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DEPARTMENT OF CIVIL

ENGINEERING

OPTION OF CONSTRUCTION TECHNOLOGY

ADOPTION OF SUSTAINABLE CONSTRUCTION MANAGEMENT IN THE RWANDAN CONSTRUCTION INDUSTRY.

CASE STUDY: RWANDA

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UNDER GUIDANCE OF: **Eng. NSENGIYUMVA Emmanuel**

Kigali, 2024

APPROVAL

It is hereby confirmed that the project with title: **"Adoption of Sustainable Construction Management in the Rwandan Construction Industry"** by ORLY DYLAN SAGISENGO has been assessed and accepted bythe Department of Construction Management on October 18, 2024.

SUPERVISION'S ATTESTATION

This project report was carried out under my supervision

Signed……Date…….

Name: Eng. NSENGIYUMVA Emmanuel

DEDICATION

I the undersigned, hereby declare that this project is my original work and it has never been presented elsewhere as a report or in any other format. All sources of information used in this report have been duly acknowledged.

Student Signature

Name: **ORLY DYLAN SAGISENGO** Date: …….

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ABSTRACT

The management of a construction project in a sustainable way should focus on the entire process from an early design stage towards the final product and on the benefits and negative impacts that are to be expected during the life of the facility. To manage such a process, sustainably, there is a need for some kind of management system or tool from the perspective of the process owner and the management of the project. To link sustainability with quality and environmental aspects is one way to systemize this process. This study investigates the level of adoption of sustainable construction management in the construction industry to improve its implementation. The quantitative research approach was used for the study. The research design was a survey (Questionnaire) in nature. The simple random sampling technique and purposive or judgemental sampling techniques were adopted. The respondents were the architects, engineers, and quantity surveyors registered in professional bodies. Hence 43 respondents filled and returned the questionnaires. Data analysis was done with frequency, mean scores, t-test, and analysis of reliability (using Cronbach alpha). In addition, all data were presented in tables. This study also assessed the awareness and performance of the roles of sustainable construction managers, drivers of SCM on the construction projects, challenges hindering their uptake, and the solutions or strategies through which SCM adoption may be improved. Results showed the levels of awareness and performance are still low. there is more necessary to improve the awareness among the construction managers to strongly improve the adoption of sustainable construction management. It was concluded there is a low level of adoption of sustainable construction management, thus there is a strong need for improving the awareness of sustainable construction management among the construction players, conducting the training on benefits of SCM and, mandating the use of sustainable construction management on big projects. This research is expected to improve the awareness and performance of SCM and its drivers in the construction industry by the fight against the relevant challenges and promoting the strategies identified in this study. Future research should be conducted to identify the main factors for improving the Adoption of SCM.

LIST OF ACRONYMS

SCM: Sustainable Construction Management

UK: United Kingdom

GHG: Green House Gas

SD: Sustainable Development

NCI: Nigerian Construction Industry

CM: Construction Management

NGTP: National Green Technology Policy

SDGs: Sustainable Development Goals

EIA: Energy Information Administration

RIA: Rwanda Institute of Architects

IER: Institute of Engineers Rwanda

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CHAPTER ONE: INTRODUCTION

1.1 Background to the study

The construction sector is one of the largest in the world economy, with about $10 trillion spent on construction-related goods and services every year (McGraw-Hill, 1991:10). However, the industry's productivity has trailed that of other sectors for decades, and there is a $1.6 trillion opportunity to close the gap (McKinsey Global Institute report, 2017:5). Globally, the construction industry contributes to economic growth from the demand side and in the traditional Keynesian economy. For example, in the UK, construction's 2.5% growth in the third quarter of 2013 helped the overall economy grow by 0.8% over the same period (Amel, 2013:3). According to Khan (2008:50), the construction sector and construction activities are considered to be one of the major sources of economic growth, development, and economic activities.

Over the past two decades, Rwanda has been one of the fastest-growing economies in Africa. Between 2000 and 2017, the Rwandan economy grew at a 7.8 percent annual rate, with GDP per capita increasing at a 7% annual rate (International Labour Office with financial assistance from the European Union, 2018:7). The construction sector plays an important role in Rwanda's economy, both in its contribution to the national economy and in creating employment.As one of the key sectors of the economy, data from the past five years shows that it contributes around 7 percent of the national GDP, and 8 percent of national employment (Sempundu,2017:22). Furthermore, according to the Business Monitor International forecast, Rwanda'sconstruction sector is expected to grow by 9 percent (which is the second-fastest growth rate in Sub-Saharan Africa) in 2021 (Charpe, 2017:34).

Despite these achievements, the construction industry has been proven to be a potentially damaging sector to the surrounding environment, and one that offers considerable opportunity for improvement (Addis and Talbot, 2001:262; Langston and Ding, 2001:262). According to Zhang et al. (2017:2), the construction industry accounted for 32% of total global energy consumption in 2010, 19% of total global energy-related greenhouse gas (GHG) emissions, and nearly one-third of total global carbon emissions. As a discipline, sustainable construction has been evolving since the late 1980s ((Landman, 1999:263). It continuously gains momentum as increasing evidence about the depletion of the environment and environmental loadings becomes obvious. However, regardless of its importance and the expanding foundation of knowledge in the field, sustainable construction is by no means standard industry practice in many countries (Landman, 1999:263).

However, sustainability has triggered a paradigm shift in the construction industry (Rohracher 2011:12). Professionals in architecture, engineering, as well as the construction (AEC) industry have drifted their attention towards the concept of sustainability. GhaffarianHoseini et al. (2012:24) indicated that the practice of sustainable building, which also refers to green buildings,

includes features such as low energy consumption. Sustainable Development (SD) has gained much attention over the last 30 years since the publication of the Brundtland report (WCED, 1987:3). However, despite an increasing number of studies highlighting the importance of sustainability in construction projects (Medineckiene et al., 2010:10), progress towards achievement within the construction industry is slow compared to other industries. Therefore, this study of the adoption of sustainable construction management is conducted to improve its implementation in the Rwandan construction industry.

1.2 Statement of the research problem

Nur and Leo (2018:5) conducted research to determine the drivers of the implementation of sustainable construction management among main contractors and identified the drivers of organizations to implement sustainable construction management in their projects. Findings from the research explain that the introduction of a series of tax incentives is the most significant driving factor for contractors to implement sustainable practices in the construction industry.

Kumar and Gupta (2014:13) conducted research on sustainable construction management to discuss the management practices for construction to make buildings as sustainable and green as possible. And also, to address the issues regarding management of any construction project alongside the concept of green technology or so-called sustainable development which could minimize the risks. The paper concludes that the task of construction of a green building is only accomplished fully when the concept of sustainability is incorporated in every step of construction practice, and the process is not limited to constructing a building with sustainable materials. This study did not identify the appropriate strategies for improving the implementation of SCM.

Persson, Olander, Landin, and Mats (2008:7) conducted research on sustainable construction management at a project level: a modified environmental management system structure to investigate how a particular construction company deals with the knowledge potentially available to it and how the organizational work of the company supports its knowledge management efforts. The result of this study is a suggestion of a combined system/tool of how to manage the process of a construction project's sustainability, environmental, and quality aspects towards a sustainable building. This study was conducted but did not identify the level of performance of the roles of sustainable construction managers.

Rawai, Fathi, and Abedi (2018:3) conducted research on mobile applications for sustainable construction management. To evaluate the potential impact of improving sustainable project management in construction industries. The findings show that there is a high potential for improving sustainability in construction projects, the effects on construction resources, and the potential impact of improving sustainable project management in construction industries. Even though this study was conducted, it did not determine the key drivers of improving sustainable project management in the construction industry.

Chawla, Chanda, Angra, and R. Chawla (2018:14) conducted research on sustainable project management: A review and future possibilities to identify the future possibilities of applying computational procedures to estimate and optimize the sustainability issues in the management of projects. This study found that sustainable project management highly depends on decision-makers, policy makers, and the implementation of decisions and policies towards sustainability in the projects. The decisions on company policies as well as their implementation both are carried out by the company's human resources. But this study did not mention the challenges hindering the uptake of SCM.

Frank and Nicole (2007:13) conducted research on sustainable management of construction projects to highlight a sophisticated approach to construction project planning and to reveal how this approach can be applied to modern construction management. Findings from this study explain that the integration of waste management and recovery strategies into the planning process of construction projects can be used to promote sustainable criteria into construction project management. However, this study did not advocate for strategies to improve SCM implementation.

Referring to the studies conducted by different researchers all over the world, we are conducting a study to investigate the level of adoption of sustainable construction management in the Rwandan construction industry to determine the level of adoption of sustainable construction management, challenges, barriers, drivers, and strategies for adopting sustainable construction management that will result in a high level of adoption of sustainable construction management in the Rwandan construction industry. Therefore, concerning the Rwandan construction industry, a few research projects have been conducted on the adoption of sustainable construction management, but there is no awareness of the level of its adoption. So, this study aims to investigate the level of adoption of sustainable construction management in the Rwandan construction industry to improve its implementation.

1.3 Research questions

The following are the research questions for this study:

1. What are the key drivers of implementing sustainable construction management?

2. What is the level of awareness of sustainable construction management in the construction industry?

3. What is the level of performance of the roles of sustainable construction managers in the construction industry?

4. What challenges are hindering the uptake of sustainable construction management in the construction industry?

5. What appropriate strategies can stakeholders adopt to improve the implementation of sustainable construction management?

1.4 Aim and objectives of the study

1.4.1 Aim of the Study

This study aims to investigate the level of adoption of sustainable construction management in the Rwandan construction industry to improve its implementation.

1.4.2 Objectives of the Study.

The following are the objectives of the study:

1. To determine the key drivers for implementing sustainable construction management.
2. To assess the level of awareness of sustainable construction management in the construction industry.
3. To identify the level of performance of the roles of sustainable construction managers in the construction industry.
4. To identify the challenges of sustainable construction management in the construction industry.
5. To identify the appropriate strategies for improving the implementation of sustainable construction management.

1.5 Hypothesis of the study

The hypothesis of this study is as follows:

Hypothesis 1

H_0 = There is no significant relationship between the level of awareness and level of performance of the roles of sustainable construction managers

H_1 = There is a significant relationship between the level of awareness and the level of performance of the roles of sustainable construction managers.

Hypothesis 2

H_0= there is no significant difference in the level of awareness of the roles of sustainable construction managers by the consultants and contractors.

H_1= there is a significant difference in the level of awareness of the roles of sustainable construction managers by the consultants and contractors.

Hypothesis 3

H_0= there is no significant difference in the level of performance of the roles of sustainable construction managers by the consultants and contractors.

H_1= there is a significant difference in the level of performance of the roles of sustainable construction managers by the consultants and contractors.

Hypothesis 4

H_0= there is no significant difference in the drivers of sustainable construction management by the consultants and contractors.

H_1= there is a significant difference in the drivers of sustainable construction management by the consultants and contractors.

Hypothesis 5

H_0= there is no significant difference in the challenges hindering the uptake of sustainable construction management by the consultants and contractors.

H_1= there is a significant difference in the challenges hindering the uptake of sustainable construction management by the consultants and contractors.

Hypothesis 6

H_0= there is no significant difference in the Appropriate strategies for improving the implementation of sustainable construction management by the consultants and contractors.

H_1= there is a significant difference in the Appropriate strategies for improving the implementation of sustainable construction management by the consultants and contractors.

1.6 Scope of the study

This study aims to investigate the level of adoption of sustainable construction management in the Rwandan construction industry. It has covered the construction project located in Rwanda to assess the level of adoption of SCM. This study has also rely on the information from the respondents who handled the projects of road construction, residential buildings, institutional buildings, commercial buildings, and factory buildings found in Rwanda.

The respondents of the study are construction professionals limited to SCM adoption, including architects, quantity surveyors, and civil engineers.

This study will cover SCM level of awareness, key drivers of implementing SCM, challenges hindering the uptake of SCM, and the appropriate strategies that can be adopted for improving the implementation of SCM in Rwanda.

1.7 Justification of the study

By conducting the adoption of sustainable construction management in the Rwandan construction industry, this study will help us to know the level of adoption of SCM and also to know the key drivers and appropriate strategies needed for improving the implementation of sustainable construction management.

In this study, we will highlight the key drivers of implementing sustainable construction management so that the practitioners in the construction industry, including architects, quantity surveyors, and civil engineers, will put together those key drivers to find out what they agreed upon to be used in implementing sustainable construction management.

Knowing the level of awareness of sustainable construction management in the construction industry will facilitate all the practitioners' understanding of their contributions and responsibilities in the adoption of sustainable construction management.

Identifying the level of performance of the roles of sustainable construction managers in the construction industry will facilitate knowing the skills and knowledge of construction managers to improve the implementation of sustainable construction management.

Identifying the challenges affecting the adoption of sustainable construction management in the Rwandan construction industry will help some NGOs to support the development of better sustainable construction management in Rwanda. Furthermore, it will help the construction industry find the appropriate strategies for those challenges.

By the time these appropriate strategies for improving the implementation of sustainable construction management are effectively developed, they will be the reference for those who will

be working on sustainable construction management in the future, and they will also be applicable in other countries.

1.8 Definition of operational terms

- **Adoption**: it is a process of acceptance and implementing technology. It's a process by which technology is communicated through certain channels over time among the members of a social system.

- **Sustainable design:** A design philosophy that seeks to maximize the quality of the built environment, while minimizing or eliminating negative impacts to the natural environment

- **Sustainable construction:** To create and operate a healthy built environment based on resource efficiency and ecological design with an emphasis on seven core principles across the building's life cycle: reducing resource consumption, reusing resources, using recyclable resources, protecting nature, eliminating toxics, applying life cycle costing, and focusing on quality. It is the combination of sustainable construction practices and sustainable building materials to reduce waste and environmental impact.

- **Building:** a relatively permanent enclosed structure over a plot of land, with a roof and usually windows, and often more than one level, used for a variety of activities such as living, entertaining, or manufacturing.

- **Sustainability**: the ability to be maintained at a certain rate or level.

- **Construction management (CM):** is a professional service that uses specialized, project management techniques to oversee the planning, design, and construction of a project, from its beginning to its end. The purpose of construction management is to control a project's time, delivery, cost, and quality.

- **Project management**: is the application of processes, methods, skills, knowledge, and experience to achieve specific project objectives according to the project acceptancecriteria within agreed parameters.

- **Construction industry:** the branch of manufacturing and trade based on building, maintaining, and repairing structures.

- **Sustainable development:** is the development that meets the needs of the present, without compromising the ability of future generations to meet their own needs.

- **Construction:** the action of building something, typically a large structure.

- **Construction technology:** refers to the collection of innovative tools, machinery, modifications, software, etc. used during the construction phase of a project that enables advancement in field construction methods, including semi-automated and automated construction equipment.

CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

This chapter examined previous works related to the study. The review of the literature examined research undertaken about the concept of sustainable construction management. It focused on the investigation of the level of adoption of the sustainable construction management concept to improve its implementation.

2.2. Sustainable construction management

Sustainable development was introduced around thirty years ago by the World Commission on Environment and Development. The definition of sustainable development was given by "meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland Report 1987:3). In other words,

Sustainable construction is seen as a new way for the building industry to respond towards achieving sustainable development in its various environmental, social-economic, and cultural facets (CIB, 1998:4). Since the first international conference on sustainable construction in Tampa, USA, 1994, green building has become a significant global issue, while several pioneer projects have demonstrated that green buildings can provide a healthier, comfortable working and living environment for both their current and future occupiers (Zhou and Lowe, 2003:3).

Various terms are used to address "sustainable" in the construction industry, such as intelligent building, green building construction, sustainable design, sustainable construction, eco-friendly design, and integrated design. Theoretically, all of these terms are used to make one understand the building architecture, construction procedure, design, and use. With the environmental progress of the 1970s and also the green movement of the 1990s, sustainable construction can be understood as the broad and far-reaching cultural evolution of society's bond with the environment (Kumar and Gupta, 2014:4).

At present, actors within the construction sector in Sweden are endeavoring to develop a more effective process than hitherto available for achieving a combination of high quality, economic advantage, and sustainable construction management. The management team of a sustainable construction project should focus on the entire process from an early design stage towards the final product, on the benefits and negative impacts regarding the triple bottom lines of sustainability that are to be expected during the life of the final product, i.e., the facility. There are relatively few examples of good practices regarding sustainability in mainstream construction. It seems that clients and project managers face barriers to implementing sustainable construction. (Persson, Olander, Landin and Mats 2008:2).

It is observed that most researchers consider sustainability in their work from a different perspective in terms of the triple bottom line approach. Some researchers consider sustainable or "green", construction projects, project management, and largely present their works on the integration of financial factors and natural factors (Khodadadzadeh, 2016:22). However, research work presented on development projects considers mainly social factors (Silvius & Schipper, 2014).

Myers (2005:7) reviewed the practices of sustainability of the main construction companies in the UK based on public disclosures made by these companies and concluded that remarkably few construction companies embrace sustainability, and relatively few companies have changed their business paradigms.

2.2.1. Measures in sustainable project management

Sustainable project management can be achieved by taking appropriate measures towards it. Some procedures are identified from the literature, namely the stage-gate process (Kerzner, 2009:13), the iron triangle approaches (Papke-Shields et al., 2010:657), and Atkinson (1999:340). Kerzner (2009:17) identified the stage-gate process as one of the core elements of project management. The conventional controlling procedures were found to be less effective in the management of projects. To overcome this, the stage-gate process was developed. The stage-gate process was found to promote, help and support in implementing effective control measures. In the stage-gate, the gates represent the controlling decision points (Kerzner, 2009:25). The gates are applied to seek the go-ahead for the actions and also facilitate early detection of losses in the projects so that resources can be judiciously utilized appropriately. Another widely applied approach for the appropriate selection of measures in project management is the iron triangle (Papke-Shields et al., 2010:657; Atkinson, 1999:340). The iron triangle represents a triple constraint, namely time, quality, and cost. The stage-gate approach also gauges a project's success in terms of time, quality, uncertainty, and cost parameters (Project Management Institute, 2013:45).

The sustainability criteria must be considered while selecting the measures in the project management. The decisions in the context of projects must address sustainability at all stages of project planning, scheduling, execution, and completion. Furthermore, the decision-makers should consider the benefits for customers, society, and nature (Zainul-Abidin, 2008:85; Habibi et al., 2018:68). Aaltonen and Kujala (2010:386) mentioned that the decision-makers of projects must consider the issues of environmentalists and social workers to achieve the success of their projects. Hwang and Ng (2013:278) studied the main attributes for the decision-making aspects of green construction projects. The authors observed that the most critical and significant action to avoid and counter various potential threats and challenges of green construction projects is decision making. To take the right decisions and select appropriate measures, decision-makers should improve and strengthen their information and skills in key fields and subjects to ensure successful and sustainable projects. It becomes evident that the processes of selecting appropriate measures

or considerations for the right decision are highly significant for sustainable project management. Furthermore, it is also understood that correct decision-making is a unique attribute for any decision-maker, which should be constantly improved to achieve high efficiency and success rate in the actions taken for sustainable project management in light of the taken decisions. From the literature review, a potential research gap for the development, analysis, and application of evolutionary computing algorithms for taking optimum decisions on sustainable project management is also observed.

2.2.2. Benefits and requirements of sustainable construction.

As shown by Hwang and Tan (2010:7), green structures bring a significant number of benefits and profitable rewards compared with normal or standard structures. U.S. Life Cycle Inventory Database." (2012:14) is in contrast with the above declaration by considering energy efficiency as a benefit of green structures. He clarifies that green structures consolidate practices for lessening energy utilization. Because superior structures use less working vitality in the material frame, vitality is expected to play a much larger role and may account for up to 30% of total life cycle vitality used. When compared to strong squares and steel, building materials such as wood shake and dull top have reduced encapsulated imperativeness.

In a case study, exploration, Riesa (2006:7) claims that production improved by about 25% and vitality lessened by about 30% in a green precast concrete manufacturing facility certified by the LEED green rating system. Yudelson (2008:20) recorded 14 points of interest of green structures, among others, imperativeness and water saving, lessened upkeep cost, extended property estimation, residential development in productivity, 5% reduced nonappearance, nonetheless extra advantages recognized with comfort, hazard, attraction, and intensity. Zuo and Zhao (2014:22) carried on examination to separate the purposes of interest that ran with green structures, which standard structures don't offer. One such favored stance is that of warmth and natural pleasing. These concentrations will be talked about in terms of their purpose, which is to generate enthusiasm for the going with sections. Financial incentives: The expense endeavors are likewise associated with the enhanced building efficiency of work, for the most part, from the life cycle point of view. Appropriately, the operation cost is advanced. Green structures are prepared to save around 30% more essentialness than customary structures, and this was revealed by economists Zuo and Zhao (2014:30). On the other hand, the requested cost of not turning out to be earth-friendly is remarkable too, in the context of the carbon trade cost. The expenditure ventures for the duration of the operation; setup and repair stages will positively alter the open cost major for green building geographies. The investigation coordinated by Zuo and Zhao (2014:17) showed that low-energy houses with green structures are suitable for saving more than 55% of the energy cost when compared with ordinary structures. Notwithstanding the above opinion, the article by Kats (2003:33) assumed that the money-related favorable circumstances of green structures are more than ten times the added expense connected with constructing green structures. The money-related

focal points are fewer energy, surplus, and water expenses, bringing down regular and release costs, and fewer operating and encouraging expenses that extend productivity and prosperity.

2.2.3. Project management for construction

It is emphasized that sustainable construction and materials for construction, management of the project for construction, from the selection of materials to placement of each step of construction, and management play the major roles that could build a perfect sustainable or green building. A well-managed project is always superior in all aspects, like quality, efficiency, and stability, to an aesthetically pleasing or expensive project. A well-managed (sustainable) building also follows the rules governed by the green building council and rating systems to rate it as a green building, follows different building codes, and uses innovative ideas to build a user-friendly and environmentally friendly system, developing its concept and providing guidance for measurements which can supply recognition and validation of the enhanced level of commitment to sustainability (Kumar and Gupta, 2014:4).

According to (B. Sarath Chandra Kumar and Gupta, S. K. 2014:5,6,7), management of any construction project can be classified based on system, size, location, and availability.

But, for the construction of a sustainable building, the basic steps are:

1. The Goal and Site Analysis
2. Construction Material Selection or Analysis
3. Design and construction
4. Management of resources
5. Energy
6. Project Team and Evaluation

2.3. The key drivers of implementing sustainable construction management

To be able to identify the drivers of sustainable construction in pursuance of the aim and objectives of this study, it is relevant to understand what is meant by "drivers and barriers" and for that matter "drivers and barriers of sustainable construction" in the context of this study. Even though the concept of "drivers" is often found in sustainability, there is no firm definition for the term (Bash & Häkkinen, 2015:3). However, it is mostly and for the purposes of this study, it is meant to be the various elements that trigger, sustain, and expand the uptake and implementation of certain activities; sustainable construction practices in this case. Drivers have a positive and enabling

effect. Drivers can be categorized into the pull and push factors according to (Revell et al., 2010:43). The "pull" is usually the potential benefits to be accrued in terms of more jobs, good corporate image, retention of quality staff, and breaking into new markets, whereas the "push" is generally a reaction to regulatory demands and financial incentives.

Government efforts have a crucial role in bringing sustainability to the forefront (Chan and Lee, 2014:1218). The government not only advocates sustainability through regulations and policies such as the National Green Technology Policy (NGTP) and Chapter Six of the Eleventh Malaysia Plan, Pursuing Green Growth for Sustainability and Resilience, but also incorporates it into tax incentives and penalties. When more tax breaks and subsidies are provided by the government, this will indirectly increase the implementation of sustainable or green construction (Khalifan, 2009:223), mentioning that green materials and technologies have always been recognized as high-cost. So, it became a burden for contractors in pursuing sustainability practices. However, when appropriate financial incentives are provided to them, they will try to implement sustainable construction management in their construction process. While the UK government implemented a landfill tax and a climate change levy to encourage residents to generate less waste and use renewable energy during construction (Longden, 2009:201).

Gomes and Silva (2005:274) also found that the government rather than the market must be the driver for sustainable development because construction firms might focus on quantitative delivery without considering life-cycle assessment.

Windapo (2014:6091) revealed that the financial benefits are the main drivers of green building in the Western Cape construction industry, alongside the environmental concerns, in gaining a competitive advantage and as a new marketing tool. Government regulation also helps to drive the industry to produce more green buildings. Ahn et al. (2013:34) ranked concerns over environmental impacts such as energy conservation, improving indoor environmental quality, resource conservation, waste reduction, and water conservation as top drivers in their study. Their study also identified the external rating tools as the drivers of green building adoption as well as the increased awareness from project clients. Education and training are identified as the drivers that help to create awareness and encourage participation. Vanegas and Pearce (2000:411) revealed multiple drivers of sustainable design and construction, highlighting the current challenge of resource depletion and degradation and noticeable impacts of the building environment on human health. as the main drivers to adopt green construction to produce a greener project.

Economic incentives are also considered as one of the driving factors in promoting the sustainable movement. This is consistent with the research from Pitt, Tucker, and Chan, Qian (2009:203) which suggests that financial incentives would help to drive demand by stakeholders. Financial incentives and more stringent rules and legislation that support and encourage sustainable practice in building regulations and planning policy will provide a minimum standard of equality across the industry. Over time, this should counterbalance the "higher cost" barrier.

The study by Love et al. (2012:47) found the drivers for deciding to use sustainable technologies in Australia to be improving occupants' health and well-being, marketing strategies, reducing the environmental impact of the building, reduction in whole-life cycle costs, marketing, and landmark development, and attracting premium clients and high rental returns. Low et al. (2014:64) showed that the important drivers for greening new and existing buildings in Singapore are return on investments, local and overseas competitions, rising energy bills, corporate social responsibility, and 99 marketing/branding motives. In Greece, Manoliadis et al. (2006:117) identified the following as the most important drivers of change towards sustainable construction: energy conservation, resource conservation, and waste reduction. Several US studies have discussed the drivers of green or sustainable design and construction (Augenbroe et al., 1998:10; Augenbroe and Pearce, 1999:15; Vanegas and Pearce, 2000:14; Ahn et al., 2013:21; Mulligan et al., 2014:7). For example, Ahn et al. (2013:30) presented the major drivers as energy conservation, improving indoor environmental quality, environmental and resource conservation, waste reduction, and water conservation.

The highest rank of energy conservation in Ahn et al.'s study reinforced the finding of the earlier study by Augenbroe and Pearce (1999:13). Zhang et al. (2011a:27) discovered that building up a green reputation and good image, gaining competitive advantage, commitment to corporate social responsibility, reduction in construction costs, developing unique green products, and reducing operation and maintenance costs are important factors driving the application of green technologies in the Chinese construction industry. Serpell et al. (2013:11) highlighted the main drivers for sustainable construction in Chile as corporate image, cost reduction, and market differentiation. Edwards (2006:15) revealed that green offices in the UK increase the productivity of employees by 2-3%, due to the improved workplace environment which in turn lessens employee absenteeism. Several other previous studies have investigated the drivers for implementing GB practices and technologies in different countries, such as in South Africa (Windapo, 2014:7; Windapo and Goulding, 2015:19), Turkey (Aktas and Ozorhon, 2015:22), and India (Arif et al., 2009:31).

2.4. The level of performance of the roles of sustainable construction managers in the construction industry

Communication should thus be seen as an essential part of a project manager's efforts to manage stakeholder interests for the purpose of the project and to the impacts of the sustainability that it brings. If the project management team, through communication, can create a working dialogue, it may be easier to pinpoint the real conflicts in a project and eliminate false conflicts and misunderstandings, thus reaching acceptance for the project (De Laval 1999:31).

In developing sustainable buildings, it's important to take the process of building into account. According to Kubba (2010:20), the emphasis in green and sustainable buildings is on buildings that are compatible with the environment in which they were built, as well as buildings that are

energy efficient and use natural or domestic materials. The criteria of rating systems for sustainable buildings also show that sustainable construction focuses more on the buildings and how the sustainability requirements are achieved by improving the building systems and details. These codes consider the buildings' specifications more than their design and construction processes, especially management practices (Wu & Low, 2010:68).

Every stakeholder involved in a building process can play a role in developing the construction industry. Among the others, the key role of project managers is emphasized in supporting the long-term vision of the construction industry.

Project managers are in an exclusive position at the project level to change the industry. As well, to ensure the continued development of the industry, project managers can be drivers of change alongside their traditional role (Hills, Fox, Hon, Fong, & Skitmore, 2008:31).

Learning about project managers' role in the sustainable building process is significant because the sustainable building has more focus than conventional buildings to achieve their benefits. Project managers can specifically encourage sustainable building by integrating sustainability concepts into their practices. Some of the primary objectives of green buildings, according to Kubba (2010:25), are reducing energy consumption, protecting the ecosystem, improving the health of occupants, and increasing productivity. Considering the responsibilities of project managers, their role is noticeable in completely attaining these objectives. Because they plan, control, and monitor the process of designing and constructing buildings, they can influence energy consumption, productivity, and the protection of the ecosystem by efficiently accomplishing their tasks.

Along with the significance of project managers' role among the other stakeholders, another reason for investigating the project managers' role in the sustainable building process is the increasing consideration towards an integrated management system in sustainable building. The strategy of the sustainable building will create healthier and more energy-efficient buildings. Therefore, it is important to have their lifecycle impacts in mind when buildings are designed and operated (Kubba, 2010:30). Wu et al. (2010:12) as well emphasized a holistic solution in the whole project lifecycle, from planning to operation to building a green building. It is not sufficient to build a green building with new materials and technologies that are environmentally friendly. So, an integrated approach is vital in the green building process. Applying an integrated design approach involves having architects, engineers, land planners, building owners, and operators, along with other members of the construction industry, collaborate in designing the project (Kubba, 2010:54). This requires an effective role of project managers during the whole process of green building to facilitate collaboration among various professionals.

Many factors also influence the successful delivery of a project in addition to project management actions that are mainly taken by project managers. These factors, according to Chan et al. (2004:82), include human-related factors, project-related factors, project procedures, and the external environment. Many variables in each group affect not only each other in a group but also the other variables in the other groups. So, the role of project managers in successfully delivering a sustainable project depends on many other factors, like the size and type of the project, economic conditions, technology advanced, etc. (Chan, Scott, & Chan, 2004:102). What is more, the factors related to the organization such as top management support and project organization structure influence the success of a project manager in dealing with the challenges and consequently the success of the project (Hyväri, 2006:37). Whereas these factors do exist and have an effect on project managers' actions, the focus of this study is on the areas that project managers can influence in integrating the sustainability concept into the project. However, the other factors mayhinder their ability to play their role effectively.

In Malaysia, Zainul-Abidin (2010:13) conducted a study, based on surveys and interviews of project developers, to investigate their level of awareness and knowledge of SC practices. She found that only large developers were starting to implement SC concepts in their projects, while many others were reluctant and uncertain about applying these concepts due to a lack of knowledge and concerns about costs. Shen *et al.* (2010:27) studied 87 projects' feasibility study reports in China to evaluate their performance in terms of economic, social, and environmental attributes. They discovered that economic attributes were the most important concern in current project feasibility study practices, with much less emphasis placed on socioeconomic performance.

2.5. The challenges of sustainable construction management in the construction industry

The delivery of SC projects has met with several obstructions. William and Dair (2012:18) observed a lack of knowledge, information, and understanding as a major problem in the delivery of sustainable structures. In addition, Opoku and Ahmed (2015:10) stated that public awareness and proper knowledge and understanding of sustainability are essential to the successful promotion of SC practices. Aghimien et al. (2018a:24), Aigbavboa et al. (2017:35), Alabi (20125), Al-Sanad (2015:11), Baron and Donath (2016:4), and Nguyen et al. (2017:23) all noted sustainability awareness and knowledge related factors as some of the major factors affecting SC in Nigeria, South Africa, Kuwait, Ethiopia, and Vietnam. Thus, poor understanding of the concept of SC in its holistic form can be a major challenge towards achieving SC.

This poor understanding can lead to a misconception regarding the adoption of SC concepts, leading to high investment costs. Although some studies have claimed that the initial cost of implementing SC is high (Darko and Lowe, 2016:43), incorporating life cycle costing during the assessment of the various costs and their implications will to a large extent show the beneficial attributes of SC in the long term (Shi et al., 2013). Isa et al. (2013:7) in Malaysia and Zhang et al. (2011:15) in China identified the perceived high initial cost of SC as a major factor affecting SC

adoption. In agreement, Ametepey et al. (2015:21) and Häkkinen and Belloni (2011:243) pointed out that there is a fear of higher investment costs for SC as compared to traditional buildings. This tends to deter the use of SC materials. Aigbavboa et al. (2017:16) and Lowe and Zhou (2003:31) attributed this problem to the assumptions made by construction participants, particularly estimators, about the cost of introducing the SC concept and materials. This assumption is made without a thorough evaluation of the actual cost and whole-life cycle cost of adopting this concept. Aigbavboa et al. (2017:9) further described this assumption as a "lazy view" of construction participants, and this, according to Lowe and Zhou (2003:6), is a serious problem for the proper adoption of SC in most countries around the world.

Djokoto et al. (2014:22) observed that the cultural background within an environment can play an active role in the adoption of new ideas. In most cases, moving from the known to the unknown might prove difficult. Hence, stagnation in the existing situation may be observed as the existing state might not favor development. Aghimien et al. (2018a:14) submitted that if SC is to be achieved within the Nigerian construction industry, the industry needs to jettison the traditional method of construction for a more innovative SC approach. According to Ametepey et al. (2015:17), the construction industry has operated in a particular style for a long period, and this has made the industry rigid in terms of adopting changes, especially for construction practices and the use of building materials.

Ogunkah and Yang (2013:41) attributed this resistance to change to the preference of construction clients. This is understandable, as in most cases, the activities of the construction industry are determined by the client. Mousa (2015:26) noted that the client-driven nature of the construction industry leaves little room for the use of sustainable products. This is because clients with insufficient knowledge prematurely eliminate any alternative that is not commonly used.

A client will most likely stick to what he already knows instead of taking chances on materials he is unfamiliar with. It is based on this challenge that Oke et al. (2019:17) submitted that if SC is to improve in developing countries through the use of sustainable practices, then clients need to demand it. This challenge can be linked to the challenge of inadequate exemplar "demonstration project" as observed by Ametepey et al. (2015:29). When there is little or no existing SC project to serve as a guide, there are bound to be problems in constructing one. The need for adequate information on past SC projects is crucial to creating a roadmap for achieving SC in subsequent ones. Azman et al. (2013:25), Hatamleh et al. (2018:14), and Kissi et al. (2018:17) all noted that limited access to historical data has been a key limiting factor of SC in most developing countries.

There are other challenges in sustainable construction regarding cost-related issues, building specifications, regulations, rating systems, technology, etc. that are worth studying, but what is

focused in this study are challenges in the sustainable building process that can be met by project managers as well as their roles and responsibilities in the successful delivery of a green project.

Cox et al., (2002:6) and Du Plessis (2007:23) mentioned that several reasons may account for the failure of the implementation of strategies and guidance by stakeholders at the project level. These may be the absence of understanding, the inability of better interpretation to the decision in the integration of construction sustainability systems, and the poor relationship amongst strategies and realities on the ground.

2.6. The strategies for improving the implementation of sustainable construction management

According to Ahadzie et al. (2009:10), the construction industry adds up to every economy by providing substantial work to many who are unemployed in society. The employment opportunities offered by the construction industry are an indication that the industry is the backbone of infrastructure development in Ghana and Great Avenue is working to implement sustainable strategies to better the lives of everyone.

This shows that policies in place are not giving the necessary attention and is the same way construction development policies and principles have been ignored by all the stakeholders. These human activities have led to climate change and it continues to affect the environment. Because of this, it has affected the growth of the building industry.

However, numerous sustainable development and construction strategies have been developed, yet we are seeing very little impact from these strategies for several reasons (Milford, 2004:17). Chief among these reasons is a lack of integration with mainstream decision-making systems, few links between policy and on-the-ground realities, a very narrow base of participation, and the fact that many strategies are little more than wish lists, lacking clear priorities or achievable targets (see Bass and Dalal-Clayton, 2002:13 and Dalal-Clayton, 2003:8). Regarding geographical distribution, most projects are located in central Malaysia, such as in Kuala Lumpur and Selangor (GBI, 2016). In the recent Eleventh Malaysian Plan (11MP) 2016-2020, a few additional strategies were introduced for green growth. One such strategy aims to enhance shared responsibility through comprehensive communication, education and awareness programs, and platforms for knowledge sharing. The 11MP also focuses on strengthening governance to drive transformation through the regulatory and institutional framework. These two strategies aim to tackle the difficulties based on their experiences during the pilot implementation process (SCP Malaysia, 2015:23).

Interviewees in Williams et al. (2007:10)'s case study believed that there is not an extensive demand for sustainable buildings. Profitability will rise if the demand for sustainable building increases. As it was mentioned before, the increasing demand for sustainable buildings is related to arising end-user understanding of green buildings' benefits. But to decrease costs, Robichaud

et al. (2011:27) suggest developing strategies for containing costs during the initial phases of the project-by-project managers. One of these strategies is cost saving in the areas of lower priorities. Project managers have a role in assisting with pricing and developing cost-saving strategies in areas of lower priority (Robichaud & Anantatmula, 2011:20).

The other strategy is to establish effective communication by forming an integrated team. Robichaud et al. (2011:33) argue the benefits of effective communication to contain costs. It will be possible to maximize sustainable practices at the most efficient costs if professionals and experts in design and construction can be involved early in project design. Although making this integrated team needs more upfront investment, this extra cost is recovered by decreasing costs related to rework and later required coordination for fixing problems (Robichaud & Anantatmula,2011:3). The project managers' role regarding forming this group and coordinating its members isdiscussed in the communication and coordination part.

Del Rio Merino et al. (2010:41) also highlight the implementation of waste management strategies, the involvement of all actors in the construction process, and allocating responsibilities between construction managers, main contractors, and subcontractors to minimize the production of waste. Thus, project managers have a role in waste reduction during the construction phase. Project managers, as involved actors in the construction phase, should be aware of the possible cost savings of successfully reducing construction waste, along with the environmental impacts and the long-term national and global consequences (Del Río Merino, Gracia, & Azevedo, 2010:203).

Ofori (1998) also suggested that if sustainability in construction is achieved, there should be changes in the thinking, behavior, production, and consumption within the construction industry. These changes can be in the form of adopting strategies such as lean construction to reduce wastage, and reduction of the consumption of natural materials, and more use of recycled materials as suggested by Miyatake (1996:76).

Handling strategies for materials or components at the end of the life cycle of a building are subject of product recovery management aims at recovering the maximum possible economic as well as ecological value of a product and its components. Therefore, its objective is to reduce the amount of waste accumulated at the end of a product's life as well as to hold down the rate of the depletion of resources (Thierry et al, 1995:15).

Many industrial countries have already set national strategies for sustainable development to measure their national or regional share of global depletion of resources (Atkinson 2008:32). For the construction sector, these national strategies imply policies for sustainable buildings and sustainable construction. The policies and objectives as formulated are, from the public's perspective, directed towards the single client in the form of different kinds of incentives, e.g., taxation subsidies, direct investment subsidies, public procurement advantages, and allowance of specific investment funds (Drouet 2003:5). It could also be a matter of sector agreements on

common sustainability objectives and targets, as in the case of Sweden's construction sector (Ecocycle Council 2003:81).

According to UN-Habitat (2006:34), it was instituted that strategies and policies' implementation are well organized in providing buildings in several states to aid their citizens. But, UN-Habitat (2006:13) again stated that policy implementation is absent in certain states as an outcome of these explanations.

This section of the paper highlighted the concept of sustainable construction management, the key drivers of implementing sustainable construction management, the level of performance of the roles of sustainable construction managers in the construction industry, the challenges of sustainable construction management in the construction industry, and the appropriate strategies for improving the implementing of sustainable construction management.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 introduction

This chapter provides a systematic description of the research methodology that was used to answer questions described in chapter one of the study. This chapter deals with the procedures used for conducting this study and the methods that have been used in data collection to answer the research question to achieve the stated objectives. The chapter specifically dealt with research design, source of data, target population, sample size, sampling technique, research instrument, method of data collection, and method of data analysis and presentation.

3.2 Research design

This study was conducted through a survey research design and made use of both quantitative and qualitative models of inquiry to investigate the adoption of sustainable construction management in the Rwandan construction industry. According to Mugenda (1999:5), a combination of quantitative and qualitative methods is advantageous because they supplement each other. Quantitative methods provide hard data, whereas qualitative methods provide in-depth explanations. Therefore, the findings delivered from one method validate the other.

The focus was on the construction project located in Rwanda to assess the level of adoption of SCM in the Rwandan construction industry. This study will also rely on the information from the respondents who handled the project of road construction, residential buildings, institutional buildings, commercial buildings, and factory buildings found in Rwanda as it relates to the scope of this study.

The respondents of the study are construction professionals limited to SCM adoption, including architects, quantity surveyors, and civil engineers.

3.3 Sources of data

Both primary and secondary data were used. Primary data was obtained from structured questionnaires filled out by the respondents.

Secondary data was collected through a review of past work, journal articles, textbooks, and the internet.

3.3.1 Primary data

Primary data is obtained from structured questionnaires filled out by the respondents.

Primary data is the kind of data that is collected directly from the data source without going through any existing sources. It is mostly collected especially for a research project and may be shared publicly to be used for another research.

Primary data for this research was collected using questionnaires in Google form links sent via email and WhatsApp to the respondents.

3.3.2 Secondary data

Secondary data is the data that has been collected in the past by someone else but made available for others to use. Data that has already been originally collected and analyzed by someone else for another research purpose. The secondary data used in this research was obtained from published literature such as journals, past work, and textbooks.

3.4 Population of the study

According to Polit and Hungler (1999:37), the population as a comprehensive group of individuals, institutions, objects, and so forth, has a common characteristic that reflects the interest of a researcher. For this research, the population of the study involves engineers, architects, and quantity surveyors handling projects of road construction, residential building, factory building, commercial building, and institutional building in the Rwandan construction industry.

The total number of registered engineers in IER (Institute of Engineers Rwanda) is 801 in 2021. The total number of architects and quantity surveyors registered in RIA (Rwanda Institute of architects) is 95 architects and 62 quantity surveyors in 2021. The total population of the study is 801 engineers, 95 architects, and 62 quantity surveyors. The RIA is the institute for both the architects and the quantity surveyors in Rwanda.

3.5 Sample size

The sample size is the number of subjects that have been qualified from the population and will be used for the study. Adopt the appropriate formula for this. In most cases, there will be a sample size but, in a few cases, where the population size is small and can be covered, there will be no need for sample size.

By using the Sample Size Calculator (https://www.calculator.net/sample-size-calculator.html). The confidence level was set at 95%, and the margin of error was set at 10%. sample for 801 engineers from IER is 86, the sample for 95 architects is 49, and the sample for 62 quantity surveyors from RIA is 38.

3.6 Sampling technique

Depending on the purpose of the study, both probability sampling techniques and non-probability sampling techniques were used for gathering the same answers from a sample that they would receive from the population.

3.6.1 Probability sampling technique

Probability sampling means that every member of the population has an equal chance of being included in the sample (Hamed, 2016:20). A simple random sampling technique was used in this study by selecting respondents randomly from the whole population of this study. The respondents in the sample are selected randomly by the automated process as a representative of the whole sample.

3.6.2 non-probability sampling techniques

In non-probability sampling, not every member of the population has an equal chance of being included in the sample (Hamed, 2016:21). The purposive or judgmental sampling technique was adopted to select respondents to obtain important information. The respondents are selected based on the researcher's knowledge and judgment.

3.7 Research instrument

In this study, structured questionnaires were used as the instruments for data collection.

A questionnaire designed in the form of a Likert scale with closed and open-ended questions was directed to different respondents, which included civil engineers, architects, and Quantity Surveyors behind the sampled project.

It contains a letter requesting the respondent to fill it and two sections of questions.

Section ONE evaluates the general personal information like gender, project details, and professional details of the respondent.

Section TWO includes the following questions on the "***adoption of sustainable construction management in the Rwandan construction industry.***"

Rate the level of agreement with the drivers of sustainable construction management using:

SD – Strongly Disagree, D – Disagree, AA– Averagely Agree, A – Agree, SA – Strongly Agree

State the level of awareness of the roles of sustainable construction managers using:

NA – Not Aware, SA – Slightly Aware, AA – Averagely Aware, A – Aware, VA – Very Aware

State the level of performance of the roles of sustainable construction managers using:

NH – Not High, SH – Slightly High, AH – Averagely High, H – High, VH – Very High

Rate the significance of the following challenges of sustainable construction management using:

NS – Not Significant, SS – Slightly Significant, AS– Averagely Significant, S – Significant, VS – Very Significant

Rate the level of importance of the following solutions to the challenges of sustainable construction management using:

NI – Not Important, SI – Slightly Important, AI – Averagely Important, I – Important, VI – Very Important

Table 3. 1 Analysis of questionnaire distribution

Respondents	Number of questionnaires distributed	Number of questionnaires retrieved
Architects	49	10
Quantity surveyors	38	5
Engineers	86	28
Total	173	43

A total of 173 questionnaires were administered to obtain expert opinions. 43 were duly completed and returned representing a 24.8 percent response rate as shown in above table 3.1.

3.8 Reliability of constructs

Reliability is the measure of the internal consistency of the constructs of the study. The objective is reliable if the Alpha(α) value is greater than .70 (Hair et., 2013). Objective reliability was assessed by using Cronbach's Alpha. The results show that the level of awareness of the SCM scale with 17 items (α= .967) and the level of performance of SCM with 17 items (α= .969) were all found reliable. Similarly, the drivers of SCM with 15 items (α= .967), the challenges hindering the uptake of SCM with 23 items (α= .983), and the solution for improving the implementation of SCM with 19 items (α= .985) were also found reliable. Reliability results are summarized in Table 3.2.

Table 3. 2 Reliability statistics

OBJECTIVES	No. of items	Cronbach Alpha (α)
The drivers of SCM	15	0.967
The awareness of SCM	17	0.967
The performance of SCM	17	0.969
The challenges hindering the uptake of SCM	23	0.983
The strategies of SCM	19	0.985

3.9 Method of data collection

Data collection is the procedure of collecting, measuring, and analyzing accurate insights for research using standard, validated techniques.

According to Muhammad (2016:202), data collection is the method of obtaining and measuring information on variables of interest, in an established, systematic fashion that enables one to answer stated research questions, test hypotheses, and evaluate outcomes. There are many methods for collecting data, which include: questionnaires, interviews, observations, surveys, case studies, focus group interviews, etc. (Muhammad, 2016:208)

For this study, the data collection method used for this study is the questionnaire which is described as a series of questions and other prompts to gather information from respondents. Questionnaires prepared in Google form links were sent to WhatsApp and emails of the respondents since physical visits to their offices and sites were prohibited due to Covid-19 restrictions.

3.10 Method of data analysis and presentation

Data analysis is the process of applying statistical practices to organize, represent, describe, evaluate, and interpret data. (Ghosh,2017:2) The data analysis process helps reduce a large chunk of data into smaller fragments, which makes sense.

In this study, we used both content and narrative analysis.

Content Analysis: It is widely accepted and the most frequently employed technique for data analysis in research methodology. It can be used to analyze the documented information from text, images, and sometimes from physical items. It depends on the research questions to predict when and where to use this method.

Narrative Analysis: This method is used to analyze content gathered from various sources, such as personal interviews, field observations, and surveys. The majority of the time, stories or opinions shared by people are focused on finding answers to research questions.

In this research, the data we collected was first processed and then presented in the form of pie charts and bar charts.

Data presentation is a way of arranging information that has already been processed from previous exercises in the data analysis process to make it understandable. The presentation of data enables a researcher to organize data in a way that will allow them to analyze and interpret data (Kothari, 2004). In this study, we used pie charts, bar charts, and frequency tables in presenting the collected data. The tables were used to present a large amount of data arranged and classified in labeled rows and columns. Pie charts were also used to show the relative contribution that different categories of information contribute to an overall total. Bar charts were used to present the quantitative data from this research because they are easy to interpret and they facilitate the comparison of data as well. They are used in this research mostly to ease the comparison of data for the readers, as they are easy to understand and quick to interpret.

CHAPTER FOUR: DATA ANALYSIS, PRESENTATION, AND DISCUSSION OF FINDINGS

4.1 Introduction

This chapter presents the analysis, interpretation, and discussion of data obtained from the respondents through a structured questionnaire. The specific areas of interest covered in the study included the adoption of sustainable construction management, the challenges hindering their uptake, and the strategies that can be put in place to promote their uptake.

4.2 Data analysis

This section presents the analysis of the information of the respondents, their organizations, and data related to the study.

4.2.1 General information of respondents

Based on the calculation of the sample size for the study,173 questionnaires were administered and 43 were returned, giving a response rate of 24.8%. Table 4.1below shows that 62.8% of the Respondents were from contracting organizations while 37.2% were from consultancy organizations. In addition, 30.2% of the respondents had an advanced level, 67.4% had B.Sc., and 2.3% had M.Sc. Also, 81.4% of the respondents had 1-3 years of work experience, 18.6% had 4–6 years of work experience. This implies that most of the respondents had 1–3 years of work experience in the construction industry. Table 4.1further indicates that 76.7% of the respondents had handled 1–3 sustainable construction projects, 18.6% had handled 4–6 sustainable construction projects and 4.7% had handled 7–9 sustainable construction projects. Moreover, 44.2% of the respondents were members of RIA, 7% were members of RQSSA, 44.2% were members of IER, 2.3% were members of ROLS and 2.3% were members of PMP.

The table 4.1also indicates that 16.3% had handled road construction projects, 34.9% had handled residential building projects, 9.3% had handled factory building, 11.6% had handled commercial building and 27.9 had handled institutional buildings. This demonstrates that the respondents for the study are members of all professional organizations involved in construction and havesufficient expertise to provide meaningful information for the study.

Table 4.1: General information of respondents and firms.

Statement	Option	Frequency	Percent
Gender of the respondent	Male	34	79.1
	Female	9	20.9
	Total	**43**	**100.0**
The profession of the respondent	Architect	10	23.3
	Quantity Surveyor	5	11.6
	Construction manager	3	7.0
	Structural Engineer	2	4.7
	Civil Engineer	21	48.8
	Mechanical Engineer	2	4.7
	Total	**43**	**100.0**
Organization of the respondent	consultancy	16	37.2
	contracting	27	62.8
	Total	**43**	**100.0**
Project handled by respondent	Road Construction	7	16.3
	Residential Building	15	34.9
	Factory Building	4	9.3
	Commercial Building	5	11.6
	Institutional Building	12	27.9
	Total	**43**	**100.0**
Degree of the respondent	advanced level	13	30.2
	BSc	29	67.4
	Master Degree	1	2.3
	Total	**43**	**100.0**
Professional Qualification of the respondent	RIA	19	44.2
	RQSSA	3	7.0
	IER	19	44.2
	ROLS	1	2.3
	PMP	1	2.3
	Total	**43**	**100.0**
Experience of the respondent	1- 3 years	35	81.4
	4 – 6 years	8	18.6
	Total	**43**	**100.0**
Sustainable construction project handled by respondent	1- 3 projects	33	76.7
	4 – 6 projects	8	18.6
	7 - 9 projects	2	4.7
	Total	**43**	**100.0**

4.2.2 Level of awareness of the roles of sustainable construction managers in the construction industry.

By consultancy organization, according to the collective responses, Developing strategies for formulating an initial budget and schedule in the presence of an integrated group (3.25) and Construction management practices during the construction phase to achieve green goals (3.25) were rated as the highest level of awareness of roles sustainable construction managers in the

construction industry, followed by Feedback and documentation of the ongoing project life cycle enhancement (3.19), Providing information regarding sustainable building benefits and value added (3.13), Providing opportunities for regulatory bodies to participate in the charette (3.13), Conducting charette to establish basic communication among key stakeholders (3.06)Establishing basic communication procedures by providing useful, objective and reliable information for end users (3.00), Providing a conceptual cost estimate for review by the owner in the charette process (2.94), Providing in-time and efficient information regarding different regulations (2.88)Adjustable role between innovation and regulation (2.88), Being a role model among the project team members (2.81), Conducting planning and strategic meetings (2.75)Stimulating collaboration and communication among actors (2.75), Being acquainted with measurable targets and their evaluation tools (2.75), Organizing evaluation process for performance-based tendering and procurement (2.69), Transmission of relevant goals to the different projects without missing the concept of sustainability in major places in the process (2.69), Setting sustainable priorities and goals early in feasibility study (2.63).

By Contracting organization, Being a role model among the project team members (3.56) and Conducting planning and strategic meetings (3.56) were rated as the highest level of awareness of roles sustainable construction managers in the construction industry followed by Providing information regarding sustainable building benefits and value added (3.37), Developing strategies for formulating an initial budget and schedule in the presence of an integrated group (3.33), Providing a conceptual cost estimate for review by the owner in the charette process (3.30), Feedback and documentation of the ongoing project life cycle enhancement (3.26), Establishing basic communication procedures by providing useful, objective and reliable information for end users (3.26), Organizing evaluation process for performance-based tendering and procurement (3.26), Providing opportunities for regulatory bodies to participate in the charette (3.22), Setting sustainable priorities and goals early in feasibility study (3.22), Construction management practices during the construction phase to achieve green goals (3.15), Providing in-time and efficient information regarding different regulations (3.15), Stimulating collaboration and communication among actors (3.15), Transmission of relevant goals to the different projects without missing the concept of sustainability in major places in the process (3.15), Adjustable role between innovation and regulation (3.07), Conducting charette to establish basic communication among key stakeholders (2.93), Being acquainted with measurable targets and their evaluation tools (2.93).

Table 4.2: level of awareness of the roles of sustainable construction managers in the construction industry.

ROLES	Consultant	Rank	Contractor	Rank	Overall	Rank	Decision	Sig. (2-tailed)	Significant
Developing strategies for formulating an initial budget and schedule in the presence of an integrated group	3.25	1	3.33	4	3.30	1	Averagely Aware	0.770	NS
Providing information regarding sustainable building benefits and value added	3.13	4	3.37	3	3.28	2	Averagely Aware	0.457	NS
Being a role model among the project team members	2.81	11	3.56	1	3.28	2	Averagely Aware	0.045	S
Conducting planning and strategic meetings	2.75	12	3.56	1	3.26	4	Averagely Aware	0.028	S
Feedback and documentation of the ongoing project life cycle enhancement	3.19	3	3.26	6	3.23	5	Averagely Aware	0.813	NS
Providing opportunities for regulatory bodies to participate in the charette	3.13	4	3.22	9	3.19	6	Averagely Aware	0.769	NS
Construction management practices during the construction phase to achieve green goals	3.25	1	3.15	11	3.19	6	Averagely Aware	0.753	NS
Establishing basic communication procedures by providing useful, objective, and reliable information for end-users	3.00	7	3.26	6	3.16	8	Averagely Aware	0.475	NS
Providing a conceptual cost estimate for review by the owner in the charette process	2.94	8	3.30	5	3.16	8	Averagely Aware	0.292	NS
Organizing evaluation process for performance-based tendering and procurement	2.69	15	3.26	6	3.05	10	Averagely Aware	0.124	NS
Providing in-time and efficient information regarding different regulations	2.88	9	3.15	11	3.05	10	Averagely Aware	0.393	NS
Setting sustainable priorities and goals early in feasibility study	2.63	17	3.22	9	3.00	12	Averagely Aware	0.076	NS
Stimulating collaboration and communication among actors	2.75	12	3.15	11	3.00	12	Averagely Aware	0.232	NS
Adjustable role between innovation and regulation	2.88	9	3.07	15	3.00	12	Averagely Aware	0.569	NS
Conducting charette to establish basic communication among key stakeholders	3.06	6	2.93	16	2.98	15	Averagely Aware	0.694	NS
Transmission of relevant goals to the different projects without missing the concept of sustainability in major places in the process	2.69	15	3.15	11	2.98	15	Averagely Aware	0.214	NS
Being acquainted with measurable targets and their evaluation tools	2.75	12	2.93	16	2.86	17	Averagely Aware	0.605	NS

Notes: a. NA –Not Aware =Mean<1.50. SA – Slightly Aware = 1.50-2.49. AA – Averagely Aware = 2.50-3.49, A – Aware =3.50-4.49, VA – Very Aware =Mean>4.50. b. NS= no significant difference (p-value >0.05) S= significant difference (p value<0.05) c. Each mean score is an average derived from the statistics of each respondent; The higher the mean score, the more the role is known.

Testing of the hypothesis

Hypothesis 1

H_0= there is no significant difference in the level of awareness of the roles of sustainable construction managers by the consultants and contractors.

H_1= there is a significant difference in the level of awareness of the roles of sustainable construction managers by the consultants and contractors.

Table 4.2 presents the result of the independent-samples T-test conducted to determine the difference in the level of awareness of the roles of sustainable construction managers. From Table 4.2, the most value of sig. (2-tailed) was greater than 0.05 which shows there is no significant difference in the level of awareness of the roles of sustainable construction managers based on the type of organization except for Being a role model among the project team members and conducting planning and strategic meetings which shows it is significantly different in the level of awareness of the roles of sustainable construction managers. Therefore, the H_0 was accepted and H_1 rejected. Hence, there is no significant difference in the level of awareness of the roles of sustainable construction managers based on the type of organization

4.2.3 Level of performance of the roles of sustainable construction managers in the construction industry.

By consultancy organization, according to the collective responses, Construction management practices during the construction phase to achieve green goals (3.13) and providing in-time and efficient information regarding different regulations (3.13) were rated as the highest level of performance of roles sustainable construction managers in the construction industry, followed by Being a role model among the project team members (3.00), Providing opportunities for regulatory bodies to participate in the charette (2.94), Establishing basic communication procedures by providing useful, objective and reliable information for end-users. (2.94), Conducting charette to establish basic communication among key stakeholders (2.94), Organizing evaluation process for performance-based tendering and procurement (2.81), Feedback and documentation of the ongoing project life cycle enhancement (2.81), Developing strategies for formulating an initial budget and schedule in the presence of an integrated group (2.81), Setting sustainable priorities and goals early in feasibility study (2.75), Providing a conceptual cost estimate for review by the owner in the charette process (2.69), Transmission of relevant goals to the different projects without missing the concept of sustainability in major places in the process (2.69), Adjustable role between innovation and regulation(2.63), Providing information regarding sustainable building benefits and value-added(2.63), Stimulating collaboration and communication among actors (2.56), Being acquainted with measurable targets and their evaluation tools (2.56) and Conducting planning and strategy meetings (2.50).

Table 4.3: level of performance of the roles of sustainable construction managers in the construction industry.

PERFORMANCE	Consultant	Rank	Contractor	Rank	Overall	Rank	Decision	Sig. (2-tailed)	Significant
Construction management practices during the construction phase to achieve green goals	3.13	1	3.30	1	3.23	1	Averagely High	0.630	NS
Providing in-time and efficient information regarding different regulations	3.13	1	3.15	5	3.14	2	Averagely High	0.941	NS
Providing a conceptual cost estimate for review by the owner in the charette process	2.69	11	3.30	1	3.07	3	Averagely High	0.067	NS
Being a role model among the project team members	3.00	3	3.07	9	3.05	4	Averagely High	0.829	NS
Providing opportunities for regulatory bodies to participate in the charette	2.94	4	3.07	9	3.02	5	Averagely High	0.705	NS
Organizing evaluation process for performance-based tendering and procurement	2.81	7	3.11	7	3.00	6	Averagely High	0.401	NS
Stimulating collaboration and communication among actors	2.56	15	3.22	3	2.98	7	Averagely High	0.037	S
Feedback and documentation of the ongoing project life cycle enhancement	2.81	7	3.07	9	2.98	7	Averagely High	0.440	NS
Establishing basic communication procedures by providing useful, objective, and reliable information for end-users.	2.94	4	2.96	15	2.95	9	Averagely High	0.938	NS
Developing strategies for formulating an initial budget and schedule in the presence of an integrated group	2.81	7	3.04	13	2.95	9	Averagely High	0.448	NS
Adjustable role between innovation and regulation	2.63	13	3.15	5	2.95	9	Averagely High	0.160	NS
Providing information regarding sustainable building benefits and value added	2.63	13	3.11	7	2.93	12	Averagely High	0.110	NS
Conducting charette to establish basic communication among key stakeholders	2.94	4	2.93	17	2.93	12	Averagely High	0.973	NS
Conducting planning and strategy meetings	2.50	17	3.19	4	2.93	12	Averagely High	0.042	S
Transmission of relevant goals to the different projects without missing the concept of sustainability in major places in the process	2.69	11	3.07	9	2.93	12	Averagely High	0.280	NS
Setting sustainable priorities and goals early in feasibility study	2.75	10	2.96	15	2.88	16	Averagely High	0.508	NS
Being acquainted with measurable targets and their evaluation tools	2.56	15	3.04	13	2.86	17	Averagely High	0.201	NS

Notes: a. NH –Not** High **=Mean<1.50. SH – Slightly** High **= 1.50-2.49. AH – Averagely** High **= 2.50-3.49, H –** High **=3.50-4.49, VH – Very** High **=Mean>4.50. b. NS= no significant difference (p-value >0.05) S= significant difference (p value<0.05) c. Each mean score is an average derived from the statistics of each respondent; The higher the mean score, the more the role is Performed.

By Contracting organization, Construction management practices during the construction phase to achieve green goals (3.30) and Providing a conceptual cost estimate for review by the owner in the charette process (3.30) were rated as the highest level of performance of roles sustainable construction managers in the construction industry, followed by Stimulating collaboration and communication among actors (3.22), Conducting planning and strategy meetings (3.19), Providing in-time and efficient information regarding different regulations (3.15), Adjustable role between innovation and regulation (3.15), Organizing evaluation process for performance-based tendering and procurement (3.11), Providing information regarding sustainable building benefits and value added (3.11), Being a role model among the project team members (3.07), Providing opportunities for regulatory bodies to participate in the charette (3.07), Feedback and documentation of the ongoing project life cycle enhancement (3.07), Transmission of relevant goals to the different projects without missing the concept of sustainability in major places in the process (3.07), Developing strategies for formulating an initial budget and schedule in the presence of an integrated group (3.04), Being acquainted with measurable targets and their evaluation tools (3.04), Establishing basic communication procedures by providing useful, objective and reliable information for end users (2.96), Setting sustainable priorities and goals early in feasibility study (2.96) and Conducting charette to establish basic communication among key stakeholders (2.93).

Testing of the hypothesis

Hypothesis 2

H_0= there is no significant difference in the level of performance of the roles of sustainable construction managers by the consultants and contractors.

H_1= there is a significant difference in the level of performance of the roles of sustainable construction managers by the consultants and contractors.

Table 4.3 presents the result of the independent-samples T-test conducted to determine the difference in the level of performance of the roles of sustainable construction managers. From Table 4.3, the most value of sig. (2-tailed) was greater than 0.05 which shows there is no significant difference in the level of performance of the roles of sustainable construction managers based on the type of organization except for Stimulating collaboration and communication among actors and Conducting planning and strategy meetings which show there is a significant difference in the level of performance of the roles of sustainable construction managers. Therefore, the H_0 was accepted and H_1 rejected. Hence, there is no significant difference in the level of performance of the roles of sustainable construction managers based on the type of organization

4.2.4 Drivers for implementing sustainable construction management.

From Table 4.4 below, drivers of sustainable construction management were ranked by the consultancy and contracting organization of the respondents on a 5-point Likert scale. The collective responses were also indicated in the study.

Table 4.4: Drivers for implementing sustainable construction management.

DRIVERS	Consultant	Rank	Contractor	Rank	Overall	Rank	Decision	Sig. (2-tailed)	Significant
Creation of technologies of the future	3.31	3	3.56	1	3.47	1	Averagely Agree	0.580	NS
International pressure from Several developed countries that have increased the control of carbon footprint produced by each developing country such as India for development purpose.	3.19	8	3.56	1	3.42	2	Averagely Agree	0.387	NS
Awareness of environmental, social and economic impacts	3.44	1	3.37	5	3.40	3	Averagely Agree	0.873	NS
Risk management	3.31	3	3.41	3	3.37	4	Averagely Agree	0.805	NS
Competitive Advantage in the industry	3.44	1	3.33	7	3.37	4	Averagely Agree	0.783	NS
Energy Cost	3.13	9	3.37	5	3.28	6	Averagely Agree	0.457	NS
Government Regulation, Policies, Tax Incentives, and Penalties.	3.00	12	3.41	3	3.26	7	Averagely Agree	0.331	NS
Cost Saving on construction projects	3.31	3	3.19	11	3.23	8	Averagely Agree	0.721	NS
Client's Awareness and Demands about the advantages of implementing Sustainable Construction Management	3.31	3	3.15	13	3.21	9	Averagely Agree	0.683	NS
Level of interest from the top management	3.25	7	3.19	11	3.21	10	Averagely Agree	0.863	NS
Civil society expectations on Sustainable Construction Management	3.06	11	3.26	8	3.19	11	Averagely Agree	0.590	NS
Stakeholders' expectations on Sustainable Construction Management/ Stakeholder influence	3.13	9	3.22	9	3.19	11	Averagely Agree	0.782	NS
Tendering and procurement processes	2.88	14	3.22	9	3.09	13	Averagely Agree	0.370	NS
Organization Image and Reputation	2.94	13	3.11	14	3.05	14	Averagely Agree	0.645	NS
Process phases and scheduling of tasks	2.81	15	3.07	15	2.98	15	Averagely Agree	0.419	NS

Notes: a. SD – Strongly Disagree =Mean<1.50. D – Disagree = 1.50-2.49. AA – Averagely Agree = 2.50-3.49, A – Agree =3.50-4.49, SA – Strongly Agree =Mean>4.50. b. NS= no significant difference (p-value >0.05) S= significant difference (p value<0.05) c. Each mean score is an average derived from the statistics of each respondent; The higher the mean score, the more the Driver is agreed.

According to the collective responses, 'Creation of technologies of the future (3.47) was rated as the highest driver to implement sustainable construction management; followed by 'International pressure from Several developed countries that have increased the control of carbon footprint that produced by each developing country such as India for the development purpose. (3.42); Awareness of environmental, social, and economic impacts (3.40); Risk management (3.37); Competitive Advantage in the industry (3.37); Energy Cost (3.28); Government Regulation,

Policies, Tax Incentives, and Penalties. (3.26); Cost Saving on construction projects (3.23); Client's Awareness and Demands about the advantages of implementing Sustainable Construction Management (3.21); Level of interest from the top management (3.21); Civil society expectations on Sustainable Construction Management (3.19); Stakeholders' expectations on Sustainable Construction Management/ Stakeholder influence (3.19); Tendering and procurement processes (3.09); Organization Image and Reputation (3.05); Process phases and scheduling of tasks (2.98). This result indicates that all the drivers used to implement sustainable construction management are important with a minimum mean of 2.98.

Testing of the hypothesis

Hypothesis 3

H_0= there is no significant difference in the drivers of sustainable construction management by the consultants and contractors.

H_1= there is a significant difference in the drivers of sustainable construction management by the consultants and contractors.

Table 4.4 presents the result of the independent-samples T-test conducted to determine the difference in the drivers of sustainable construction management based on the type of organization. From Table 4.4, the most value of sig. (2-tailed) was greater than 0.05 which shows that there is no significant difference in the drivers of sustainable construction management based on the type of organization. Therefore, the H_0 was accepted and H_1 rejected. Hence, there is no significant difference in the drivers of sustainable construction management based on the type of organization.

4.2.5 challenges hindering the uptake of sustainable construction management in the construction industry

Table 4.5 below illustrates the challenges that hinder the uptake of sustainable construction management in the construction industry their assessment is based on the analysis derived from the data collected through a questionnaire survey. For consultancy organization, From the result the most dominant challenge toward sustainable construction management uptake was Lack of related legislation and government support (3.63), followed by Lack of knowledge and availability of alternative sustainable materials (3.56), Unwillingness to adopt new construction methods (3.50), Resistance to change (3.44), Lack of Public awareness (3.38), Incompetence of Contractor/Subcontractors (3.38), Absence of a Rating tool to measure Sustainable Construction Management (3.38), Poor knowledge of sustainable design (3.38), Fear of increase in construction cost (3.31), Risk of investment (3.31), Mode of funding of the project (3.31), Managing competing and conflicting targets with other business aims (3.31), Lack of strategy for promotion (3.25), Economic, physical and social environment of the educational building project (3.25), Sustainability is down/below on the board's priority list (3.25), Poor understanding of the project objectives and requirements (3.25), Poor workmanship during construction (3.19), Unrealistic

project duration (3.13), Lack of Building Codes and Regulation (3.13), Lack of database and information (3.00), Lack of a measurement tool (3.00), Poor working condition for workers in terms of safety (2.81). According to the collective responses, Poor Construction methods (2.75) were rated as the lowest challenge by the consultant that hinder the uptake of sustainable construction management.

By contracting organization, according to the collective responses, Lack of Public awareness (3.52) was rated as the highest challenge by contractor that hinder the uptake of sustainable construction management. followed by Unwillingness to adopt new construction methods (3.44), Lack of strategy for promotion (3.44), Lack of knowledge and availability of alternative sustainable materials (3.41), Economic, physical and social environment of the educational building project (3.41), Fear of increase in construction cost (3.37), Sustainability is down/below on the board's priority list (3.37), Poor Construction methods (3.37), Incompetence of Contractor/Subcontractors (3.33), Risk of investment (3.33), Unrealistic project duration (3.33), Lack of related legislation and government support (3.30), Poor understanding of the project objectives and requirements (3.30), Resistance to change (3.26), Absence of a Rating tool to measure Sustainable Construction Management (3.22), Lack of Building Codes and Regulation (3.22), Lack of database and information (3.22), Poor knowledge of sustainable design (3.19), Mode of funding of the project (3.19), Managing competing and conflicting targets with other business aims (3.19), Poor working condition for workers in terms of safety (3.19), Lack of a measurement tool (3.11), Poor workmanship during construction (3.07).

Table 4.5: challenges hindering the uptake of sustainable construction management in the construction industry.

CHALLENGES	Consultant	Rank	Contractor	Rank	Overall	Rank	Decision	Sig. (2-tailed)	Significant
Lack of knowledge and availability of alternative sustainable materials	3.56	2	3.41	4	3.47	1	Averagely Significant	0.734	NS
Unwillingness to adopt new construction methods	3.50	3	3.44	2	3.47	1	Averagely Significant	0.901	NS
Lack of Public awareness	3.38	5	3.52	1	3.47	1	Averagely Significant	0.764	NS
Lack of related legislation and government support	3.63	1	3.30	12	3.42	4	Averagely Significant	0.447	NS
Lack of strategy for promotion	3.25	13	3.44	2	3.37	5	Averagely Significant	0.657	NS
Fear of increase in construction cost	3.31	9	3.37	6	3.35	6	Averagely Significant	0.890	NS
Incompetence of Contractor/Subcontractors	3.38	5	3.33	9	3.35	6	Averagely Significant	0.926	NS
The economic, physical, and social environment of the educational building project	3.25	13	3.41	4	3.35	6	Averagely Significant	0.704	NS

Table 4.5 continued

Resistance to change	3.44	4	3.26	14	3.33	9	Averagely Significant	0.674	NS
Risk of investment	3.31	9	3.33	9	3.33	9	Averagely Significant	0.962	NS
Sustainability is down/below on the board's priority list	3.25	13	3.37	6	3.33	9	Averagely Significant	0.795	NS
Poor understanding of the project objectives and requirements	3.25	13	3.30	12	3.28	12	Averagely Significant	0.912	NS
Absence of a Rating tool to measure Sustainable Construction Management	3.38	5	3.22	15	3.28	12	Averagely Significant	0.665	NS
Unrealistic project duration	3.13	18	3.33	9	3.26	14	Averagely Significant	0.599	NS
Poor knowledge of sustainable design	3.38	5	3.19	18	3.26	15	Averagely Significant	0.680	NS
Mode of funding of the project	3.31	9	3.19	18	3.23	16	Averagely Significant	0.721	NS
Managing competing and conflicting targets with other business aims	3.31	9	3.19	18	3.23	16	Averagely Significant	0.726	NS
Lack of Building Codes and Regulation	3.13	18	3.22	15	3.19	18	Averagely Significant	0.823	NS
Poor Construction methods	2.75	23	3.37	6	3.14	19	Averagely Significant	0.110	NS
Lack of database and information	3.00	20	3.22	15	3.14	19	Averagely Significant	0.566	NS
Poor workmanship during construction	3.19	17	3.07	23	3.12	21	Averagely Significant	0.742	NS
Lack of a measurement tool	3.00	20	3.11	22	3.07	22	Averagely Significant	0.787	NS
Poor working conditions for workers in terms of safety	2.81	22	3.19	18	3.05	23	Averagely Significant	0.410	NS

Notes: a. NS –Not Significant =Mean<1.50. SS – Slightly Significant = 1.50-2.49. AS – Averagely Significant = 2.50-3.49, S – Significant =3.50-4.49, VS – Very Significant =Mean>4.50. b. NS= no significant difference (p-value >0.05) S= significant difference (p value<0.05) c. Each mean score is an average derived from the statistics of each respondent; The higher the mean score, the more the challenge is significant.

Testing of the hypothesis

Hypothesis 4

H_0= there is no significant difference in the challenges hindering the uptake of sustainable construction management by the consultants and contractors.

H_1= there is a significant difference in the challenges hindering the uptake of sustainable construction management by the consultants and contractors.

Table 4.5 presents the result of the independent-samples T-test conducted to determine the difference in the challenges hindering the uptake of sustainable construction management. From Table 4.5, all values of sig. (2-tailed) were greater than 0.05 which shows that there is no significant difference in the challenges hindering the uptake of sustainable construction management. Therefore, the H_0 was accepted and H_1 rejected. Hence, there is no significant

difference in the challenges hindering the uptake of sustainable construction management based on the type of organization

4.2.6 Appropriate strategies for improving the implementation of sustainable construction management.

Table 4.6 below illustrates the strategies for improving the implementation of sustainable construction management in the construction industry their assessment is based on the analysis derived from the data collected through a questionnaire survey.

By consultancy organization, according to the collective responses, Educating owners on the future benefits of Sustainable Construction Management (4.00) was rated as the highest strategy to implement sustainable construction management followed by Reduction and reuse of resources (3.63), Develop codes of conduct based on shared ethics (3.63) Switching to eco-friendly construction materials (3.63,) Linking research to implementers (3.63), Develop regulatory mechanisms (3.63), Reducing demolition waste materials (3.63), Strengthening implementing mechanisms (3.56), Clarification of roles and responsibilities(3.50), Engaging personnel with Sustainable Construction Management background (3.50), Understanding what drive current value systems (3.50), Insistence from client (3.50), Re-evaluating heritage and tradition (3.50), Regional centers of excellence (3.38), Using institutions as drivers (3.38), Mapping the route and landmarks of change (3.38), Corporate social responsibility reporting (3.25), Emphasizing sustainability in property development (3.19), Choosing locally-sourced resources (3.19).

By Contracting organization, Educating owners on the future benefits of Sustainable Construction Management (3.70) was rated as the highest strategy to implement sustainable construction management; followed Strengthening implementing mechanism (3.70), Reduction and reuse of resources (3.59), Emphasizing sustainability in property development (3.59), Clarification of roles and responsibilities (3.56), Engaging personnel with Sustainable Construction Management background (3.56), Develop codes of conduct based on shared ethic (3.52), Switching to eco-friendly construction materials (3.52), Linking research to implementers (3.48), Develop regulatory mechanisms (3.48), Reducing demolition waste materials (3.48), Corporate social responsibility reporting (3.44), Choosing locally-sourced resources (3.41), Understanding what drive current value systems (3.37), Insistence from client (3.37), Regional centers of excellence (3.37), Using institutions as drivers (3.33), Mapping the route and landmarks of change (3.30) and Re-evaluating heritage and tradition (3.26).

Table 4.6: Appropriate strategies for improving the implementation of sustainable construction management.

SOLUTIONS	Consultant	Rank	Contractor	Rank	Overall	Rank	Decision	Sig. (2-tailed)	Significant
Educating owners on the future benefits of Sustainable Construction Management	4.00	1	3.70	1	3.81	1	Important	0.425	NS
Strengthening implementing mechanisms	3.56	8	3.70	1	3.65	2	Important	0.733	NS
Reduction and reuse of resources	3.63	2	3.59	3	3.60	3	Important	0.932	NS
Develop codes of conduct based on shared ethics	3.63	2	3.52	7	3.56	4	Important	0.763	NS
Switching to eco-friendly construction materials	3.63	2	3.52	7	3.56	4	Important	0.801	NS
Clarification of roles and responsibilities	3.50	9	3.56	5	3.53	6	Important	0.887	NS
Linking research to implementers	3.63	2	3.48	9	3.53	6	Important	0.723	NS
Develop regulatory mechanisms	3.63	2	3.48	9	3.53	6	Important	0.750	NS
Engaging personnel with Sustainable Construction Management background	3.50	9	3.56	5	3.53	6	Important	0.884	NS
Reducing demolition waste materials	3.63	2	3.48	9	3.53	6	Important	0.700	NS
Emphasizing sustainability in property development	3.19	18	3.59	3	3.44	11	Averagely Important	0.298	NS
Understanding what drive current value systems	3.50	9	3.37	14	3.42	12	Averagely Important	0.707	NS
Insistence from client	3.50	9	3.37	14	3.42	12	Averagely Important	0.713	NS
Regional centers of excellence	3.38	14	3.37	14	3.37	14	Averagely Important	0.991	NS
Corporate social responsibility reporting	3.25	17	3.44	12	3.37	14	Averagely Important	0.571	NS
Using institutions as drivers	3.38	14	3.33	17	3.35	16	Averagely Important	0.920	NS
Re-evaluating heritage and tradition	3.50	9	3.26	19	3.35	16	Averagely Important	0.542	NS
Mapping the route and landmarks of change	3.38	14	3.30	18	3.33	18	Averagely Important	0.837	NS
Choosing locally-sourced resources	3.19	18	3.41	13	3.33	18	Averagely Important	0.571	NS

Notes: a. NI –Not Important =Mean<1.50. SI – Slightly Important = 1.50-2.49. AI – Averagely Important = 2.50-3.49, I – Important =3.50-4.49, VI – Very Important =Mean>4.50. b. NS= no significant difference (p-value >0.05) S= significant difference (p value<0.05) c. Each mean score is an average derived from the statistics of each respondent; The higher the mean score, the more the strategy is important.

Testing of the hypothesis

Hypothesis 5

H_0= there is no significant difference in the Appropriate strategies for improving the implementation of sustainable construction management by the consultants and contractors.

H_1= there is a significant difference in the Appropriate strategies for improving the implementation of sustainable construction management by the consultants and contractors.

Table 4.6 presents the result of the independent-samples T-test conducted to determine the difference in the Appropriate strategies for improving the implementation of sustainable construction management. From Table 4.6, all values of sig. (2-tailed) was greater than 0.05 which shows that there is no significant difference in the Appropriate strategies for improving the implementation of sustainable construction management.

Therefore, the H_0 was accepted and H_1 rejected. Hence, there is no significant difference in the Appropriate strategies for improving the implementation of sustainable construction management based on the type of organization.

4.2.7 Relationship between the level of awareness and level of performance of the roles of sustainable construction managers

Table 4.7 presents the result of the Correlation test statistics, conducted to determine the relationship between the level of awareness and level of performance of the roles of sustainable construction managers. From Table 4.7, the most value of sig. (2-tailed) was less than 0.05 which shows that there is a significant relationship between the level of awareness and the level of performance of the role of sustainable construction managers.

Table 4.7: Relationship between the level of awareness and level of performance of the roles of sustainable construction managers

	Performance 1	Performance 2	Performance 3	Performance 4	Performance 5	Performance 6	Performance 7	Performance 8	Performance 9	Performance 10	Performance 11	Performance 12	Performance 13	Performance 14	Performance 15	Performance 16	Performance 17
Awareness 1	0.004	0.005	0.032	0.019	0.002	0.002	0.001	0.074	0.003	0.030	0.002	0.010	0.000	0.054	0.002	0.170	0.101
Awareness 2	0.000	0.000	0.001	0.000	0.000	0.003	0.000	0.001	0.000	0.001	0.062	0.003	0.004	0.246	0.055	0.056	0.009
Awareness 3	0.001	0.003	0.002	0.003	0.000	0.000	0.000	0.012	0.001	0.017	0.000	0.001	0.000	0.014	0.001	0.065	0.069
Awareness 4	0.001	0.000	0.000	0.000	0.000	0.001	0.000	0.002	0.000	0.026	0.019	0.002	0.001	0.139	0.017	0.213	0.063
Awareness 5	0.000	0.000	0.000	0.001	0.000	0.046	0.000	0.001	0.000	0.009	0.001	0.000	0.000	0.039	0.006	0.027	0.002
Awareness 6	0.002	0.001	0.014	0.009	0.002	0.003	0.002	0.014	0.000	0.017	0.000	0.001	0.001	0.068	0.003	0.129	0.046
Awareness 7	0.012	0.007	0.000	0.044	0.003	0.010	0.000	0.060	0.001	0.038	0.012	0.007	0.013	0.051	0.012	0.093	0.048
Awareness 8	0.007	0.002	0.001	0.033	0.010	0.010	0.000	0.006	0.000	0.001	0.012	0.000	0.006	0.021	0.032	0.026	0.015
Awareness 9	0.020	0.000	0.001	0.009	0.036	0.035	0.000	0.022	0.000	0.020	0.096	0.003	0.049	0.030	0.038	0.131	0.020
Awareness 10	0.004	0.005	0.002	0.050	0.001	0.016	0.000	0.002	0.002	0.028	0.021	0.004	0.004	0.034	0.013	0.004	0.001
Awareness 11	0.003	0.002	0.005	0.011	0.001	0.007	0.000	0.006	0.000	0.008	0.007	0.001	0.001	0.054	0.017	0.011	0.005
Awareness 12	0.001	0.002	0.003	0.015	0.009	0.050	0.003	0.025	0.000	0.008	0.038	0.001	0.020	0.158	0.057	0.080	0.033
Awareness 13	0.000	0.000	0.001	0.000	0.000	0.008	0.000	0.005	0.000	0.002	0.002	0.000	0.000	0.019	0.007	0.027	0.024
Awareness 14	0.000	0.000	0.011	0.003	0.000	0.000	0.000	0.001	0.001	0.000	0.005	0.000	0.000	0.049	0.025	0.018	0.121
Awareness 15	0.001	0.002	0.000	0.002	0.000	0.011	0.000	0.000	0.000	0.007	0.003	0.000	0.000	0.020	0.004	0.015	0.001
Awareness 16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000
Awareness 17	0.000	0.001	0.000	0.001	0.002	0.017	0.000	0.000	0.000	0.001	0.003	0.000	0.005	0.003	0.037	0.001	0.000

Table 4.8: Awareness and Performance variables from Awareness 1/ Performance 1 to Awareness 17/ Performance 17.

Awareness / Performance	ROLES
Awareness 1/ Performance 1	Setting sustainable priorities and goals early in the feasibility study
Awareness 2/ Performance 2	Providing information regarding sustainable building benefits and value-added
Awareness 3 / Performance 3	Establishing basic communication procedures by providing useful, objective, and reliable information for end-users
Awareness 4/ Performance 4	Being acquainted with measurable targets and their evaluation tools
Awareness 5/ Performance 5	Conducting charette to establish basic communication among key stakeholders
Awareness 6/ Performance 6	Stimulating collaboration and communication among actors
Awareness 7/ Performance 7	Conducting planning and strategic meetings
Awareness 8/ Performance 8	Being a role model among the project team members
Awareness 9/ Performance 9	Organizing evaluation process for performance-based tendering and procurement
Awareness 10/ Performance 10	Providing a conceptual cost estimate for review by the owner in the charette process
Awareness 11/ Performance 11	Developing strategies for formulating an initial budget and schedule in the presence of an integrated group
Awareness 12/ Performance 12	The adjustable role between innovation and regulation
Awareness 13/ Performance 13	Providing on-time and efficient information regarding different regulations
Awareness 14/ Performance 14	Providing opportunities for regulatory bodies to participate in the charette
Awareness 15/ Performance 15	Transmission of relevant goals to the different projects without missing the concept of sustainability in major places in the process
Awareness 16/ Performance 16	Construction management practices during the construction phase to achieve green goals
Awareness 17/ Performance 17	Feedback and documentation of the ongoing project life cycle enhancement

Testing of the hypothesis

Hypothesis 6

H_0 = There is no significant relationship between the level of awareness and level of performance of the roles of sustainable construction managers

H_1 = There is a significant relationship between the level of awareness and the level of performance of the roles of sustainable construction managers.

Table 4.7 presents the result of the Correlation test statistics, conducted to determine the relationship between the level of awareness and level of performance of the roles of sustainable

construction managers. From Table 4.7, the most value of sig. (2-tailed) was less than 0.05 which shows that there is a significant relationship between the level of awareness and the level of performance of the role of sustainable construction managers. Therefore, the H_0 was rejected and H_1 accepted. Hence, there is a significant relationship between the level of awareness and the level of performance of the roles of sustainable construction managers.

4.3 Discussion of findings

This study investigated the level of adoption of sustainable construction management in the Rwandan construction industry to improve its implementation.

Level of awareness of the roles of sustainable construction managers in the construction industry.

The analysis of the result of the study in Table 4.2 indicates that the level of awareness of the roles of sustainable construction managers of the contracting organizations are above average compared to consultancy organization and the result shows that there is no significant difference in the level of awareness of the roles of sustainable construction managers based on the type of organization except for Being a role model among the project team members and conducting planning and strategic meetings which shows it is significantly different in the level of awareness of the roles of sustainable construction managers.

The study of Marvin Delnavaz on Project Managers' Role in Sustainable Building Process found that project managers can play a vital role in integrating sustainability into a building project during the design and construction process to deliver a successful sustainable building. Their role is significant for the sustainable building process due to the challenges that they should deal with.

Norshakila Muhamad Rawai, Mohamad Syazli Fathi, and Muhammad Abedi (2008) evaluated the potential impact of improving sustainable project management in construction industries and the findings show that there is a high potential for improving sustainability in construction projects, the effects on construction resources, and the potential impact of improving sustainable project management in construction industries.

Level of performance of the roles of sustainable construction managers in the construction industry.

In Table 4.3, The analysis of the result of the study also indicates that according to the mean scores the level of performance of the roles of sustainable construction managers of contracting organizations are above average compared to consultancy organization the result shows that there is no significant difference in the level of performance of the roles of sustainable construction managers based on the type of organization except for Stimulating collaboration and communication among actors and Conducting planning and strategy meetings which show there is significantly different in the level of performance of the roles of sustainable construction managers.

The study of Myers (2005) reviewed the practices of sustainability of the main construction companies in the UK based on public disclosures made by these companies and concluded that remarkably few construction companies embrace sustainability, and relatively few companies have changed their business paradigms.

Drivers for implementing sustainable construction management.

Table 4.4, The analysis of the results of the study indicates that all drivers investigated in this study were important for implementing sustainable construction management with construction projects as shown in Table 4.4. It also shows that the level of agreement with the drivers for contracting organizations is above average compared to the consultancy organization but below average in some cases. And the result shows that there is no significant difference in the drivers of sustainable construction management based on the type of organization.

The study of Nur Syamimi Zulkefli and Leo Yu Ling (2006) identifies what drives the organization to implement sustainable construction management in their projects, Findings from the researchers explain that the introduction series of tax incentives is the most significant driving factor for contractors to implement sustainable practices in the construction industry.

Challenges hindering the uptake of sustainable construction management in the construction industry.

Table 4.5 The analysis of the result of the study indicates that according to the mean scores, challenges hindering the uptake of sustainable construction management of the consultancy organization are above average and very significant compared to contracting organizations. the result shows that there is no significant difference in the challenges hindering the uptake of sustainable construction management.

The study of Persson, Olander, Landin, and Mats (2008), the finding of the study It seems that clients and project managers face barriers to implementing sustainable construction.

Appropriate strategies for improving the implementation of sustainable construction management.

In table 4.6 The analysis of the result of the study indicates that according to the mean scores, Appropriate strategies for improving the implementation of sustainable construction management of contracting organizations are above average and very important compared to consultancy organizations. the result shows that there is no significant difference in the Appropriate strategies for improving the implementation of sustainable construction management.

B. Sarath Chandra Kumar and Gupta, S. K. (2014) discussed the management practices for construction to make buildings as sustainable and green as possible. / Proper management in construction practice and this paper found that the task of construction of a green building is only accomplished fully when the concept of sustainability is incorporated in every step of construction practice, and the process is not limited to constructing a building with sustainable materials.

Relationship between the level of awareness and level of performance of the roles of sustainable construction managers.

Also, the correlation test statistics, as it was conducted to determine the relationship between the level of awareness and level of performance of the roles of sustainable construction managers Table 4.7 presents the result of the Correlation test statistics indicated that the most value of sig. (2-tailed) was less than 0.05 which means there is a significant relationship between the level of awareness and the level of agreement of the roles of sustainable construction manager. However, some variables have values of sig. (2-tailed) which was greater than 0.05.

CHAPTER FIVE: SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of findings, conclusion, and recommendation based on the information presented in data analysis where we focused our interest on the adoption of sustainable construction management, the challenges hindering their uptake, and the strategies that can be put in place to promote their uptake.

5.2 Summary of findings

The analysis of the result of the study indicates that the level of awareness of the roles of sustainable construction managers of the contracting organizations are above average compared to consultancy organization and the result shows that there is no significant difference in the level of awareness of the roles of sustainable construction managers based on the type of organization except for Being a role model among the project team members and conducting planning and strategic meetings which shows it is a significant difference in the level of awareness of the roles of sustainable construction managers.

The analysis of the results of the study indicates that all drivers investigated in this study were important for implementing sustainable construction management with construction projects as shown in Table 4.4. It also shows that the level of agreement with the drivers for contracting organizations is above average compared to the consultancy organization but below average in some cases.

For consultancy organizations, From the result, the most dominant challenge toward sustainable construction management uptake was Lack of related legislation and government support (3.63) and According to the collective responses, Poor Construction methods (2.75) was rated as the lowest challenge by a consultant that hinders the uptake of sustainable construction management. By contracting organization, according to the collective responses, Lack of Public awareness (3.52) was rated as the highest challenge by the contractor that hinder the uptake of sustainable construction management, and Poor workmanship during construction (3.07) was rated as the lowest challenge by the contractor to hinder the uptake of sustainable construction management.

By consultancy organization, according to the collective responses, educating owners on the future benefits of Sustainable Construction Management (4.00) was rated as the highest strategy to implement sustainable construction management, and choosing locally-sourced resources (3.19) was rated as the lowest strategy to implement sustainable construction management. By contracting organizations, educating owners on the future benefits of Sustainable Construction Management (3.70) was rated as the highest strategy to implement sustainable construction management, and Re-evaluating heritage and tradition (3.26) was rated as the lowest.

5.3 Conclusions

From the findings of this study, it is evident that between consultancy organization and contracting organization there is a significant difference in the level of awareness of the roles of sustainable construction managers and according to the mean scores, it shows that there is no significant difference in the level of performance of the roles of sustainable construction managers based on the type of organization except for stimulating collaboration and communication among actors, conducting planning and strategy meetings which shows that there is a significant difference. Also, the analysis of the results of the study indicates all the drivers investigated in this study were important for implementing sustainable construction management with construction projects and there is no significant difference in the drivers based on the type of organization. Furthermore, the analysis of the results of the study shows that there is no significant difference in the challenges hindering the uptake of sustainable construction management and there is no significant difference in the appropriate strategies for improving the implementation of sustainable construction management.

5.4 Recommendations

This study recommends that the challenges identified in the analysis of the results of the study should be worked on to boost sustainable construction management in the Rwandan construction industry by encouraging both consultancy and contractors organizations to put more effort into identified gap thus Emphasizing sustainability in property development, Choosing locally-sourced resources, Mapping the route and landmarks of change, Re-evaluating heritage and tradition for an enhancement project performance based on sustainable construction management. This is not only recommended for the Rwandan construction industry but also for academia for raising knowledge and skills-based sustainable construction management by doing more research and being familiar with it. This will lead to awareness of the roles of sustainable construction management and an increase in the level of adoption.

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