $\beta_{ATT} = .305, t(98) = 3.012, p = .003 < .05.$ Subjective behavior norms (SN) were not significantly related to actual sustainability behavior $ACT, \beta_{SN} = .183, t(98) = 1.511, p = .134 \geq .05.$ Perceived behavior control(PBC), was not significantly related to actual sustainability behavior $ACT, \beta_{BC} = .064, t(98) = .558, p = .578 \geq .05.$

Table 5

Multiple Regression Analysis Predicting Actual Sustainability Behavior (ACT) from Attitudes (ATT), Subjective Norms (SN) and Perceived Behavior Control (PBC)

	Unstandardized Coefficients		Standardized Coefficient			95% Confidence Interval for B	
	B	Std. Error	β	t	Sig	Lower Bound	Upper Bound
(Constant)	8.906	2.613		3.408	.001	3.718	14.094
ATT	1.599	.531	.305	3.012	.003	.545	2.652
SN	.844	.558	.183	1.511	.134	-.265	1.952
PBC	.310	.556	.064	.558	.578	-.794	1.414
AG	-.612	.314	-.180	-1.951	.054	-1.235	.011
R	.504						
R^2	.255						
Adjusted R^2	.223						
Std.Error of the Estimate	3.047						
R^2 Change	.255						
F Change	8.203						
df1	4						
df2	94						
Sig. F Change	.000						

Research Question 3 was focused specifically on age. From the regression table in Table 5, age was not related to actual sustainability behavior significantly, β_{AG} = -.180, $t(98)$ = -1.951, p = .054 ≥ .05.

The MLR model equation for this study was:

$$\hat{Y}_{ACT} = \beta_O + \beta_{ATT}\, X_{ATT} + \beta_{SN}\, X_{SN} + \beta_{BC}\, X_{BC} + \beta_{AG}\, X_{AG.}$$

The predictive model from the MLR, including all independent variables was as follows:

Actual Sustainability Practices = .305 Attitudes + .183 Subjective Norms + .064 Perceived Behavior Control - .180 Age.

The adjusted r^2 for this model was .223, meaning that only about 22% of the variation in *ACT* was attributed to the full model. This indicates either a phenomenon with much variation, or the presence of other explanatory variables that might be included in a predictive model of *ACT*.

Considering only those independent variables found to be significant in the initial MLR, as depicted in Table 5, I ran another MLR with results depicted in Table 6.

Table 6

Simple Linear Regression Analysis Predicting Actual Sustainability Behavior (ACT) from Attitudes (ATT)

	Unstandardized Coefficients		Standardized Coefficient			95.0% Confidence Interval for B	
	B	Std. Error	β	t	Sig	Lower Bound	Upper Bound
(Constant)	8.566	2.080		4.118	.000	4.437	12.964
ATT	2.128	.486	.406	4.374	.000	1.162	3.093

R	406
R^2	.165
Adjusted R^2	.156
Std. Error of the Estimate	3.175
R^2 Change	.165
F Change	19.128
df1	1
df2	97
Sg F Change	.000

I then examined how well independent variable *ATT* predicted the dependent variable *ACT*. Table 6 shows the results of the linear regression analysis. I rejected the null hypothesis and concluded that there was sufficient evidence of a relationship between the dependent variable *ACT* and the independent variable *ATT*: β_{ATT} = .406, *t (98) = 4.37, p = .00 < .05.*

The adjusted r^2 for this model for *ATT* was .156, meaning that only about 16% of the variation in *ACT* was attributed to *ATT*. The adjusted r^2 for the model with all four independent variables was .223, indicating that the original model accounts for more variation in *ACT* than the model with only one independent variable, *ATT*, in spite of the fact that not all of the independent variables were significant.

Qualitative Analysis

In this sequential explanatory mixed methods study, I followed up the quantitative analysis with the evaluation of interview responses for the qualitative part. Since interviews took place at their workplaces, or at settings of their choice, and confirmed taking the interviews, the environmental conditions did not affect the participants. Upon transcribing, I coded the interview data to find themes. I used the appriori coding approach whereby I used the interview questions as the guiding themes. I also performed the grounded coding whereby I discarded known information to find additional themes.

I combined the appriori and the grounded coding approach to generate sufficient explanatory data about the themes. Researchers associate the grounded coding with the follow-up or probing questions. Appendix H shows the interview coding of the themes. I analyzed the interview excerpts to find themes associated with Research Question 4.

Evidence of Research Validity and Trustworthiness

I followed the steps I planned for ascertaining validity in the quantitative part and trustworthiness in the qualitative part. To ascertain research validity in the quantitative part I carried out hypothesis tests and evaluated the credibility of the survey instrument. I set the criterion for testing the hypothesis to a .05 level of significance. The level of

significance was the criterion researchers use in similar studies (as I discussed in Chapter 3). The survey instrument was credible as its Cronbach's alpha was .707. I obtained the Cronbach's alpha value from the pilot testing of the survey instrument before applying to the main study. I applied the survey instrument consistently to participants. I evaluated the participants' responses from the same basis and applied the same instrument to all participants consistently. I did not change the instrument over time. Hence, I achieved validity of my data due to the consistency in applying the instrument.

For the qualitative part of this research I maintained credibility, dependability, and transferability to obtain trustworthiness in the research process. To achieve credibility in the interview data, I followed-up interview responses with participants to confirm the accuracy of the response transcripts thereby increase credibility of my data. To obtain transferability, I described and presented the interviews and the research process in detail to allow replication of my study in future research. I also included transcripts of interviews as raw data to allow researchers to asses and confirm the dependability of the data. The interview questions I applied to all participants were consistent to allow conformability. Therefore, the steps I followed confirm the evidence of validity and trustworthiness of my study.

Qualitative Results

Research Question 4

Research Question 4 was for the qualitative component and asked: What experiences, feelings, beliefs, and perceptions do building designers and similar experts explain about sustainability innovations? To find answers to Research Question 4, I used

four interview questions (Q1, Q2, Q3, and Q4) to ask participants to illicit their

experiences, feelings, beliefs and perceptions about sustainability innovations as follows:

Q1:What are your experiences with sustainability innovations?

Q2: What are your feelings about sustainability innovations?

Q3: What are your beliefs about sustainability innovations?

Q4: What are your perceptions about sustainability innovations in Malawi?

I discovered four themes from analyzing the interviews comprising community

challenges, support for sustainability actions, factors controlling sustainability actions,

and prospects for sustainability innovations.

The first theme that emerged was about *community challenges*. When explaining

their experiences, participants expressed challenges about environmental degradation due

to community activities. Participants observed lack of attention from authorities to

address the environmental problem. Participants explained these experiences and

concerns when responding to interview question Q1.

Interview question Q1 asked about what experiences participants held about

practicing sustainability innovations. In response, participants demonstrated their

knowledge by explaining experiences and views on sustainability issues. Participants

expressed concerns and suggestions about implementing sustainability innovations. The

following were the excerpts of the interview about participants' experiences and thoughts

on sustainability approaches:

Participant 1. My experience with this sustainability in general is we are excited

about sustainability. I think the challenge is most of the clients don't understand

the importance of using sustainable materials on sites. Over the year's materials that are conducive to the environment, people have destroyed them. It seems the country is having problems to accept them first hand. But the donor-funded projects most of them are imposing the issue of sustainability on material and other things, mostly for schools and hospitals and whatever. That has been the experience that I have been seeing. But for a local Malawian, I think we're having problems to accept the sustainability of materials. They still believe in burnt bricks and whatever, and the departure from that is taking a long time. I believe government would have put as a law or enforcement. Government must consider this matter must for sure.

Participant 2. Since I do have the experience for years since I started landscaping, I have done many works. I've seen that in most places of building construction, contractors are building without using concrete blocks made on site. They use burnt bricks.. For burnt bricks, people cut trees. This concerns me since they degrade large areas due to cutting down of the trees, grading, and leveling. When you build houses you need to plant back the trees which you had cut. However, people are not doing this. Like you want to clear a place for constructing a school, but you overdo the clearing. The school block requiring only 28 meters by maybe 50, 30, but you see one coming in to clear the whole two hectares of land. Now you come in and say you have built a school there, or a hospital, you find wide open areas which they don't come back to plant in new trees. That is the one thing

that concerns. I find this practice unwelcome. Secondly, these burnt bricks

consume our wood, our trees. We do not replace trees. You see the brick maker,

this brick maker, the guy who is burning bricks and selling, he does not know

about the environment.

Participant 3. I have long experience. Fortunately, I am one of the people who

pioneered, the SSBs from United Kingdom through Kenya. The Malawi

government brought SSBs here for the Schools program. So yes, I've good

experience on especially the construction materials and some of the

technologies. For the SSBs, there were some successes. The reason was when

the government was introducing the program into the country there was

resistance. However, due to collaboration with local communities and private

sector, government institutions started adopting and increasing the use of the

SSBs.

The excerpts evidenced participants' experiences around the community

challenge theme that interview question Q1 asked. Participant 1 stated, "I think the

challenge is most of the clients don't understand the importance of using sustainable

materials on sites." Participant 1 added, "It seems the country is having problems to

accept them first hand. However, the donor-funded projects most of them are

imposing the issue of sustainability on material and other things, mostly for schools

and hospitals and whatever. That has been the experience that I have been seeing."

Participant 2 stated, "Since I do have the experience for years since I started

landscaping. I have done many works." Participant 2 also stated "When you build

houses you need to plant back the trees which you had cut. However, people are not

doing this." Similarly, Participant 2 said, "I have long experience. Fortunately, I am

one of the people who pioneered the SSBs from United Kingdom through Kenya."

(SSBs are stabilized soil blocks and are low cost bricks for constructing buildings).

However, Participant 3 further explained about the experience with community

resistance and stated, "The reason was when the government was introducing the

program into the country there was resistance."

Interview Question Q1 was for starting the conversation and participants

responses revealed the knowledge and experience to contribute to the study. My

analysis of the interview excerpts for interview question Q1 showed the theme about

community challenges that emerged. The community challenges were lack of

knowledge and resistance to adopt sustainability innovations.

The second theme was about *peoples' attitudes towards sustainability actions*.

Despite challenges, participants expressed support and justifications for sustainability

innovations I obtained the theme from analyzing responses to interview question Q2.

Interview Question Q2 explored participants' personal attitudes by asking about how they

liked, enjoyed, or felt about the worthiness of sustainability innovations. The question

allowed them to express their feelings and attitude about practicing sustainable

innovations. Participants had positive attitudes about sustainability innovations but

expressed concern on the high costs and lack of incentives to increase sustainability

practices. The following excerpts explained participants' attitudes:

Participant 4: I like sustainable materials. The reason is, you can imagine if you're having a big project. It maybe a hospital, or a secondary school. If you use firewood bricks for the project, you lose many trees. So I can say I'm excited about using sustainable material. So we can save the environment.

Participant 5: I enjoy doing sustainability innovations because I know I am preserving the environment for future. Furthermore, we don't destroy trees when we're using solar energy, we don't even use much energy for that. We use nature, the sun and it's enjoyable because it's like you're discovering new things, what nature provides. We're using natural energy. It's enjoyable. I can say it's enjoyable.

Participant 6: I think practicing sustainability approaches is worthwhile, and I'm sure slowly the community is going to understand the implications of conserving the environment. So it's worthwhile pursuing the use of sustainable innovations or materials. It is not too much involving as it used to be previously. The reason is one can make bricks within the site where construction is happening. Previously you had to buy some of the sustainable materials from somewhere far. So you talk of transportation of the materials like bricks and the curing of the bricks. You include some transportation of the firewood and so on. That was, to me, that was too much involving than the use of sustainable materials like making SSBs on site, and so on. So I like it because you do everything within the site.

Participant 7: Yes, practicing sustainability innovations is worthwhile. It would bring a major change, especially concerning our climate. Especially this time when you can see the effects of all the climate changes. This is due to degradation of the environment, which the construction industry is contributing a lot here in Malawi.

Participant 8: Sustainability innovations are worthwhile, because I think to me these are the right materials, especially going by the environmental degradation. Firewood burning method of making brick is too involving than environmental soil bricks. You use ordinary soils, furthermore, they are faster during constructing any structure than the ordinary fire cured bricks. You also look at the uniformity. Soil bricks are usually more equal in shape than burnt bricks. The structure also looks nice because of the uniformity of the material.

The responses showed participants' positive attitudes towards sustainability innovations. For example, in interview excerpts, Participant 4 stated, "So I can say I'm excited about using sustainable material. So we can save the environment." Participant 5 said, "I enjoy doing sustainability innovations because I know I am preserving the environment for future." In another interview, Participant 6 stated "I think practicing sustainability approaches is worthwhile, and I'm sure slowly the community is going to understand the implications of conserving the environment." Similarly, Participant 7 said "Sustainability innovations are worthwhile, because I think to me these are the right

materials, especially going by the environmental degradation." The responses to interview question Q2 provided the attitude theme and confirmed participants had positive behavior supporting the sustainability innovations.

The third theme was about *factors controlling decisions* to implement sustainability actions. I found the theme by exploring excerpts of the responses of interview question Q3. Interview question Q3 explored perceived behavior control that influence ultimate decisions and subjective norms that are external factors a person considers important. Interview question Q3 explored how these factors influenced participants' decisions to implement sustainability innovations. The question inquired participants' ultimate decisions to practice sustainability innovations by asking them about their beliefs, significance, or importance that guide their intentions about sustainability innovations. Participants agreed on the importance of sustainability innovations but blamed society, policy-makers, and the government for resisting to change the mindset. According to the participants changing mindset among authorities was a behavior affecting the adoption of sustainability innovations. The following excerpts demonstrated participants' beliefs about sustainability innovations:

> *Participant 9*: It is not involving too much as it used to be previously. The reason is one can make bricks within the site where construction is happening. Previously you had to buy some of the sustainable materials from somewhere far. So you talk of transportation of the materials like bricks and the curing of the bricks. You include some transportation of the firewood and so on. That was, to

me, that was too much involving than the use of sustainable materials like making

SSBs on site, and so on. So I like it because you do everything within the site.

Participant 10: Personally, I go for sustainable innovations and materials and I

am for them. However, in our country, the problem, we have many challenges.

We like to use conventional things. Hence, when you introduce something which

is innovative it is difficult for people to accept it. This applies to clients,

government, institutions, and people who prefer using the conventional methods.

So this leads to a problem of sustainability at the end of the day. The best would

be most of the things start with civic education and some awareness.

Participant 11: Sustainability innovations are worthwhile, because I think to me

these are the right materials, especially going by the environmental degradation.

Firewood burning method of making brick is too involving than environmental

soil bricks. You use ordinary soils because they are faster during constructing any

structure than the ordinary fire cured bricks. You also look at the uniformity. The

soil bricks are usually more equal in shape than burnt bricks. The structure also

looks nice, because of the uniformity of the material.

Participant 12: Of course sustainable material is beneficial because the

environment is safe. For example solar energy systems you don't need any fuels to

have those things running. You just put them in the sun and protect them maybe

with something against vandalism. They are just good and cost effective.

Participant 13: Sustainable technologies are worthwhile because like the solar,

when you install it, you don't need to pay bills or something like that. I think it's

good. The source of that electricity is easy because it depends on the natural sun.

The excerpts demonstrated the third theme about factors controlling decisions to

implement sustainability innovations. Participants explained their observations and

thoughts when they responded to interview question Q3. Participants pointed out

subjective behaviors as among the barriers to sustainability innovations. Participants felt

people and authorities were not ready for the sustainability innovations. For example,

participant 10 said, "We like to use conventional things. Hence, when you introduce

something which is innovative it is difficult for people to accept it. This applies to clients,

government, institutions, and people who prefer using the conventional methods."

However, participants perceived behavior control was positive. However, as individuals

participants expressed readiness to adopt sustainability innovations. For instance,

participant 11 stated: "Sustainability innovations are worthwhile, because I think to me

these are the right materials, especially going by the environmental degradation."

Participant 9 explained that technologies were difficult in the past but now felt ready to

use them and said: "It is not involving too much as it used to be previously. Previously

you had to buy some of the sustainable materials from somewhere far."

The fourth theme was about *prospecting the future of sustainability innovations.* Excerpts from the interview question Q 4 demonstrated the theme about what participants perceived were the prospects of the sustainability innovations. Interview question Q4 explored what participants thought were the general perceptions about sustainability innovations among stakeholders in Malawi. The question asked about prospects of sustainable innovations in Malawi. Participants thought that international organizations advocated for and implemented sustainability more that he government and local organizations. They thought the practicing of sustainability innovation would increase in future if government implemented the policies fully. Excerpts on participants' perceptions about sustainability innovations were as follows:

> *Participant 14:* We have positive future, we can see, because many people here in Malawi are learning about the importance of using a sustainable approach to construction. There are indicators, like we do get phone calls where people ask us how best we can use these sustainable materials. People are leaving from the culture of using the traditional materials and now accepting that we have to use these sustainable materials. But we still have a challenge. For example, one of the materials which contribute a lot to the degradation of the environment here is molding bricks. They have to burn the bricks using firewood in large quantities without replanting. Using large quantities of firewood without replanting depletes our forests. The people who are in the business of curing and selling bricks are reluctant to find other means of survival.

Participant 15: The future for sustainability materials is there, but the resistance will still be there. We are talking of the people. The people in the villages a few of them can afford to go and do their house with concrete blocks. Maybe this is easy, if you teach them about technology. But how fast would they complete. So, to me in the nearest future, there's a problem in the rural areas. Personally, it wouldn't matter on the cost if government decision for buildings is to subsidize costs; I see there is a bright future. It's just about the government and where they stand.

Participant 16: My perceptions about the prospects are positive. As long as all stakeholders, mostly like government should put legislative principles for us to enhance the emergence of sustainable materials. There's hope if all stakeholders unite and they have to accomplish such a noble cause. But I don't think architects can do it by themselves, but also need change of mindset of the clients and policymakers.

Participant 17: I think sustainability has a great future if the government had a full involvement. I will give the example of firewood curing of bricks. The government with the help of the National Construction Industry Council could stop the firewood curing of bricks. Now, the entrepreneurs, the stakeholders, would then start putting in alternative materials like the SSBs, like the cement sand blocks which can be affordable to the communities out there. I'm sure people will begin to use to these sustainable materials, but now they have no alternatives

because sometimes it's the cost that people fear. So we need to balance the two. If

they are not using firewood for curing bricks, they should have an alternative

which is equal or similar in cost.

In the theme about prospects for sustainability, participants expressed their

perceptions by prospecting the future of sustainability innovations Participants were

optimistic about the future of sustainability innovations but were also pessimistic about

government due to lack of involvement. For example Participant 14 said: "We have

positive future, we can see, because many people here in Malawi are learning about the

importance of using a sustainable approach to construction." Participant 15 noted

resistance against sustainability innovations and said: "The future for sustainability

materials is there, but the resistance will still be there. I see there is a bright future. It's

just about the government and where they stand." Similarly participant 16 said: "My

perceptions about the prospects are positive. As long as all stakeholders, mostly like

government, should put legislative principles for us to enhance the emergence of

sustainable materials." Participants thought the prospects for sustainability innovations

were favorable but felt government and stakeholders should increase support for the

sustainability implementation programs by providing policy guidelines and legal

framework.

Summary of the Qualitative Analysis

Research Question 4 explored experiences, feelings, beliefs and perceptions about

sustainability among building designers and similar experts. Through the interviews I

obtained participants' explanations about their experiences, feelings, beliefs, and

perceptions towards sustainability innovations to answer Research Question 4. I deduced four themes from the interviews showing that participants supported the sustainability innovations but, did not implement the sustainability innovations fully due to external factors. Upon analyzing the interview excerpts I found four themes that participants expressed comprising community challenges, personal attitudes, external control factors, and prospects for the sustainability innovations. I explain the themes in the following:

The first theme was about community challenges I found that participants were concerned about how communities damaged the environment and about the lack of community efforts to safeguard and restore the environment to its original condition. The second theme was about personal attitude behaviors towards sustainability innovations. I found participants showed positive attitudes when explaining their feelings towards sustainability innovations. However, participants did not practice sustainability innovations fully and attributed this to lack of action by government and regulatory authorities. The third theme was factors controlling sustainability actions participants explained their feelings in support of the sustainability innovations. However, they also felt their peers such as, government or authorities were not yet supporting sustainability innovations fully and they needed a change of mindset in favor of the sustainability innovations.

In the fourth theme was about prospects for sustainability innovations. Participants expressed positive prospects for the sustainability innovations but thought that the prospects also depended on government to intervene and control the costs and

provide legal framework. Participants' explanations around the four themes clarified the trend of sustainability innovations in Malawi.

Comparison of Quantitative and Qualitative Analysis

I compared the results of the interviews to the survey analysis. The interview findings confirmed the analytical findings. In the correlation analysis I found a medium correlation between actual sustainability behavior *ACT* and attitudes *ATT* (r_{ATT} = .406) Similar to the attitude correlation, the regression equation showed significant relationship between actual sustainability practices, *ACT* and attitudes *ATT* (β_{ATT} = 305, *p* < .05). Similarly, in the interviews responses supported positive attitudes towards sustainability actions. Participants explained that they enjoyed practicing sustainability approaches and considered sustainability innovations worthwhile. Hence, the interview results confirmed the correlation between the participants' attitudes and actual practicing of sustainability innovations.

As Table 4 shows, correlation between actual sustainability *ACT* and subjective norms *SN* was moderate (r_{SN} = .391). Similarly, perceived behavior control *PBC* correlated moderately with actual sustainability practiced *ACT* (r_{BC} = .319). However, correlation between actual sustainability practices and age *AG* was weak (r_{AG} = -.215).

The results of the regression showed that the coefficients for subjective norm variable *SN* and perceived behavior control variable *PBC* were insignificant in influencing the practicing of sustainability innovations (β_{SN} = .183, *p* ≥ .05 and β_{BC} = .064, *p* ≥ .05). The interviews results complimented this observation as participants stated that they liked practicing sustainability to safeguard the environment, but highlighted barriers

that prevented practicing the sustainability approaches fully. Participants pointed out lack

of government decision and commitment to support the sustainability innovations.

Participants felt government expectations were not known fully and this was among

subjective behavior norms preventing participants from practicing sustainability fully.

The age factor was also insignificant in influencing the behaviors to practice

sustainability innovations ($\beta_{AG} = -.180, p \geq .05$).

Summary

In this explanatory mixed methods study, I collected and analyzed survey and interview data sequentially. The aim of the study was to explore how behaviors affected building designers to practice sustainability innovations. The first step was the correlation analysis. I found the subjective behaviors and perceived behavior control were moderate in their correlation with practicing sustainability. The correlation was weak between age and the practicing of sustainability. Attitudes correlated more strongly with practicing sustainability than the perceived behavior control, subjective norm, and age. In the second step I used the multiple regression to find the extent the behaviors affected actual sustainability innovations participants practiced. In the regression equation, I found that attitudes were the only significant factor in influencing the practicing of sustainability.

The interviews supported the analytical findings. Participants supported practicing sustainability. Participants felt practicing sustainability was enjoyable and worthwhile when asked about their feelings towards practicing sustainability. The participants' feelings confirmed the strong correlation and regression significance for attitudes. However, participants explained that government and authorities were not supporting sustainability innovations fully. Participants' explanations confirmed the moderate correlation coefficients for subjective norm and behavior control behaviors. According to the TPB, attitudes relate to how a person likes or dislikes an action or phenomena, subjective behaviors relate to how superiors or important people influence a person to act. Perceived behavior control relates to a person's ultimate decision to take action upon self

assessment of capability. The result in this study was that attitudes among the participants were significant in influencing the participants to perform sustainability innovations. Subjective norms and perceived behavior control were not significant and influenced practicing sustainability only moderately. In Chapter 5, I interpret the findings, explain the limitations and implications of the findings, provide recommendations, and conclude this study.

Chapter 5: Recommendations and Conclusion

In this study, I explored how the behaviors of building designers and stakeholders affected the implementation of sustainability innovations in Malawi. Generally, government and organizations advocate for sustainable development approaches to preserve the environment and reduce effects of changes in climate (Abolore, 2012, Lai, 2014). However, building designers and similar experts do not implement the sustainability innovations fully. The literature I reviewed demonstrated lack of knowledge about how behaviors of building designers and similar experts influence the implementation of sustainability innovations (Abolore, 2012; Duplessis, 2005). The purpose of this mixed methods study with sequential explanatory design was to analyze how behaviors of building designers and stakeholders affected the implementation of sustainability innovations. In this explanatory mixed methods study, I collected and analyzed both statistical and interview data sequentially. I used a mixed methods design to respond fully to the research question for the study. The aim of this research was to study how attitudes and similar behaviors affected building designers to practice sustainability innovations. The primary research question asked what perceptions and attitudinal behaviors building designers held and how these behaviors reflected on the practicing of sustainability innovations in Malawi.

Answering the research questions required an evaluation of two strands of inquiries. The first strand was a quantitative inquiry, designed to evaluate the effect of internal behavior beliefs on practicing sustainability innovations. The second strand was a qualitative inquiry designed to record feelings and perceptions that building designers

and similar experts held to explain their actions. The results showed that attitude of the building designers was the major factor influencing them to practice sustainability innovations. Perceived behavior control and subjective norms influenced the designers moderately but, were insignificant. Age was weak and insignificant in affecting the participants' action towards practicing sustainability innovations. This chapter comprises an interpretation of the results, an explanation of the limitations of the study, implications of the findings on social change, recommendations, and conclusion.

<div align="center">**Interpretation of the Findings**</div>

Theoretical Basis

I chose Ajzen's (1991) theory of planned behavior (TPB) since it uses three behavior constructs that were appropriate for my study. According to Ajzen's TPB, the ultimate decision to perform an activity was an effect of three behaviors constructs comprising attitudes (*ATT*), subjective behavior norms *(SN)*, and perceived behavior control (*PBC*). Ajzen described attitudes as the behavior that explains a persons' liking or disliking of something, some action, or phenomena. A subjective norm is a belief that a person's superior or someone the person respects would want him or her to perform or not to perform the action. Perceived behavior control is a person's ultimate belief that the intended action is beneficial and he or she is capable to perform the action (Ajzen, 1991).

Other behavior theories I reviewed in the literature were Fishbein's and Ajzen's (1975) theory of reasoned action (TRA) and Davis' (1989) technology acceptance model (TAM). According to Fishbein and Ajzen, the TRA states that before acting, a person mediates two internal beliefs about their behavior intentions. The first is the belief that

the action will be favorable to him or herself and this is what regulates the person's

attitudes towards the intended action. The second is the belief that the outcome of the

intended actions meets the expectations or is acceptable to the person's peers or

superiors. This factor is a subjective belief and is an external factor regulating a person's

decisions.

The TAM (Davis,1989) is similar to TRA but focuses on user behaviors towards

technologies. According to Davis, a person's intention to use a technology or system

depends upon how the user perceives the usefulness of the technology or system and how

the user believes it will be easy to use. According to Davis, the main constructs in the

TAM model are the usefulness and ease of use. In Ajzen's (1991) TPB, the behavior

constructs are similar to the two behavior constructs in TRA. However, TPB includes the

PBC as the third behavior construct. The PBC construct accounts for the ultimate

decision control a person confirms before executing the actual behavior.

The literature review for this study showed how researchers applied the behavior

models. They used either one model in a research or a combination of the models. This

allowed the researchers to generate adequate constructs or variables to suit their studies. I

found TPB appropriate for my study since it generates three behavior constructs that were

adequate for my study as I explain in the research examples.

Researchers applied TPB to their studies similar to my study. For instance, Lee

and Shepley (2012) used the TPB in South Korea. Lee and Shepley studied how

conditions in neighborhood environments influenced the decisions of adults to perform

leisure-time walking to improve their health. Uhlaner, Berett-Braun, Jeurissen, and Dewit

(2012) also used TPB to analyze ultimate behavior actions similar to my study. Uhlaner et al. (2012) explored factors that predicted the intentions of small to medium enterprises (SMEs) to practice environmental management in Netherlands. DeBebruin, Sheeran Prins, Hospers, and Van Breckelen (2012) studied correlation between intentions and actual behaviors of patients in health environments. The aim was to investigate whether self-regulatory processes or behavior control in patients affected intentions and behavior actions to take medication and perform exercises. Similar to my study, DeBruin et al. used elements of the TPB as one of the frameworks to test and predict behaviors.

In my study I demonstrated the correlation and relationship between preplanned behavior beliefs or intentions and actual behaviors. This also confirmed the TPB framework prediction. Upon applying the TPB and performing the correlation analysis in my study, I found that preplanned behavior beliefs or intentions of the designers and similar stakeholders correlated moderately with the ultimate implementation of sustainability innovation. The finding confirmed the TPB prediction theory. The TPB application examples were similar to my study in the application of TPB framework in general. I compared current research with my study to confirm how researchers used the TPB elements to predict behaviors.

Current Research

I reviewed studies and found that researchers reached similar conclusion to my study, that different types of behavior beliefs or constructs people hold correlate with their ultimate actions. My findings were similar to research by Lo, Breukelene, Peters, and Kok (2014) confirming that behaviors correlate with peoples' intentions and ultimate

actions. Lo et al. (2014) studied factors influencing people to prefer teleconferencing instead of travelling to attend conferences physically. Using TPB they found habits and subjective behavior norms correlated with participants' intentions and ultimate actions. Workers preferred teleconferencing instead of travelling to conferences. Furthermore, Lo et al. also confirmed the differences in the strength of behavior correlations with ultimate actions similar to my study. Upon comparisons they found subjective behavior norms stronger than attitudes and perceived behavior control. Lo et al. (2014) stated the workers' behavior norm to use teleconferencing was consistent with their habit of avoiding travel. Lo et al. had similar findings in my study that behaviors correlated with ultimate actions. However, Lo et al.'s (2014) conclusion was different from my study. Lo et al. found that normative behaviors were stronger than attitudes and behavior control elements, whereas I found attitude to be the strongest element.

Using TPB, Lee and Shepley (2012) also arrived at conclusions consistent with my findings that people's behavior beliefs or intentions correlate with their ultimate actions. Lee and Shepley studied how conditions in South Korean neighborhood environments affected the decisions of adults to perform leisure-time walking to improve their health. Lee and Shepley hypothesized that differences existed between adults who performed leisure walking and adults who did not perform leisure walking depending on how they understood the significance of their neighborhood environments. Lee and Shepley modeled the TPB to predict walking behaviors among participants. Lee's and Shepley using constructs of the TPB found convergence between the behaviors and intention to walk. The subjective norms were the strongest and led to positive walking

behaviors in the environment. Although in a different context, this study yielded findings similar to my study that the TPB behavior constructs correlated with ultimate action.

Uhlaner, Berett-Braun, Jeurissen, and Dewit (2012) also confirmed the correlation between the TPB behaviors and person's ultimate action similar to finding in my study. As I observed in the literature review section, Uhlaner et al. (2012) explored factors that predicted the intentions of small to medium enterprises (SMEs) to practice environmental management in Netherlands. Uhlaner et al. analyzed a random sample of 689 SMEs and found that family influence and perceived financial benefits from energy savings were among factors that influenced Dutch SMEs to engage in environmental management practices. Uhlaner et al. used the TPB to construct relationships between behavior attitudes, subjective family norms, and perceived behavior control in the SMEs, and the resultant intentions to practice environmental management, Uhlaner et al. confirmed that family concerns correlated and significantly influenced SMEs to engage in environmental management practices. The findings confirmed similar behavior correlation findings in my study of behaviors toward sustainability among infrastructure design professionals in Malawi.

Studies I reviewed in the health environments also confirmed correlation between personal internal behaviors and ultimate actions. DeBebruin, Sheeran Prins, Hospers, and Van Breckelen (2012) studied correlation between intentions and actual behaviors of patients in health environments. The aim was to investigate whether self-regulatory processes or behavior control in patients affected intentions and behavior actions to take medication and perform exercises. DeBruin et al. used elements of the TPB as one of the

frameworks to test and predict behaviors. DeBruin et al. found that self-regulatory

processes correlated and predicted the actual behaviors in both the HIV interventions and

exercise adherence. DeBebruin, et al. (2012) was similar to my study in confirming

correlation between internal behaviors and ultimate actions. Although the studies I

reviewed were in different context and expertise, the studies confirmed my study in

finding that internal behaviors correlated with ultimate actions.

Explaining Behavior Effects

Research Question 2 asked about the extent attitudes, perceived behavior control,

and subjective norms affect sustainability innovations. I analyzed quantitative data to find

the extent of the relationship between sustainability practicing behavior and attitudes,

subjective behaviors, and perceived behavior control. I used multiple regression analysis

to evaluate the relationships. The regression results showed that attitudes were significant

in influencing participants to practice sustainability innovations. According to TPB,

attitudes are self-beliefs that an action or phenomena or object is likeable, worthwhile, or

favorable. Positive attitude is more likely to predict that the person will favor or support

an action, and will propel them towards performing the ultimate action if there are no

restraining conditions. In my study, due to their positive attitudes, participants favored

sustainability innovations personally as the analysis showed but, external factors

restrained their ultimate actions.

Participants expressed lack of full control due to external factors and this

corroborated with the result of the regression I found for perceived behavior control and

subjective behaviors. The analytical result showed that subjective norms and perceived

behavior control were insignificant in influencing sustainability in contrast to the attitude variable. Participants explained impediments to implementing actual sustainability fully. Participants stated that it was not within their ultimate control and it required support and guidelines from government and policy-makers.

Studies with similar findings to my study were evidence showing how attitudinal behaviors were more influential than subjective norms and perceived behavior control. Thomas and Lamm (2012) focused on attitudes, observing that researchers gave little attention to understand attitudes. Thomas and Lamm suggested that attitudes influenced managerial decisions. Using their proposed decision model framework, Thomas and Lamm compared internal and external behaviors with attitudes, subjective norms, and behavior control of Ajzen's (1991) TPB. Thomas and Lamm mapped the attitude legitimacy model that showed external and internal attitude elements and subjective moral norms. According to Thomas and Lamm, management could use the mapping model to study and demonstrate attitudinal behaviors for quick decisions.

Using different theoretical backgrounds, researchers reached similar conclusion about the effectiveness of attitudes on ultimate actions. Other researchers preferred the TRA framework due to the context of the study. For instance, using the TRA instead of the TPB, Coleman, Bahnan, Kelkar, and Curry (2011) investigated the reasons consumers adopted green technologies. Coleman et al. (2011) used the TRA to develop survey instrument and studied how attitudes and beliefs among students and adults influenced their intentions to adopt green innovation in Northeastern communities United States s. Coleman et al. observed that although the TPB model was strong, since it includes the

personal control element, Coleman et al. preferred to use the TRA since attitudes were more predominant in the study than the effect of PBC. Coleman et al. developed several hypotheses to test these relationships; one of the key hypotheses was that attitudes toward green technologies and subjective norms influenced intentions to purchase green innovations. Coleman et al. found that both the student and nonstudent samples confirmed that attitudes influenced respondents positively toward green consumption behaviors and the main finding agreed with expectations from the TRA.

Moons and Des-Pelsemacher (2012) is also a demonstration of the effect of attitudes on intentions and ultimate actions. Moons and Des-Pelsemacher studied factors that determined usage intentions of electric cars in Belgium. Moons and Des-Pelsemacher applied the TPB to analyze emotions and attitude toward electric car driving and its general usage. Moons and Des-Pelsemacher found that emotions and attitudes correlated strongly with usage intentions. According to Moons and Des-Pelsemacher, emotions and attitudes had the strongest effect on intentions to use electric car; however, subjective norms and reflective behavior control were the least. Furthermore, Moons and Pelsemacher studied different groups, and found that people concerned about the environment had strong intentions or inclinations to use electric cars. Moons and Des-Pelsemacher observed that such characteristic factors were obvious in people with proenvironmental behaviors. Moons and Despelsemacher observed that people with less interest in the environment exhibited lesser emotion toward electric cars.

Tan (2013) confirmed my finding that attitudes were stronger in affecting ultimate actions than subjective norm and perceived behavior control. Tan used TPB modeling to

study intention of homeowners to purchase sustainable homes in Malaysia. Tan found that attitudes were higher in influencing homeowners toward green housing than perceived behavior control and subjective behavior.

Context of the Research Findings

The context and field of application of the past studies and my study were different. However, despite the differences, the findings in past studies were similar to my study in confirming how attitudes had strong effect on ultimate actions that people performed. I found that Ajzen's (1991) TPB was suitable in my study. My study was about how internal behaviors of building designers and similar persons affected the extent that they practiced sustainability innovations. Ajzen stated that the combination of the behavioral beliefs results in intentions and actual performance of a behavior action. Ajzen observed that in general when behavioral beliefs are favorable, they result in influencing strong intentions to perform the action.

According to Ajzen's (1991) TPB, three types of beliefs guide human thinking before performing a behavior. The first is the belief about what consequences result from the behavior, and this behavioral belief produces favorable or unfavorable attitudes toward the behavior. The second is the normative belief and concerns the person's ideas about what people regard as normal behavior for him or her to perform. The normative belief is a social pressure or subjective norm that compels individuals toward or against a behavior. The third consideration is about the factors or conditions that a person believes impedes or facilitates performance of the behavior. This belief regulates a person's final steps toward performing a behavior as the perceived behavior control.

Hence, in the context of my study, the TPB was useful and appropriate for analyzing how attitudes, subjective norms, and perceived behavior control behaviors affected building designers to perform sustainability innovations. The positive correlation and significance for attitudes that I found meant that participants favored performing sustainability innovations. Participants considered the sustainability innovations worthwhile.

However, effects due to participants' subjective beliefs and perceived behavior control were lower than effect of attitudes in influencing sustainability actions. According to the TPB theory, the result meant that participants believed other factors compelled them against performing sustainability innovations fully. Examples of the factors were lack of direction from authorities. Participants felt government or authorities provided inadequate support, guide lines, or regulations. Participants thought government or building owners were not ready for the sustainable technologies or innovations.

In the regression analysis of the TPB elements, I found attitudes to be significant in influencing designers and similar experts to practice sustainability innovations. Subjective norms and perceived control behaviors were insignificant. The results of the interview confirmed the regression finding. Thus, my research also confirmed the TPB theory explaining the relationship between preplanned behavior beliefs or intentions and the actual execution of the behavior.

In brief, my study was similar to current research analyzing the relationship between internal beliefs or intentions and prediction of actual behaviors. In addition to confirming TPB theory, my study has contributed to the professional practice. It has

extended current research knowledge by confirming positive attitudes towards

sustainability innovations in Malawi. Hence, my study is useful since current research

highlighted lack of knowledge on how behavior beliefs affect sustainability practices in

different countries (Abolore, 2012; Duplessis, 2005). Despite the findings, my study had

limiting factors. In the next sections, I explain specific limitations, recommendations, and

implications for my study.

Limitations

I minimized the potential effects due to my personal biases when executing the

research. I ensured that I collected data without influencing participants when

responding. Participants submitted survey responses online. Alternatively, participants

who submitted the printed version of the survey signed the questionnaire sheets. I was

neutral in the interviews and participants expressed themselves freely. I analyzed

interview data without influencing the narrative transcripts.

However, other factors had potential to limit the trustworthiness of the study. The

factors were limitations due to gender imbalance, and limitation due to using one

theoretical framework. Limitation due to gender inequality in the sample population may

have affected the generalizeability of the findings. For the proposed population study

sample of 99, I planned to balance the sample by recruiting 49 male and 50 female

participants for the quantitative phase. However, only 15 female participants responded

and caused the gender imbalance. I increased the male participants to 84 to achieve the

sample of 99 participants. In the qualitative phase, where I required 24 interview

participants, only 6 were female and this caused another gender imbalance. I increased

the male interviewees to 18 to achieve the sample of 24 interviewees. The gender imbalance is prevalent in the Malawian workforce (Malawi Government, 2009).

The other limitation was due to using one theoretical framework. To study the effects of behaviors, I used TPB only to suit the research time limits and suited the constructs I planned to study. However, other theoretical frameworks such as the TRA and TAM have processes to analyze behavior constructs. Razaei-Moghaddan and Salehi (2010) used TRA, TAM, and TPB in one study. Razaei-Moghaddan and Salehi studied and compared results of each of the three frameworks as a triangulation process and selected an integration TAM and TPB in the final study. Future researchers could replicate my study and apply more than one theoretical framework to enhance the research findings. Future researchers may apply different research methods such as qualitative design only and compare with the results from the mixed method design as I used in this study. To improve research quality, I explain recommendations for future research.

Recommendations for Future Research

To minimize the effects of the limitations and improve trustworthiness, I outline four recommendations for future researchers to consider. I considered two limitations at the beginning of this study comprising the restriction to a convenient sample of building designers and similar experts and the limitation of the study boundary. However, additional limitations emerged during the study. The additional limitations were gender imbalance and limitation to one theoretical framework.

Therefore, to address the impact of the limitations, I recommend four areas for future research. Firstly, since I targeted building designers only in my research, future researchers should involve a wider population. Researchers may include other groups. Example of the groups to consider are economists, lawyers, environmentalists, and other experts who play roles directly or indirectly in the construction of buildings.

Secondly, I used only the TPB to suit my study. However, future researchers may combine other theoretical or conceptual frameworks such as, TRA and TAM to compare results and enhance the validity of the research. Thirdly, I focused my study within the study boundary of Lilongwe and Blantyre cities of Malawi. Future researchers should extend the study to other areas of Malawi. Extending this study boundary would enhance the generalizeability of the findings.

The fourth recommendation is to use a sample that has equal number of female and male participants. I used a sample with fewer female participants than male. The gender imbalance in the sample was due to a lack of female respondents. Although I ignored the effect of gender imbalance, future researchers should use a gender-balanced sample to enhance the findings.

My study focused only on the impact of human behaviors on practicing sustainability innovations in buildings and similar infrastructure. Future researchers should consider additional factors. The analysis in Table 5 showed a small coefficient of variation suggesting that the predictive model did not account for all possible factors influencing the sustainability actions as the dependent variable. This meant that other factors may have contributed to the actual sustainability practices. Hence, to realize a

broader understanding, future researchers should consider economic, legal, political, geographical, and other factors.

Implications

Methodological and Theoretical Implications

The review of the literature showed insufficient research about how attitudes and related behaviors affect sustainability practices in different countries (Abolore, 2012; Duplessis, 2005). My study contributes to a better understanding about how attitudes and related behaviors affect sustainability innovations in Malawi. However, further research will be necessary to understand the problem fully. Future researchers could expand the methodological or theoretical frameworks to analyze the problem further. For instance, I used the TPB as the only theoretical framework for studying the problem. Future researchers may expand the study by combining TPB with other theoretical frameworks to explain more variables affecting intentions to practice sustainability innovations.

The TPB theoretical framework enabled explaining different behavior elements and the mixed methods design was appropriate since I analyzed different impacts from the behavior elements. I was able to examine the effects due to each of the TPB elements of attitudes, subjective behavior, or perceived behavior control and their combined effect. I aligned the interview questions closely to the TPB elements to find explanations. Using elements of TPB implied the possibility that future studies could combine the TPB with elements from other theoretical frameworks.

Recommendation for Practice

Government and policy-makers need to address challenges such as environmental degradation and effects of climate changes to preserve resources for present and future generations (Bruntland, 1997). Practicing sustainability methods involves using sustainable material, technologies, and innovations are among strategies to protect the environment (Abolore, 2012; Lai, 2014).

As a contribution to the professional practice, my findings confirmed that building designers and similar experts in Malawi did not practice sustainability methods fully due to external factors. Despite government and authorities advocating sustainable approaches, designers and similar experts in building construction do not implement sustainability innovations fully. I found that people's attitudes favored sustainability innovations, but external factors prevented them from implementing sustainability innovations fully. The factors included lack of policy guidelines and government support. Government and authorities need to strengthen support and guide designers and similar stakeholders to increase sustainability practices in Malawi.

Social Change Impact

My study contributes to positive social change in the building construction community in Malawi. As interviews showed, building designers and similar experts favor the use of sustainability innovations, but lack support. To increase the sustainability innovations and enhance positive social change, I recommend government and authorities increase the sensitization of stakeholders and communities to change their mindset and embrace the sustainability approaches.

My study will assist government and policy-makers to understand the current situation regarding sustainability practices in Malawi. The government and policy-makers could increase incentives to change stakeholders' mindset to adopt more sustainability innovations than the present situation. Government could strengthen regulations and bylaws to enforce sustainability innovations. Government and authorities could also offer incentives such as, tax exemptions on material needed for sustainable construction. If government and authorities implement my findings, my study will influence positive societal change by enhancing positive behaviors towards sustainability innovations. My study will contribute to changing the mindset of building construction communities, government, and policy-makers to increase sustainability practices. Therefore, implementing findings in my study will influence positive societal change by impacting the building construction community to increase the practicing of sustainability innovations in Malawi.

Conclusion

Sustainable development goals include the preservation of the environment and reduction of the effects of climatic changes. Incorporating sustainability innovations in buildings such as renewable energy systems, environmentally friendly material, and energy efficient technologies is among the key strategies to achieving the sustainable development goals. Although government and policy-makers advocate for sustainable development goals, building designers and related stakeholders do not implement the sustainability innovations fully.

The problem I studied in this research was how perceptions and attitudinal behaviors affect designers and related stakeholders to implement sustainability innovations fully in Malawi. The main research question asked as to what extent attitudinal behaviors and beliefs affect building designers and related stakeholders to practice sustainability innovations and what are their feelings and perceptions about sustainability innovations that explain their behavior.

My key finding was building designers and related stakeholders have positive attitudes supporting sustainability innovations. However, external factors, such as inadequate support from government and building owners prevent them from implementing sustainability innovations fully. My key recommendation is government and policy-makers should increase their support and provide effective policies, guidelines, and incentives to increase the practicing of sustainability innovations in the building construction industry. Supportive policies, guidelines, and incentives will enhance attitudes and stimulate behavior change among the building construction professionals to implement more sustainability innovations than the present situation.

The great benefit of my study is it has confirmed behavior beliefs and attitudes of building designers and related planners that impact the practicing of sustainability innovations in the Malawian building construction industry. Although the building designers and related stakeholders support sustainability innovations, they do not practice sustainability fully due to inadequate support from government and building owners. As sustainable development includes environmental protection and reduction of climatic change effects, the government, policy-makers, and building owners need to pay attention

by increasing their support for sustainability innovations in buildings for Malawi to

achieve the sustainable development goals.

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Appendix A: Survey Demographic Questions

Building designers perceptions and the effect on sustainability in Malawi

1. What is your occupation?

   o Architect

   o Engineer

   o Surveyor

   o Construction Expert

   o Other (Specify)

2. What is your gender?

   o Female

   o Male

3. What is your age group?

   o 30 years or younger

   o Between 31 and 40 years

   o Between 41 and 55 years

   o Above 56 years

4. What is your work experience?

- o Lower than 5 years

- o Between 5 and 10 years

- o Between 10 and 20 year

- o Above 20 years

Appendix B: Survey Questionnaire to Measure Attitudes towards Sustainability

Innovations in Buildings

Building designers perceptions and the effect on sustainability in Malawi

5. For me, practicing sustainability is worthwhile.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

6. For me, practicing sustainability is important.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

7. For me, practicing sustainability is enjoyable.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

8. For me, practicing sustainability is good.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

9. For me, practicing sustainability is pleasant.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Appendix C: Survey Questionnaire to Measure Subjective Norms about Sustainability

Innovations in Building Designs

Building designers perceptions and the effect on sustainability in Malawi

10. Most people whose opinion I respect expect me to practice sustainability

innovations.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

11. Most people who are like me, in the profession, practice sustainability.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

12. Most people important to me (such as my spouse and relatives) expect me to

practice sustainability.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

13. Most people I value (such as relatives, spouse, colleagues, and my superiors)

approve of me to practice sustainability.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Appendix D: Survey Questionnaire to Measure Perceived Behavior Control about

Sustainability Innovations in Buildings

Building designers perceptions and the effect on sustainability in Malawi

14. It is usually up to me whether to strengthen the practicing of sustainability in

my work.

Strongly Agree   Agree   Neither   Disagree   Strongly Disagree

☐   ☐   ☐   ☐   ☐

15. It is definitely under my ultimate control to decide on practicing sustainability

in my work.

Strongly Agree   Agree   Neither   Disagree   Strongly Disagree

☐   ☐   ☐   ☐   ☐

16. I have controlled the practicing of sustainability in my work in the past.

Strongly Agree   Agree   Neither   Disagree   Strongly Disagree

☐   ☐   ☐   ☐   ☐

17. It is under my control to strengthen the practicing of sustainability in my work

in future.

Strongly Agree   Agree   Neither   Disagree   Strongly Disagree

☐   ☐   ☐   ☐   ☐

Appendix E: Survey Questionnaire to Measure Intentions to Practice Sustainability

Innovations in Building

Building designers perceptions and the effect on sustainability in Malawi

18. Definitely, I will continue practicing sustainability.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

19. I intend to start practicing sustainability innovations in the future.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

20. I will try to practice sustainability in the future,

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

21. I plan to practice sustainability innovations in the future.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Appendix F: Survey Questionnaire to Measure Actions to Practice Sustainability

Innovations in Building Designs.

Building designers perceptions and the effect on sustainability in Malawi

The frequency that designers and related professionals practice sustainability to projects varies. The survey is intended to measure how often participants implement sustainability activities.

Instructions

a) As participant to this survey, please indicate the frequency you perform sustainability actions in the designs for each of the listed activities ranging from very high to low frequency and scoring points as follows: Very high (5 points), High (4 points), Moderate (3 points) Low (2 points), and Very Low (1 point).

b) Insert Total score and percentage at bottom of the score sheet.

Sustainability Implementation Score sheet

Item	Description	Max points	Score	Percentage
1	Site selection (e.g. environmental assessments, pollution control etc.)	5		
2	Water efficiency (e.g. Water Conservation, recycling etc)	5		
3	Energy efficiency (energy lamps, renewable energy e.g. solar water heaters, photovoltaics etc)	5		
4	Indoor Environmental quality (building orientation, natural ventilation etc)	5		
5	Sustainable material/resources (reuse of existing materials and structures in new designs,	5		
	TOTAL SCORE	25		

c) Proceed to respond to Question 21 using the result of your percentage score.

Note: Very High score: Above 80%; High score: Between 80 and 60 %; Moderate score:

Between 60 and 50%; Low score: Between 50 and 30%; Very Low score: Below 30%

21. I practice sustainability to the following degree of frequency. (See also my

sustainability item score sheet Appendix F.)

Very High	High	Moderate	Low	Very Low
☐	☐	☐	☐	☐

Appendix G: Qualitative Interview Questions

Building Designers' Perceptions and the Effect on Sustainability in Malawi

The question in this mixed methods study is to what extent could building designers' attitudinal behaviors relate to sustainability practices and what experiences, feelings and perceptions could explain their behavior

Purpose of Interview.

The purpose of this interview is to explore experiences, feelings, beliefs, and perceptions about sustainability innovations that could explain behaviors about sustainability practices among building designers and associated professionals in Malawi.

Qualitative Research Question

What experiences, feelings, beliefs, and perceptions do building designers and similar experts explain about sustainability innovations?

Interview questions:

- What are your experiences with sustainability innovations?

- What are your feelings about sustainability innovations?

- What are your beliefs about sustainability innovations?

- What are your perceptions about sustainability innovations in Malawi?

Appendix H: Interview Coding

1) <u>Experiences on sustainability innovations: Appriori theme based on RQ1</u>

Description of Experiences = DS-EXP

Challenges: Emergent themes from experiences:

Awareness challenges = AW-CH

Legal framework = LG-CH

2) <u>Attitudes towards sustainability innovations: Appriori theme base on RQ2</u>

Description of attitudes towards sustainability innovations = DS-ATT

Justifications and challenges: Emergent themes from attitudes:

Attitude to conserve the environment = Env-JUS

Attitude to conserve energy = Ergy-JUS

Mindset challenges = Mst-CH.

3) <u>Subjective and perceived behavior control Appriori theme based on RQ3</u>

Perceived worthiness of sustainability innovations = Wor-PER

Perceived benefit of sustainability innovations = Ben-PER

Favor sustainability innovations due to conservation requirements = Cons-

FAV

4) <u>Perceptions about sustainability: Appriori theme based on RQ4</u>

Prospects for sustainability = Pro-PRC

Feelings about sustainability: Fear of income loss = FEA-PRC, Mindset

change = MD-PRC.

Appendix I: Institutional Review Board Approval

IRB Materials Approved - Lloyd Ndau

Dear Mr. Ndau,

This email is to notify you that the Institutional Review Board (IRB) has approved your application for the study entitled, "Building designers' perceptions and the effect on sustainability in Malawi."

Your approval # is 09-03-15-0197101. You will need to reference this number in your dissertation and in any future funding or publication submissions. Also attached to this e-mail are the IRB approved consent forms. Please note, if these are already in an on-line format, you will need to update those consent documents to include the IRB approval number and expiration date.

Your IRB approval expires on September 2, 2016. One month before this expiration date, you will be sent a Continuing Review Form, which must be submitted if you wish to collect data beyond the approval expiration date.

Your IRB approval is contingent upon your adherence to the exact procedures described in the final version of the IRB application document that has been submitted as of this date. This includes maintaining your current status with the university. Your IRB approval is only valid while you are an actively enrolled student at Walden University. If you need to take a leave of absence or are otherwise unable to remain actively enrolled, your IRB approval is suspended. Absolutely NO participant recruitment or data collection may occur while a student is not actively enrolled.

If you need to make any changes to your research staff or procedures, you must

obtain IRB approval by submitting the IRB Request for Change in Procedures Form.

You will receive confirmation with a status update of the request within 1 week of submitting the change request form and are not permitted to implement changes prior to receiving approval. Please note that Walden University does not accept responsibility or liability for research activities conducted without the IRB's approval, and the University will not accept or grant credit for student work that fails to comply with the policies and procedures related to ethical standards in research.

When you submitted your IRB application, you made a commitment to communicate both discrete adverse events and general problems to the IRB within 1 week of their occurrence/realization. Failure to do so may result in invalidation of data, loss of academic credit, and/or loss of legal protections otherwise available to the researcher.

Both the Adverse Event Reporting form and Request for Change in Procedures form can be obtained at the IRB section of the Walden website: http://academicguides.waldenu.edu/researchcenter/orec Researchers are expected to keep detailed records of their research activities (i.e., participant log sheets, completed consent forms, etc.) for the same period of time they retain the original data. If, in the future, you require copies of the originally submitted IRB materials, you may request them from Institutional Review Board.

Both students and faculty are invited to provide feedback on this IRB experience at the link below:

http://www.surveymonkey.com/s.aspx?sm=qHBJzkJMUx43pZegKlmdiQ_3d_3d

Sincerely,

Libby Munson

Research Ethics Support Specialist

Office of Research Ethics and Compliance

Email: irb@waldenu.edu

Fax: 626-605-0472

Phone: 612-312-1283

Office address for Walden University:

100 Washington Avenue South, Suite 900

Minneapolis, MN 5540.

Appendix J:National Commission for Science and Technology

Approval to Conduct Research in Malawi

NATIONAL COMMISSION FOR SCIENCE & TECHNOLOGY

Lingadzi House
Robert Mugabe Crescent
P/Bag B303
City Centre
Lilongwe

Tel: +265 1 771 550
+265 1 774 189
+265 1 774 869
Fax: +265 1772 431
Email:directorgeneral@ncst.mw
Website:http://www.ncst.mw

Ref No: NCST/RTT/2/6

7 October, 2015

L Ndau
C/O M&E Associates
P.O Box 1078
Lilongwe

Dear Lloyd Ndau,

RESEARCH ETHICS APPROVAL OF PROTOCOL: P.09/15/55 BUILDING DESIGNERS PERCEPTIONS AND THE EFFECT ON SUSTAINABILITY INNOVATIONS IN MALAWI

Having satisfied all the ethical, scientific and regulatory requirements, procedures and guidelines for the conduct of research in the social sciences sector in Malawi, I am pleased to inform you that the above referred research study has officially been approved. You may now proceed with its implementation. Should there be any amendments to the approved protocol in the course of implementing it, you shall be required to seek approval of such amendments before implementation of the same.

This approval is valid for one year from the date of issuance of this letter. If the study goes beyond one year, an annual approval for continuation shall be required to be sought from the National Committee on Research in the Social Sciences and Humanities in a format that is available at the secretariat. Once the study is finished, you are required to furnish the Committee and the Commission with a final report of the study.

Wishing you a successful implementation of your study.

Yours sincerely,

Martina Chimzimu
NCRSH ADMINISTRATOR AND RESEARCH OFFICER
HEALTH, SOCIAL SCIENCES AND HUMANITIES
For: CHAIRMAN OF NCRSH

Appendix K: Letters of Cooperation

RENEWABLE ENERGY INDU~TRIES **ASSOCIATION OF MALAWI**

P.O. Box 2047. Lilongwe, Malawi.

Tel: 0 I 750 560/Fax 0 I 750 560

Email: info@reiama.org/reiama.renewableenergy@gmail.com

22 July 2015

Mr. Lloyd Ndau,

M&E Associates

Dear Mr. Lloyd Ndau,

Letter of Cooperation with Renewable Energy Industries Association of Malawi

I am very pleased to inform you that the Renewable Energy Industries Association of Malawi, of Wiyule Business Centre, Off Likuni Road, P.O. Box 2047, Lilongwe has accepted to be a community research partner to you, Mr. Lloyd Ndau of M&E Associates in Lilongwe.

Based on my review of your research proposal, I give permission for you to conduct the study entitled "Building designers' perceptions and the effect on sustainability in Malawi" within themembership community of the Renewable Energy Industry Association of Malawi (REIAMA).

As part of this study, I authorize you to recruit participants, collect data, conduct interviews, and disseminate results. Individuals' participation will be voluntary and at their own discretion.

I understand that our organization's responsibilities include providing contact information of members of our institution. We reserve the right to withdraw from the study at any time if our

circumstances change.

I confirm that I am authorized to approve research in this setting and that this plan complies with the organization's policies.

I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the student's supervising faculty/staff without permission from the Walden University's Institutional Review Board (IRB).

Sincerely,

Executive Director

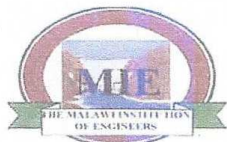Renewable Energy Industries Association of Malawi,

P.O. Box 2047,

LILONGWE.

EMAIL: reiama.renewableenergy@gmail.com/atamandikec@live.com

THE MALAWI INSTITUTION OF ENGINEERS

(MIE is a Registered Professional Organisation in Malawi)

ALL CORRESPONDENCE TOBE ADDRESSED TO THE EXECUTIVE SECRETARY

MPC Conference Centre Premises, Kasungu Crescent Road, Opposite Blantyre Museum

PO BOX 1193, BLANTYRE
Tel/Fax 01 871 615
E mail: mw.engineers@gmail.com
Website: www.mwengineers.mw

Date: 17TH June 2015

Dear Mr. Lloyd Ndau,

Letter of Cooperation

Based on my review of your research proposal, I give permission for you to conduct the study entitled "Building designers' perceptions and the effect on sustainability in Malawi" within the membership community of the Malawi Institute of Engineers. As part of this study, I authorize you to recruit participants, collect data, conduct interviews, and disseminate results. Individuals' participation will be voluntary and at their own discretion.

I understand that our organization's responsibilities include: providing contact information of members of our institution. We reserve the right to withdraw from the study at any time if our circumstances change.

I confirm that I am authorized to approve research in this setting and that this plan complies with the organization's policies.

I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the student's supervising faculty/staff without permission from the Walden University's Institutional Review Board (IRB).

Your Sincerely,

Eng.Andrew Thawe
PRESIDENT

MALAWI INSTITUTE OF ARCHITECTS
Member of AUA – Africa Union of Architects, CAA – Commonwealth Association of Architects
UAI – International Union of Architects

PHYSICAL ADDRESS
Regional Buildings Department (Centre) Complex
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POSTAL ADDRESS
Private Bag B485
Capital City
Lilongwe 3. Malawi

Our Ref: 01407/LNWUniv/2015/SN/cc

28th July, 2015.

Community Research Partner Name: Malawi Institute of Architects
Contact Information: Sam Ngoma
Email: sanngoma@iCloud.com
Date: July 28, 2015

Dear Mr. Lloyd Ndau,

LETTER OF COOPERATION FROM A COMMUNITY PARTNER

Based on my review of your research proposal, I give permission for you to conduct the study entitled "Building designers' perceptions and the effect on sustainability in Malawi" within the membership community of the Malawi Institute of Architects. As part of this study, I authorize you to recruit participants, collect data, conduct interviews, and disseminate results. Individuals' participation will be voluntary and at their own discretion.

I understand that our organization's responsibilities include: providing contact information of members of our institution. We reserve the right to withdraw from the study at any time if our circumstances change.

I confirm that I am authorized to approve research in this setting and that this plan complies with the organization's policies. I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the student's supervising faculty/staff without permission from the Walden University's Institutional Review Board (IRB).

Sincerely,

Sam Ngoma
MIA VICE PRESIDENT

C/o Surveys Department
P/Bag B525
Capital City
LILONGWE 3

Tel: +265 (0) 111 731 853
Cell: + 265 (0) 995 538 589

Our ref: EN/el

Letter of Cooperation from a Community Partner

Community Research Partner Name: Surveyors Institute of Malawi

Contact Information: Ms. E. C. Nyasulu

Email: nyasulue@mpicomw.com

Date: 29th July, 2015

Dear Mr. Lloyd Ndau,

Letter of Cooperation

Based on my review of your research proposal, I give permission for you to conduct the study entitled "Building designers' perceptions and the effect on sustainability in Malawi" within the membership community of the Surveyors Institute of Malawi. As part of this study, I authorize you to recruit participants, collect data, conduct interviews, and disseminate results. Individuals' participation will be voluntary and at their own discretion.

I understand that our organization's responsibilities include: providing contact information of members of our institution. We reserve the right to withdraw from the study at any time if our circumstances change.

I confirm that I am authorized to approve research in this setting and that this plan complies with the organization's policies.

I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the student's supervising faculty/staff without permission from the Walden University's Institutional Review Board (IRB).

Sincerely,

Authorization Official

Contact Information