INFRASTRUCTURE ENGINEERING IN THE HOSPITALITY SECTOR IN ZIMBABWE:

The Search for Sustainable Practices

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ISBN 978-1-77934-184-6
EAN 9781779341846

Published by the Zimbabwe Ezekiel Guti University (ZEGU) Press
Stand No. 1901 Barrassie Rd,
Off Shamva Road
P.O. Box 350
Bindura, Zimbabwe

SUBSCRIPTION AND RATES
Zimbabwe Ezekiel Guti University Press Office
Stand No. 1901 Barrassie Rd,
Off Shamva Road
P.O. Box 350
Bindura, Zimbabwe
Telephone: ++263 8 677 006 136 | +263 779 279 912
E-mail: zegupress@zegu.ac.zw
http://www.zegu.ac.zw/press

DEDICATION

This dissertation is dedicated to my family and my future which to a greater extent depends on the knowledge I acquire in my academic endeavours.

ACKNOWLEDGEMENTS

My sincere gratitude goes to the Almighty God for taking me this far. I also acknowledge various mentors and people who inspire my day-to-day life and career in the hotel industry.

ABSTRACT

Revitalization and redevelopment of infrastructure has become a significant factor in the hospitality sector in Zimbabwe and beyond. The country has a mantra of 'Zimbabwe is open for business' that attracts tourists and investors from all over the world, hence, the first thing they look for is good accommodation in hotels. The hotel infrastructure is expected to meet and exceed the high standards demanded by customers, both from Zimbabwe and foreign countries. This is the major reason why hotel infrastructure is revitalized and redeveloped to be able to meet the international standards. This study aimed at developing a framework for sustainable infrastructure engineering practices in the hospitality sector: a case of Hwange Safari Lodge. The study had three main objectives that were to identify engineering practices that can be adopted in infrastructure development in the hospitality sector, to develop a framework for sustainable engineering practices in the refurbishment of infrastructure in the hospitality sector and to evaluate the proposed framework with expert validation in the engineering sector. To achieve those goals, the study gathered data from staff members mostly engineered in the hotel through interviews and also from external experts in the refurbishment of infrastructure who provided data through a Delphi study that evaluated the framework that was developed from the insight of the staff of the hotel. The study found that the major sustainable engineering practices that can be adopted in the framework are: continuous checking and fixing of faults on the infrastructure, technology adoption and the use of green equipment that preserves the environment. Further, it was also found that sustainable engineering practices will help the infrastructure to be sustainable and also meet international standards at a relatively low cost in the long run. The framework was key in helping the hotel improve its performance through being attractive and gaining competitive advantage.

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CHAPTER 1
INTRODUCTION

This study focuses on creating a framework for sustainable engineering practices in the hospitality sector and was done at Hwange Safari Lodge in Zimbabwe. The study aims at identifying the engineering practices that should be adopted in infrastructure development at Hwange Safari Lodge therefore also moving towards creating a framework that ensures the implementation of sustainable engineering practices and to evaluate the proposed framework using expert opinion. It is important to develop a sustainable engineering practices framework in the hospitality business as it helps to ensure that infrastructure is developed in a never-ending process that also helps to improve standards. Good infrastructure standards help the business to compete in the market hence also achieving sustainability or perpetuity especially international or global level. The study is of great significance to the stakeholders in the businesses in the hospitality sector is it provides factors that can be used as strategies to enhance sustainable engineering on the infrastructure in the process of renovations and revitalization. Revitalization and renovation of hotel infrastructure can be costly if not undertaken in regular intervals hence making it important to adopt sustainable engineering practices. The first chapter of the study therefore introduces the entire study through showing the problems that have triggered the study to be undertaken through the background of the study and the statement of the problem. The introductory chapter shows the study objectives. The study aims at producing a framework that can be adopted in the hospitality sector to adopt sustainable engineering practices. This outcome would help the firms in the entire sector to ensure that there is sustainable development of the infrastructure hence meeting international standards.

Across the globe, all businesses are started mainly to enhance wealth maximization. Sustainability is one of the major objectives and corporate governance principles of a business organization (Law, 2021). Sustainability entails the ability to be in existence for the foreseeable future and serve generations. In the hospitality sector, sustainability is enhanced by various practices which includes sustainable engineering practices, which have been identified as being key in fuelling the rebuilding and reshaping of the hospitality sector through maintaining and refurbishing hotel infrastructure in a continuous manner thereby ensuring quality of services (Chambers, 2021).

In developed countries such as the United States of America and China where there is greater competition and demand for hotel accommodation, sustainable engineering practices such as regular maintenance of hotel infrastructure, have been pointed out as a key factor that helps to enhance competitive advantage of firms in the sector (Paulsen, 2020; Lee, 2022). Failure to continuously maintain and develop hotel infrastructure leads to challenges such as deterioration of the infrastructure and damages therefore leading to poor performance of the hotels as customers' needs and expectations are not met (Gordon, 2020).

Post the COVID-19 pandemic, the hospitality sector in Nigeria experienced a fall in the overall performance due to neglect of the infrastructure therefore the services delivery became poor (Nwanko, 2022). Poor engineering practices in Ghana, for example at Peekay Guesthouse have been identified as a major factor that led to the temporary closure of the hospitality firm resulting from severe leakages in guests' rooms as well as electrical faults thereby threatening the sustainability of the company. Sustainable engineering practices such as continuous maintenance of infrastructure on regular intervals has been regarded as key in ensuring that the revitalization of hotel infrastructure costs effectively (Gordon, 2021).

According to Mahlangu and Coetzee (2022), it is of great importance for companies in the hospitality sector specifically those that provide accommodation such as hotels and lodges to implement sustainable engineering practices to ensure good performance. Hotels in South Africa such as Plattenberg Bay Hotel and Cape Winelands have implemented a sustainable engineering practices policy which ensures that the firms in short regular intervals carry out checks and maintenance of infrastructure to avoid repairs and further in-depth damage that threatens their viability (Mahlangu, 2022). According to Hughes (2021), it is of great importance and cost effective for businesses to enhance sustainable engineering practices such as continuous maintenance of buildings and rooms unlike waiting for serious or visible damage that may injure or cause harm to customers or staff members. In Zimbabwe, amidst and post the Covid-19 pandemic, Hwange Safari Lodge, a subsidiary of the African Sun has been facing various challenges including poor service delivery as a result of deteriorating infrastructure thereby losing significant market share to Baobab Hotel in Hwange. Recently in the year 2023, African Sun completed the first phase facelift and refurbishment of Hwange Safari Lodge, which cost the firm approximately US$4.3 million which is 45% higher than the budgeted cost (Dube, 2023). The budgeted and the actual budget for the refurbishment is shown below in Figure 1.1 below.

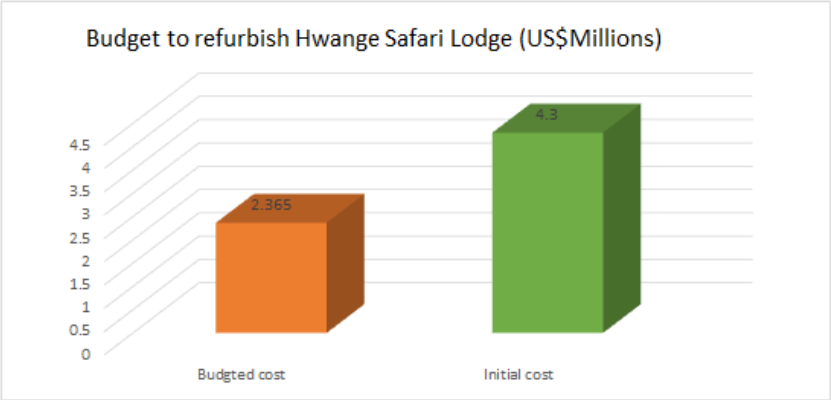

Figure 1.1: Budget to refurbish Hwange Safari Lodge (Africa Sun, 2023).

Regardless of a successful refurbishment, the inadequacy of the budget shown in figure 1.1 above was because of new problems that were discovered. These problems were because of lack of sustainable engineering practices at the lodge which eroded the profits made by the company in the year 2022 post the COVID-19 pandemic (Mandaza, 2023).

Reports have pointed out that phase one of the refurbishment of Hwange Safari Lodge took longer than expected to complete (3 months) because of new problems that were discovered thereby taking a toll on the overall plans of the firm (Africa Sun, 2023). Thus, the longer it took to complete the facelift of the hotel, the more opportunity the competitors such as Baobab Hotel had to gain market share which threatened the competitiveness of Hwange Safari Lodge. The hotel is scheduled for phase 2 of refurbishment focusing on revitalising the public area and the phase 3 which focuses on.

The major question being asked is how best can the sector adopt sustainable engineering practices in revitalising infrastructure? This study therefore seeks to come up with a framework that will be key to enhancing the adoption of sustainable engineering practices. The framework will be developed in line with Hwange Safari Lodge which is one of the largest in Zimbabwe.

The lack of sustainable engineering practices in the construction projects at Hwange Safari Lodge led to a budget of unexpected costs and expenses during the refurbishment of the infrastructure and the process also took 3 months more to be complete than expected, hence, negatively affecting the performance of the business. Due to the unexpected costs and delays, the hotel lost business to

competitors such as the Baobab Hotel in Hwange thereby losing expected revenue in the process which threatened wealth maximisation and growth of the business. The management at the Safari Lodge played a key role in requesting more funds to complete the refurbishment of the infrastructure as well as keeping afloat during the process but this took a toll on the financial position of Africa Sun and a backlash from the shareholders was also felt. It is against this background that this study will be conducted focusing on developing a framework to enhance sustainable engineering practices in revitalising infrastructure in the hospitality sector.

The study aims to develop a framework for the adoption of sustainable engineering practices in revitalising hotel infrastructure.

Study Objectives:

1. The major objective of the study is to develop a framework to enhance sustainable engineering practices in revitalising infrastructure in the hospitality sector in Zimbabwe.
2. To identify engineering practices that can be adopted in infrastructure development in the hospitality sector.
3. To develop a framework for sustainable engineering practices in the refurbishment of infrastructure in the hospitality sector.
4. To evaluate the proposed framework with expert validation in the engineering sector.

Research questions:

1. What are the engineering practices that can be adopted in infrastructure development?
2. Which framework can be developed to enhance sustainable engineering practices in infrastructure development?
3. How effective is the developed sustainable engineering practices framework as per the view of experts in the engineering field?

First and foremost, this study will play a key role in coming up with theories that will help to explain the phenomenon of sustainable engineering practices and the revitalization of the hospitality sector in Zimbabwe. This will be done through the study findings and recommendations in the Zimbabwean context that will provide facts and statements that help to explain the phenomenon for future use by other scholars or key stakeholders of the sector. Further, the study will also be important in coming up with key recommendations that can be used by relevant authorities in the hospitality industry to enhance effective planning and development of infrastructure hence also focusing on improving the overall

performance of the business and the sector at large. More so, the researcher will also benefit at large from the study because, through the research, information on sustainable engineering practices and replenishing of hotels will be acquired and will be useful now and in the future regarding decision making as the researcher is a key stakeholder in the hospitality sector of Zimbabwe.

The primary focus of this study will be on the concepts of sustainable engineering practices and revitalisation of infrastructure.

The study focuses only on Safari Lodge in Hwange, Zimbabwe and on its refurbishment of the hotel that started in the year 2022 to 2023 thereby using secondary data that is between the years 2018 and 2023. This study started in 2023 and was completed 2024.

The researcher may face challenges in attaining permission from the relevant authorities from Africa Sun and the Hwange Safari Lodge to undertake a study on their firm due to various factors such as fear of the unknown. Nonetheless, the researcher will use the letter from the university to show the purpose of the study which should help to attain permission.

The respondents in this study may not be willing to participate due to fear of being victimized but the researcher will read them the ethical considerations to show how they will be protected.

More so, the researcher may have time constraints in conducting the study which may affect its quality however proper planning and time management will be important in making sure that the research is done in a timely manner and that accurate data will be gathered and analysed.

The study will assume that all the factors that affect sustainable engineering practices and hospitality sector rebuilding and reshaping do not change during the research.

It will also be assumed that the data that will be collected from the respondents is accurate and not force or lies were used to ensure that respondents participate in the study.

Chapter One is the general introductory phase of the study and it focuses on showing the research problem and gaps through components such as the background of the study and the statement of the problem. It goes on to show

the study's objectives and questions together with the significance of the study, its scope, limitations and also assumptions.

Chapter Two is the literature review, and it highlights theoretical and empirical underpinning that explains the phenomenon understudy.

Chapter Three is the research methodology showing the strategies and methods that will be used in the study to gather and analyse data. This chapter initially discusses the research philosophy and the research design as well as including the selected research approach and data collection methods. This study employed multimethod data collection approaches including literature review, semi-structured interviews, and a Delphi study. The justifications for each selected research approach are then appropriately explained. Furthermore, this chapter also describes the data analysis process to analyze the results of each research approach. Data triangulation method was also adopted to gain richer insight as well as provide the rigour and reliable outcome. Accordingly, the ethical considerations of this research are then clarified.

Chapter four of the study is the data analysis and presentation. The chapter also describes the design of the semi-structured interviews employed in this research that involved twenty selected participants from industrial practitioners. The interviews validate the preliminary conceptual framework that has been developed from the literature studies. This chapter also provides a holistic view of local industry's perceptions and understanding of sustainable engineering practices application and infrastructure revitalization.

The Fifth Chapter of the study will be the results of the Delphi study. This chapter therefore describes the process of data collection and data analysis of the Delphi study. The data and results from the two-round Delphi survey are presented. It verifies the preliminary findings from interviews and literature. This chapter also addresses the relevant and critical items relating to the consideration factors for sustainable engineering practices application, the drivers and challenges of its implementation, the attributes that contribute to infrastructure sustainability, and its potential to facilitate future redevelopment. The reliability, stability, and accuracy of the Delphi results are also appropriately explained.

The Sixth chapter of the study presents the discussion of the results and the findings and findings from semi-structured interviews and two-round of Delphi study. The key consideration factors and the sustainability contributions of sustainable engineering practices application to revitalize infrastructure is also

discussed. The significance of sustainable engineering practices in revitalizing infrastructure in the sector will be explained.

The sustainable engineering practices application strategies for facilitating future revitalization of the infrastructure are also consolidated. Correspondingly, the overall results are represented as the "Framework for enhancing sustainable engineering practices in revitalizing infrastructure in the hospitality sector" with the aim of assisting future engineers with their decision making.

This first chapter presented the general introduction to a study on sustainable engineering practices perception study in the hospitality sector in Zimbabwe. The chapter thus showed the background of the study and the statement of the problems which shows the problem that triggered the research and also the study gaps. The chapter also presented the objectives and research questions as well as the significance of the study, its scope, limitations and assumptions. The structure of the entire study was also shown as the chapter concludes and the next chapter presents the literature review showing theoretical underpinnings and empirical review that explains the phenomenon understudy.

CHAPTER 2
REVIEW OF RELATED LITERATURE AND FRAMEWORKS

The previous chapter provided a general introduction to the research, highlighting key aspects such as the study problem, the research gap, and the study objectives. This led to the second chapter, the literature review, which presents the existing body of knowledge on sustainable engineering practices to develop a framework for enhancing these practices in Zimbabwe's hospitality sector. The chapter offers an overview of engineering practices and the concept of sustainability. It also explores literature on the sustainable development of infrastructure, the life cycle engineering of infrastructure, and the challenges faced in advancing sustainable engineering practices in the sector. The chapter concludes by identifying the knowledge gap.

In basic terms, engineering refers to a scientific field and jobs involving taking our scientific understanding of the world to use it to come up with inventions, designs and build things such as infrastructure which solves various problems and attain certain set goals. Engineering as a practice, is therefore responsible for the designing and construction of essential infrastructure in the economy such as buildings and bridges. Other researchers have pointed out that engineering is the building of things to solve problems being faced in a sector or economy for instance the building of houses or buildings.

It is engineering that leads to the designing of the buildings seen around the country as well as bridges and road networks that help the economy to grow and be sustainable (Moore, 2020). Engineering has been essential in various sectors such as in hospitality where it plays a key role in designing attractive and strong infrastructure such as hotels as well as revitalizing them to ensure they are up to the ever-changing standards (Gould, 2021).

It is the job of the engineers to ensure that they constantly design, develop, and build infrastructure that helps to meet certain targets in the country and beyond such as economic growth. Engineering comes through various practices which are defined as the process of identifying problems relating to engineering therefore coming up with solutions to solve the problems through methods such as

construction of models, science, and mathematics as well as technology (Cole, 2020).

Thus, engineering practices refer to the action that is taken to make sure that there is continuous improvement on building or infrastructure for instance continuous maintenance and checking of emanating problems (Gordon, 2019). With engineering practices, the major aim is to attain sustainability of building hence this means that the practices are used to ensure that there is immediate fixing of problems as soon as they are determined, and it is key in minimizing risks such as collapse of buildings (Moore, 2020).

One of the major or popular engineering practices is the continuous maintenance of infrastructure at regular intervals. Such a practice entails that the fitness of the building and infrastructure is continuously determined and checked to fix emanating problems before they grow or become a threat to the suitability of the business (Hughes, 2021).

Regular maintenance of infrastructure such as buildings and rooms in hotels or restaurants is key in modernising their looks and attracts key stakeholders to the business such as customers and investors. Engineers are essential in the regular maintenance of infrastructure through innovative design and implementation of certain designs on the infrastructure as well as fixing problems on the building such as rooms, elevators, stairs or escalators in buildings such as hotels and malls.
Other engineering practices include the adoption of technology in diagnosing and fixing engineering problems which has been adopted hugely in first world countries such as China, the USA, and Germany (Lee, 2018; Carter, 2020; Gomez, 2022). Through technology adoption, it is easier to discover engineering problems in infrastructure and enhance the easy design of innovations that engineers can use to revitalise or improve infrastructure for instance the use of Computer Aided Design (CAD) (Lee, 2018). Further, according to Carter (2020), the adoption of technology has helped to improve the standard of infrastructure and hotels for instance the use of air conditioners in rooms, and elevators. Gomez (2022) alludes that in most cases, technology is used as an engineering practice to diagnose defects in buildings and also design the best possible aspects that can help improve the situation at hand such as cracks in the buildings or weak trusses.

According to Law (2020), adoption of environmentally friendly equipment is key in enhancing sustainable engineering in infrastructural development. The

researcher points out that sustainability now comes from undertaking practices that do not pollute the environment in any way but that ensures that there is the preservation of natural resources. These include the use of solar power instead of fossil fuels that emits carbon into the atmosphere.

According to Danubianu (2016), sustainability means the ability to survive or exist for a foreseeable future or even for eternity through various practices or implementation of certain strategies. In business, sustainability is the existence of the firms for a long period of time to serve different generations and in accounting terms, sustainability is known as being perpetual (Gomez, 2021). In other terms, sustainability is the ability to survive in the business environment for time immemorial and be able to serve generations and generations to come. Thus, sustainability entails a going concern and means something that exists or is done repeatedly to achieve certain set targets such as improving standards (Law, 2021).

Therefore, in engineering, sustainability has various meanings such as the ability for engineering projects such as hotels or bridges to exist for a long time to serve generations and generations to come. When designing projects, sustainability is critically considered by engineers as it helps to make sure that their work stays in existence for a very long time (Demsetz & Villalonga, 2017). In the same context, sustainability also entails having behaviors or practices that are done repeatedly to solve a certain problem or meet certain targets which is also common in engineering or the revitalization of infrastructure in the hospitality sector (Paulsen, 2021).

According to Keller (2018), the concept of sustainability is common in industry and commerce where it has been used to explain the need for businesses to be able to carry out business today and be able to survive to see tomorrow and this is usually as a result of good performance in all the performance indicators of the company such as finances and the products or service as well as the efficient allocation of resources. Nonetheless, Hugh, (2018) alludes that sustainability is also been adopted in other fields such as engineering in which various practices such as continuous repairs, refurbishment and revaluation of infrastructure has been adopted in building and on bridges.

Sustainable engineering hence means the never-ending engineering practices that are put in place by engineers to ensure that buildings have ever improving standards. According to Lee (2018), sustainable engineering is more common in

infrastructure such as building in sectors which include hospitality in which the appearance of the buildings is of great importance regarding luring and retaining customers.

Several concepts of sustainable engineering have been developed across the globe in the last century and one of the well celebrated is Environmental Engineering (EE). In general, according to Moore (2021), EE has its focus on the adverse environmental effects of nature and human activities on natural resources that are essential to human survival such as fresh water supply and it also affects other key components such as waste management and sanitation amongst others (Davis & Cornwell, 2006).

Thus, EE comes along with ecosystems that are key in integrating human society with natural environment to achieve a mutual benefit (Mitsch, 2012). In all countries, they are used to carrying out tasks such as restoration of lakes, grassland and phytoremediation sites. According to Mitsch and Jorgensen (2013), EE has been used widely to design, construct, restore and manage ecosystems. The researchers point out that this is achieved mainly by the usage of 5 classes of EE design which are:

- Ecosystem utilisation to reduce pollution problems
- Ecosystem imitation to resolve a source problem which may be burning of fossil fuels,
- Ecosystem recovery for instance land restoration,
- Ecosystem ecological modification such as selective plant harvesting
- Balanced use of ecosystems, such as sustainable agricultural systems.

It is also pointed out by Weizsäcker *et al.* (2016) that EE is adopted in environments to reduce the pollution, and waste in organisations. It was developed by researchers, policy makers, and practitioners from many countries. On the other hand, there is also Industrial Ecology (IE) which is about shifting processes from open loop systems to the closed loop system. IE has its primary focus on imitation since natural systems do not produce waste so it works with "industrial metabolism" as well as life cycle planning and eco-industrial parks to imitate the natural systems (Mulder, 2020). It is key to note that both EI and EE are environmentally oriented, but lack the social component of sustainability.

The hierarchy of sustainability is key in showing the key components that enhance sustainable engineering in organizations and Figure 2.1 below provides a diagrammatical illustration of the hierarchy.

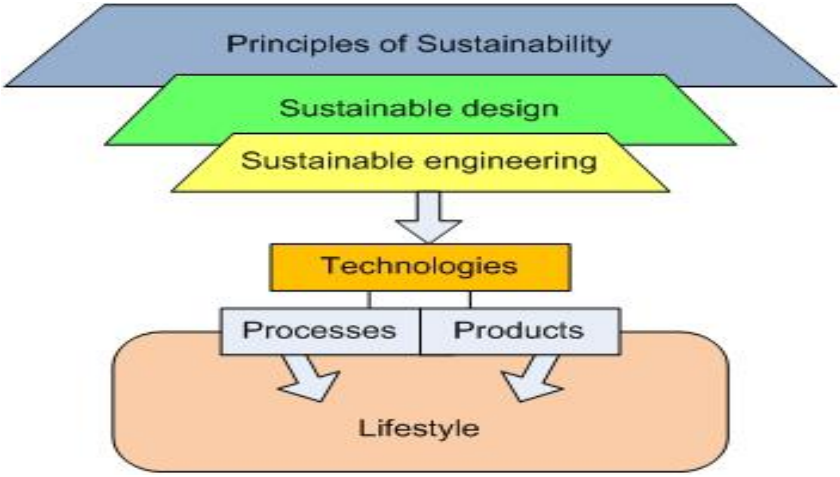

Figure 2.1: Hierarchy of sustainability.

As shown in Figure 2.1 above, the Principles of Sustainability are at the top of the hierarchy which shows that it is key to achieving sustainability in engineering. To achieve that, there is a need to have Sustainable Design, the process of thinking. The following stage, Sustainable Engineering deals with the technical implementation of ideas or innovations that are developed or designed by the engineers. The design and engineering stages therefore work hand in hand to influence the Technologies to be used for example in construction or in revitalising infrastructure, which provide the Processes and Products. It is a portal through which the established principles of sustainable design and engineering affect people's lifestyles creating changes in society. Because of people's strong dependence on multiple technologies, these become the factors that can facilitate change in society and can even become tools of manipulation and initiation of global trends (Eli, 2018).

As the world continues to evolve in many aspects day by day, engineers have developed many approaches to engineering systems development. Most of the modern design approaches have a number of similarities with a few differences that get rid of setbacks of the earlier ones and to put in novel knowledge and

developments in the field (Gericke & Blessing, 2012). The following are some of the modern design approaches which are key in solving longstanding African infrastructure problems;

According to Hines (2020) Concurrent Engineering (CE) as an engineering management philosophy comes along with a set of operating principles guiding a product development process by means of quick successful completion. This means that it is an effective method used to manage the development of complex systems that are used in societies and organisations, but it requires a set of tools and procedures in order to operationalise its concepts. It promotes the integration of downstream concerns into the upstream phases of a development process (INCOSE, 2014).

According to INCOSE (2014), System Engineering is an interdisciplinary approach used in the realization of successful systems that aims at satisfying stakeholder's needs in a high quality, trustworthy, cost efficient, and schedule compliant manner throughout a system's entire life cycle. It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, and then proceeding with design synthesis and system validation while considering the complete problem.

Lifecycle Engineering refers to the consideration of the entire lifecycle of a system right from the point of conception of the idea to the end-of-life management of the system. The necessity for Lifecycle Engineering of a system arose from the realisation that a new industrial culture has to be developed (Alting & Jorgensen, 2013). The new industrial culture must drastically reduce the amount of waste generated, reduce environmental damage and occupational health damages. Furthermore, the new industrial culture would need to increasingly.

A theory refers to the statements and facts that emerge from a study and are used to explain or predict a certain phenomenon (Kumar, 2014). Theories are key in showing that the study is not coming from nowhere but has a theoretical underpinning that guides it. Therefore, a theoretical framework in research refers to the adoption of a certain theory or theories that are closely related to the phenomenon understudy and help to explain the current study. In this study, Dissiter's Law of Fives Theory was adopted to provide the theoretical guidance to the study.

According to Dissiter's Law of Fives, neglecting maintenance and repairs when they are essential will generally equal five times the maintenance cost. Thus, when the organization forgoes maintenance of the building at regular intervals, it will

end up repairing the building at a cost that is five times more than what it could have incurred if it had maintained the buildings on regular intervals through sustainable engineering practices (Moore, 2020).

The Law of Fives explains that it is cheaper to maintain infrastructure, for instance, in the hospitality sector if the maintenance is done on regular intervals to make sure that any damages are fixed before they get out of hand (Gordon, 2021). Fixing damages in the early stages or as soon as they are discovered is important in making sure that the repairs are done cheaper than when the damages have affected other parts of the infrastructure or the business which is costly and affects sustainability.

Further, it was pointed out that through Dissiter's Laws of Five, refurbishing or repairing infrastructure such as hotels and restaurants on regular intervals for instance annually helps the authorities to make sure the damages on the building or infrastructure does not worsen which is a threat to the perpetuity of the business (Borris, 2022). The theory helps to explain that lack of infrastructure repairment in the hospitality sector on regular intervals means that businesses such as hotels face a huge threat of high costs when they decide to improve the infrastructure and, in some cases, this affects the performance of the businesses in aspects such as profitability and market share.

The costs that come from failure to revitalize infrastructure in the hospitality sector on regular intervals do not just concern financial costs but also losing business as the standards of the hotel fall as compared to the competition. In that manner, research has also pointed out that getting or luring new customers is 3 times costly than retaining already existing customers (Kottler, 2017) hence, it is important to make sure that hotel standards are kept high through sustainable engineering that enhances sustainability in the performance of the hotels.

Therefore, Disitter's Law of Five theory plays a major role in this study in showing the consequences of not maintaining hotel infrastructure as it will cost more during repairs that are part of the refurbishing of the infrastructure. Further, it shows that the costs do not include money that is lost when fixing a greater problem but also the cost of losing and luring customers to the business through aggressive marketing strategies. These costs have a negative effect on the sustainability of the business as they eat through the profit and hinders investors from coming into the firm.

Life-cycle Engineering (LCE) is a decision-making methodology that considers environmental, performance and cost requirements in the entire duration of an infrastructure. It is centred on the design and production of products with minimal environmental impact during their entire life cycle (Stuart & Sommerville, 1998). Therefore, it has all its support on a more balanced view of investment considering construction, development, and revitalisation issues. Thus, LCE is crucial in infrastructural development because design decisions made early in the design process can have multiple impacts on life-cycle metrics for instance costs and time (Borg *et al.*, 2020). According to Asiedu and Gu (1998), decisions made by designers at the design phase influence between almost 80% of the total costs. Therefore, the interest in sustainable development has influenced various original equipment manufacturers to scrutinize the manner they deal with the cost and environmental issues (Glazebrook *et al.*, 2000). Some of the approaches state that there is need to reduce the adoption of non-renewable resources and toxic releases into the environment (Rivera-Becerra & Lin 1999).

The primary reason that maintenance is deferred is because there is unavailability of the money or funds to finance it. That is, if budget planning does not allocate enough money for maintenance of infrastructure then an increase in deferred maintenance is inevitable (Cole, 2020). Additionally, if allocated funding is the used for emergencies in the business and more visible projects then the risk of equipment failure and building deterioration increases. Inadequate funding of regular maintenance has also occurred in part because the segments redirected funds budgeted by the state for routine maintenance to other activities (AO, 2016).

Although some public systems of higher education and individual institutions have addressed this problem aggressively in recent years, many struggle with identifying their needs and presenting a persuasive as well as a credible argument for the financial support necessary to restore deteriorating or remedy unsafe conditions (Kaiser, 2004). The facilities manager must understand the corporate goals of an organization, the interaction and relative importance of the social, political, and economic forces that affect those goals.

Obvious examples of the consequences of this lack of understanding include expenditure on maintenance of buildings that are to be rendered obsolete in the strategic plan (Worthing, 2020). Another challenge faced in applying sustainable engineering practices is inadequate Projects Preparation and project planning

(LAO, 2016). It is key to be proactive and come up with the future in enhancing or implementing engineering practices such as continuous maintenance of infrastructure. It has been discovered in studies that some engineers are not future oriented and do not plan on their job or instill certain practices before the problem arises (Morris, 2020). This means that the engineers do not embrace innovation and therefore are not able to put in place practices such as technology adoption and also continuous maintenance of buildings or infrastructure. Engineers are builders and problem-solvers who play crucial roles in industry and society. As such, engineering education provides an excellent platform for imparting additional skills that can address contemporary challenges worldwide. Multi and interdisciplinary approaches are necessary to address these complex social, economic, and technological challenges.

These approaches can effectively complement the result-oriented analytical approach to problem solving that engineers receive as an integral part of their rigorous training. There also exists a clear trend toward multidisciplinary education in all fields of engineering; de Graaff and Ravesteijn (2001) describe the crucial need for the "complete engineer," an individual who not only has technical scientific skills, but also has an understanding of the interplay between technology and society, organisational and management skills, as well as social and communications skills.

Engineers, for example, often select materials for infrastructure or other processes. Infrastructure is highly important, as it is needed by humans to live in urban settings, shelter them from environmental risks, and protect the environment from wastes. Some materials such as minerals are not renewable and may be depleted eventually. Others such as wood are considered renewable. Other materials for construction such as concrete contain a wide variety of materials. Thus, the choice of materials can have significant impacts on resources. Past practices are not sufficient for the changing world. Engineers provide solutions to problems in the real world. However, there are many constraints for engineers as the world is becoming more and more complex. New technologies are being developed. Numerous sciences including biological and social sciences must be considered by engineers.

Engineers must work with people of various cultures and within many different regulations. Different cultures prioritize aspects differently, for example, such as access to clean water over considerations of climate change. Environmental

standards may not be stringent in the developing country so higher than local standards must be applied or practices or materials modified for local conditions. The World Federation of Engineering Organisations (WFEO) has developed the Model Code of Ethics and the Model Code of Practice for Adaption to Climate Change (WFEO, 2015). The purpose of these codes is to ensure that ethics based on universal values are practised but modified to local conditions. Engineers must be able to understand the implications of their work in social, economic, and environmental contexts. Budgets and business plans have always impacted engineering projects. More recently, energy efficiency and reduced environmental impact have been incorporated into design. Tools have been developed to assist in this process such as sustainability and life cycle assessments that will be discussed later.

Indicators for social and cultural impacts are more difficult to assess quantitatively and are subject to viewpoint. For example, a mining company might see the project as beneficial to the community for employment. However, the local community might view that the project is negatively impacting their cultural values or land. Allenby (2012) has suggested that engineers should be able to identify potential social and cultural issues of a project or process, enable communication to address concerns, reduce impacts as much as possible, and communicate the changes to the concerned groups before finalizing the work plan. Therefore, engineers now have to think beyond the traditional aspects that engineers have been used to. Many things have impacted the natural environment. Safe service and cost effectiveness have been the main drivers for engineering design without the concern for material or energy reduction.

Technologies are more complicated, and solutions are thus more complex. Engineers have to now think about environmental and social systems over the whole life of a project. Environmental, social, and economic concerns must all be balanced while meeting technical demands. These are the challenges and responsibilities of the present and future engineers, particularly in light of global warming. Reduction in greenhouse gas emissions is essential for slowing climate change. Ainger and Fenner (2014) showed that more natural flood defence schemes such as natural wetlands are now being considered more frequently, as they are less expensive, can increase carbon sequestration, and mitigate urban heat-island effects. The American Society of Civil Engineers (ASCE) has recently developed three policies to reflect the new issues of climate change adaptation and mitigation and sustainable development. One of the policies indicated "the need for social equity in the consumption of resources." In addition, engineers "must actively promote and participate in multidisciplinary teams with other

professionals, such as ecologists, economists, sociologists and work with the communities served and affected to effectively address the issues and challenges of sustainable development." In their problem-solving, engineers must use the most appropriate measures to achieve sustainability for society.

Yong et al. (2014) showed that to understand the degradation of the environment, knowledge of the impacts of humans on the environment is required. Some of the issues can be summarized as pollution of (a) water, (b) atmosphere, and (c) land.

- Loss and degradation of soil quality due to the use of pesticides, insecticides, fertilizers, and other soil amendments
- Increased use of natural resources by mining and forestry activities and energy production
- Increased greenhouse gas and other emissions, leading to acid rain and climate change that increases severe weather occurrences, water levels, and erosion of coastal areas among other effects.
- Biological magnification of pollutants by plants, aquatic organisms, and animals

In addition, Yong et al. (2014) also indicated that sustainability principles require the classification of resources as renewable and non-renewable. Renewable natural resources, however, can become non-renewable, if they are used at rates higher than they can be replaced and hence this is not sustainable.

The frameworks related to engineering and development of infrastructure are not novel to the academic body of knowledge as they have been put through across the globe in various sectors. Sushilawati (2018) took a similar study on developing a framework for sustainable industrialised building systems (IBS) for infrastructure projects in Malaysia. The study made use of a preliminary conceptual framework which it developed based on a systematic literature review and gathered data using semi-structured interviews involving 20 participants to have an insightful opinion from construction practitioners and to determine their view on IBS application in the construction industry. Further, a two round Delphi study was undertaken, and it involved 13 experienced and knowledgeable panellists and it was aimed at identifying, verifying, and prioritising the factors developed from the literature review and interview findings. The major findings of the study were that there are four categories of important elements to be considered for implementing IBS in infrastructure projects: design requirements, policy, project characteristics, and industrial readiness.

The study found that the integration of IBS attributes and performance were found to correspond well with the three pillars of sustainability principles: economic, social, and environment. Furthermore, the study results showed that optimisation of IBS application through its capacity of changeability and adaptability can facilitate redevelopment works. Therefore, the results of the study were key in the development of a framework for sustainable IBS application for an infrastructure project that incorporates future redevelopment considerations to enhance the sustainability of infrastructure projects. On the other hand, in South Africa, a similar study was undertaken by Sekhota (2019) on developing a framework for innovation adoption in the development of infrastructure in the public sector in the country.

The aim of the study was to enhance the development of infrastructure through innovative and technological approaches. This was crucial for meeting international standards, while also improving the standards of living for the general population in the country. The study also gathered data through interviews with experts from various related fields, including engineers, environmental agencies, and government representatives. This provided rich data that helped answer the study's key questions. The study findings revealed that ensuring innovation in infrastructure development requires embracing change and being proactive in developing infrastructure that serves future generations. It was found that there should be collaborations amongst different parties to foster idea generation and sharing hence making sure that innovation is adopted in developing public sector infrastructure in South Africa.

In Kenya, a framework was developed by Mugebi (2021) on the sustainable revitalization of infrastructure in the hospitality sector. The primary aim of the study was to guide the modification of hotels in the country. The goal was to ensure these hotels meet international standards and effectively serve the 'Visit Rwanda' initiative, which seeks to attract more tourists and investors to the country. The study findings showed that there is need to be innovative and invest in regular revitalization of the hotel infrastructure, put in modern features and be able to attract foreign and local customers.

The above literature reviewed in this chapter helped to explain the phenomenon of sustainable engineering practices. The literature above was in line with various studies and frameworks from many other countries in the world including the United States of America, the United Kingdom, South Africa and Germany

amongst others. The literature however did not mention anything from Zimbabwe let alone in the hospitality sector pertaining to coming up with a framework that helps to enhance the adoption of sustainable engineering practices in the hospitality sector which is a gap that this study sought to explore in the context of Hwange Safari Lodge.

This second chapter of the study was the literature review, and it presented the already existing body of knowledge pertaining to sustainable engineering practices. This was aimed at coming up with a framework to enhance the practices in the hospitality sector in Zimbabwe. The chapter provided an overview of engineering practices and the concept of sustainability. It also provided literature on the sustainable development of infrastructure, life cycle engineering of infrastructure and the challenges faced in enhancing sustainable engineering practices in the sector. The chapter concludes with a knowledge gap. The next chapter is the research methodology.

CHAPTER 3
RESEARCH METHODOLOGY

In the previous chapter, the study presented the literature review which showed the existing data that explains sustainable engineering practices. This paved the way for this third chapter of the study, which is the research methodology, it shows how the study seeks to gather and analyse data that can help build a framework to enhance the engineering practices in the hospitality sector in Zimbabwe. In this chapter, the study is shown to have adopted a mixed methods approach to achieve its objectives. This involved conducting interviews with experts in the engineering subject sector as well as a Delphi study with experienced practitioners in Zimbabwe. Both primary and secondary data were analyzed to establish the application of sustainable engineering practices.

A research philosophy refers to the worldview of the researcher when undertaking a certain study and it plays a key role in assisting the researcher to identify suitable approaches that will be used for the research to collect and a analyse data by understanding the basic ideas of research nature (Mugenda, 2019). According to Creswell (2014), there are four main research philosophies that can be adopted in a study, and these are shown below in Figure 3.1 below.

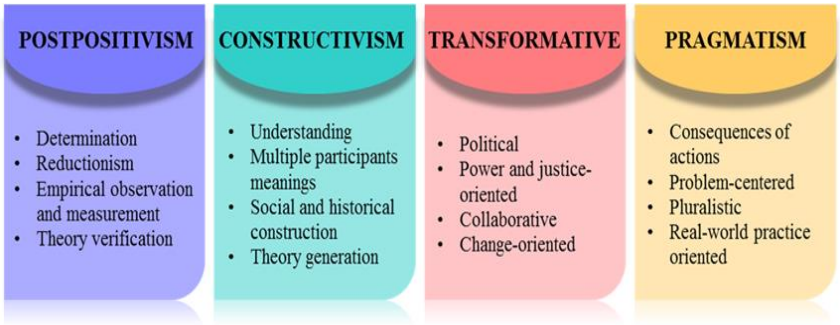

Figure 3.1: Research philosophies (*Creswell, 2014).*

As shown in the above figure 3.1, post-positivism is a philosophy that is used to identify and assess the factors that affect results. This philosophy adopts existing theories to develop hypotheses in the study therefore it is ideal to use in a purely quantitative study that seeks to measure relationships between variables (Saunders *et al.*, 2009). On the other hand, constructivism or interpretivism is opposing to

post-positivism as it supports qualitative aspect of the study and it relies as much as possible on participants' point of views (Creswell, 2014). It overrules the post-positivism assumption that structural laws and theories do not fit marginalized individuals in society (Creswell, 2014). The pragmatism philosophy might work well to deal with variation in the research questions (Saunders *et al.*, 2009). The application of qualitative and quantitative methods is combined to find a solution for the research problems caused by actions, situations, and consequences (Creswell, 2014). This paradigm, which concentrates more on research problems, prefers to adopt multiple approaches to determine the best practicable solution. For this study, the aim was to come up with a framework that enhances sustainable engineering practices in the hospitality sector and therefore a constructivist paradigm was deemed the most applicable approach to this study, as the focus of this research is to discover and understand the grounds of a concept, and to delve into the concept in comprehensive detail.

A research design according to Saunders (2017) is a roadmap of the study which shows where it is coming from and where it is heading. Research design is therefore a logical and concise procedure that drives a specific research direction through putting in place the appropriate research inquiries among research approaches. It is important in a study to primarily demonstrate the strategies and approaches that will be adopted to make sure that it is sound and feasible to be carried out (Marshall & Rossman, 2016).

The researcher recognised the overall strategy for this research, which coordinated the research questions, research objectives, and expected research outcomes with the data collection and analysis methods. This research is qualitatively designed, as it focuses on a single concept of phenomena that deals with in-depth investigation through theoretical and philosophical reviews. Thus, a qualitative design is adopted.

Qualitative design research adopted in this study was based on constructivist perspectives and it seeks to gain a better understanding by investigating what is occurring in the problem nature (Maxwell, 2013). Researchers have found qualitative data to work best for research that aims to discover, to explore a new area, and to develop hypotheses (Ogula, 2015). Therefore, the design of qualitative research should be reflective and flexible throughout the research process, and it should also be ready to modify the data collection and analysis activities and the developed theory, as well as the research questions, as these

may affect and be affected by one another. Creswell (2014) points out that the initial research plan cannot be tightly prescribed but the key issue is to focus on the participants and not the researcher's thoughts and the literature. The research design should not be rigid but flexible, as on-going research input may lead the flow of the research over time.

According to Maxwell (2009) in his interactive model of research design states that research design is based on the coherency among five components (goals, conceptual framework, research questions, methods, and validity) without strictly fixing and directional sing the sequence order (see figure 3.2). This interactive design is systematically conceptualised, in that every element has multiple connections among them instead of being in linear or cyclic form. However, Fellow and Liu (2008) also mentioned that in addition to the research questions and constraints, other factors, such as measurement instruments, reliability, and validity requirements, must also be considered in order to underpin the selection of approaches and strategies.

Figure 3.2: Interactive model of research design *(Maxwell, 2009).*

A qualitative approach can make use of various types of inquiry strategies, such as narratives, phenomenologist, ethnographers, grounded theory studies, or case studies (Creswell, 2014). According to Saunders *et al.* (2009), the selection of applicable strategies should be based on the research questions and objectives as well as the topic understudy. In this study, the researcher used the adaptive theory that used a combination of pre-existing theory and theories emerging from data analysis in the research process.

This means that this research not only explores but also explains what is going on with regards to sustainable engineering practices. The study employed a multi-method qualitative approach, utilizing various data collection methods such as semi-structured interviews and a Delphi study. A detailed discussion of the data collection and analysis procedures is presented in the following section. On the first objective, the study sought to understand the major sustainable engineering practices that can be adopted in the framework. The objective also sought to identify the contribution of sustainable engineering practices in enhancing infrastructure sustainability. Further, the potential of sustainability in facilitating the redevelopment of infrastructure in the hospitality sector.

In summary, the overall research approach can be visualized using the "research onion" framework adapted from Saunders *et al.* (2009), as shown in Figure 3.3 below:

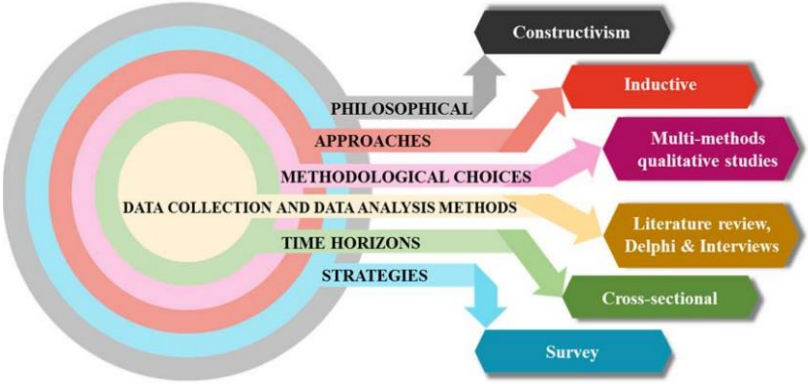

Figure 3.3: Overall research approach *(Saunders et al., 2009).*

The research process of this study was divided into two phases: the first being collecting data from the staff members in the hotel with regards to the sustainable engineering practices that are adopted in revitalizing or renovating hotel infrastructure. Further, a Delphi study was then undertaken to further identify, validate, and priorities relevant factors recognized during the interviews until a reliable consensus was achieved. The findings from the interviews, and Delphi study were triangulated to integrate the in-depth understanding, related issues, solutions, and recommendations.

Data collection is regarded as one of the major phases in research studies and it involves collecting and assembling information (Mugenda, 2019). Data comes in various forms, such as:

Fellow and Liu (2008) point out that data collection is a chain of communication that is between the respondent or the provider of data and the researcher who is the collector of data. There are two types of communication in data collection: either one-way or two-way communication. One-way communication requires either acceptance or rejection of the data that is provided. On the other hand, two-way communication allows for feedback from the provider to gather more information. It is important to show what types of data are to be collected before deciding on a data collection mechanism. Qualitative studies require considerable amount of time for assembling multiple types of research data. Observations, interviews, document archival, and audio-video recordings have been conducted to accumulate qualitative data. Each mechanism has its own advantages and limitations, as shown in Table 3.1 below.

Table 3.1: Qualitative data collection: Advantages and limitations *(Fellow & Liu, 2008)*

Data Collection Mechanism	Advantages	Limitations
Observations	• Researcher has a firsthand experience with the participant. • Researcher can record information as it occurs. • Unusual aspects can be noticed during observation. • Useful in exploring topics that may be uncomfortable for participants to discuss.	• Researcher may be seen as intrusive. • Private information may be observed that researcher cannot report. • Researcher may lack good attending and observing skills. • Certain participants may present special problems in gaining rapport.
Interviews	• Useful when participants cannot be directly observed. • Participants can provide historical information. • Allows the researcher to have control over the line of questioning.	• Provides indirect information filtered through the views of interviewees. • Provides information in a designated place rather than the natural field setting. • Researcher's presence may bias responses. • Not all people are equally articulate and perceptive.
Documents	• Enables a researcher to obtain the language and words of participants. • Can be assessed at a time convenient to researcher – an unobtrusive source of information. • Represents data to which participants have given attention. • As written evidence, it saves the researcher the time and expense of transcribing.	• Not all people are equally articulate and perceptive. • May be protected information unavailable to public or private access. • Requires the researcher to search out the information in hard-to-find places. • Requires transcribing or optically scanning for computer entry. • Materials may be incomplete. • The documents may not be authentic or accurate.
Audio-Visual Materials	• May be an unobstructive method for collecting data. • Provides an opportunity for participants to directly share their reality. • It is creative, in that it captures attention visually.	• May be difficult to interpret. • May not be accessible publicly or privately. • The presence of an observer may be disruptive and affect responses.

Therefore, qualitative researchers have alluded three main purposes for this type of research which are: to explore, to explain, or to describe (Marshall & Rossman, 2016). This study adopted an exploratory nature and made us of defined theories and applies them in a research context. The selection of an appropriate data collection mechanism depends on the types of information required to

answer the research questions. Robson (2002) provided simple rules to choose the method based on what the researcher is looking for, and these are presented.

According to Burns and Groove (2015) as target population refers to a certain large group of people known as who can provide primary data to a study mainly based on their involvement or relation to the subject matter under study. It is ideal to only select a target population that can provide accurate data that helps to attain clear results on the phenomenon understudy. In this study, the major aim was to come up with a framework that helps to enhance attaining accurate results. For this study, the target population was selected due to their knowledge, involvement and experience in the subject of engineering specifically in revitalizing or renovating infrastructure in the hospitality sector. These include internal stakeholders from the Hwange Safari Lodge specifically: the maintenance department which consists of engineers, welders, electricians and management. The target also includes external stakeholders who will participate in the Delphi method phase of the study specifically from the Environmental Management Agency (EMA) and engineers in various fields such as civil engineers, electrical engineers and structural engineers. In this study, the target population was made up of 40 elements divided as shown in the below Table 3.2

Table 3.2: Target population *(Field work, 2024)*

Description	**Target population**
Staff at Hwange Safari Lodge	30
Experts	10
Total	**40**

As shown above, the study participants will be dominated by the internal stakeholders of the hotel mainly because they are involved and responsible in the revitalization and maintenance of the infrastructure. These were made up of:

Sampling refers to the process adopted to minimize the size of the target population which may be hard to gather data from since the elements may be geographically dispersed or there may be a time limit in gathering data or the researcher may suffer from fatigue (Mugenda, 2019). Therefore, it is ideal to come up with a sample size that is big enough to represent the entire target population and it should involve all the elements of the population. This plays a key role in

making sure the results attained can be generalized to the entire population. For this qualitative study, the sample size will be determined by the point of saturation when gathering data from the population. The point of saturation works mostly when gathering data using interviews and it states that when a certain number of respondents says the same or similar responses to a certain question successively, the researcher can conclude the response to be representative of the entire population. In this study, the point of saturation was 10 elements.

Sampling technique are the methods used in a study by the researcher to select elements of the study (Kumar, 2014). There are two main forms of sampling techniques: probability sampling which entails the researcher using randomness to select elements and it work well in a quantitative study. Probability sampling adopts various methods such as simple random sampling and stratified random sampling. There is also non-probability sampling in which the researcher uses their own judgement to select the elements and work well in qualitative study. It also comes in various methods such as snowball sampling and judgmental sampling which was adopted in this study. Judgmental sampling entails the researcher selecting elements who are in the right occupation to answer the research question based on their own profession or expertise (Zickmund, 2013). In this study, the method was used to select staff members in the hotel who were directly involved in its maintenance or renovations. It was also used to select the experts from the external environment of the business who have expertise in engineering practices.

The study gathered data using interviews with staff members at the hotel and a Delphi with expertise that will help to build the framework of sustainable engineering practices in the hospitality sector in Zimbabwe.

An interview is an insightful discussion that involves at least two people to collect relevant and reliable research data. Saunders *et al.* (2009) divided interviews into two main categories: standardized interviews and non-standardized interviews. A standardized interview, also known as a structured interview, is typically used for quantitative data collection using interviewer-administered questionnaires. Meanwhile, non-standardized interviews are those that are more modifiable. They may use multiple forms of communication, as shown in Figure 3.4.

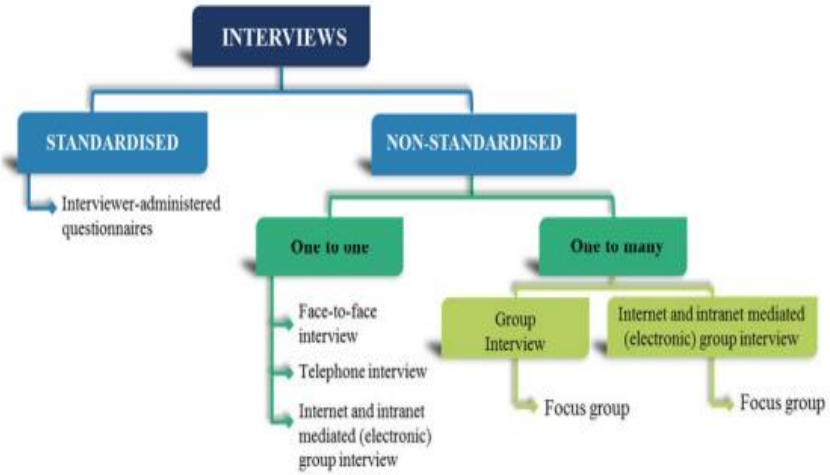

Figure 3.4: Forms of Interviews *(Saunders, 2017).*

Interviews may also be categorized into three types; structured, semi-structured, and unstructured. Structured interviews operate with a list of predetermined questions, while unstructured interviews are conducted freely without a specific flow of questions. Intertwined between these, semi-structured interviews are designed with several main predetermined questions to guide the flow of conversation. Relevant or potential sub-questions also are prepared by the researcher. This research was highly exploratory, because there is limited a priori information regarding the adoption of sustainable engineering practices in the hospitality sector. The interviews allowed the researcher to recognize the limit of understanding, as well as to gain access to the interviewees' subjective understanding (Seidman, 2006). Moreover, data were gathered in a relatively short timeframe with the resources available. Figure 3.5 shows the flow of the interview process used for this research, which is further explained in the following sub-sections.

Figure 3.5: General flow of interviews *(Creswell, 2014).*

In this study, face to face interviews were conducted and the researcher made use of technology through the voice recording device to capture the responses of the interviewees. The face to face-to-face interviews in this study were an effective form of engagement that provided prompt responses through direct verbal exchange of information. This was key in helping the researcher to determine the body language of the respondents and facial expression which are key in showing the mood of the respondents (Rowe & Wright, 2011). Face to face interviews are key in helping the participants to express their own perceptions as well as to clarify any questions or instructions.

The Delphi technique refers to systematic procedure of structuring a group communication process between the researcher and a group of identified experts in a specific field on a specified topic by assessing the feedback of individual contributions in relation to information and knowledge (Yousuf, 2007). This exchange of information encompasses anonymous interaction where disagreement among experts exists, and iteration is then repeated to the extent that a general

agreement achieved. The Delphi method is particularly adopted in situations where there is lack of empirical evidence for the study (Ameyaw *et al.*, 2016). It is also more useful in relatively new topics that require a holistic perspective.

However, on the other hand, Delphi study requires more time to undertake and complete as the proceeding rounds can only be executed once the analysis of the previous outcome has been completed. The process of each round may last up to several weeks. On the other hand, developing electronic and information technology provides an opportunity for researchers to employ this technique more easily. It also provides convenient times and places for individuals to be able to participate in a group communication process without a physical presence (Linstone & Turoff, 2011), making it an inexpensive method to organize and administer (Gupta & Clarke, 1996).

In this study, a modified Delphi was used in this research. Differing from the traditional Delphi practices, where the first Delphi round is intended to seek qualitative information from the panellists, this Delphi study aimed to evaluate the relative importance or relevance of the thoughts that emerged from the interviews and literature studies. The round of the Delphi questionnaire was designed to validate the consolidated list of items identified in the literature and interviews. A total of 10 panelists participated in this round. The questionnaires were distributed online and physically to make sure they are received on time. The panelists were informed that there would be a second rounds of questionnaires and the approximate expected length of time for them to complete the questionnaire which was between 7 days (1 week).

Triangulation is practice of combining multiple methods of research (Oleinik, 2011). In qualitative research, triangulation is regarded as a strategy to provide validity to the study through the merging of information from different methods (Carter *et al.*, 2014). The integration of multiple methods and cross-verification is more reliable than relying on a single source of evidence. This study used triangulation in the data collection method by using interviews, and the Delphi study. This research involved both qualitative and quantitative data, and by combining multiple types of data covered the disadvantages that comes with adopting a single method.

The important element of conducting research is to demonstrate research rigour and validity. According to Zickmund (2013), this begins with the researcher as the

main instrument. The researcher should be well-equipped with research skills and literature knowledge about the subject to be researched. Research rigor needs to be upheld and maintained during the whole research process (Meadows & Morse, 2001). However, the rigour of qualitative and quantitative research is construed differently (Given, 2016). Quantitative research is not viewed as more rigorous than qualitative research, or vice versa.

Credibility is equivalent to internal validity in quantitative research, which denotes the ability to represent the truth value of a study. Appleton (1995) claimed that the credibility of a qualitative study is deemed if it reveals accurate descriptions of individual experiences. Thus, other people who shared a similar experience will recognize it (Thomas & Magilvy, 2011). Shenton (2004) also suggested that qualitative research is credible when the investigator can demonstrate a true picture of the phenomenon under study. He stated that it is important to provide a detailed description of the research area, the actual situations being investigated, and the context surrounding them. In this research, the researcher provided the scope of study, as presented in chapter 1, to make sure the research topic and scope were appropriately identified and described. More so, to ensure credibility of the interviews, audio recordings were used in this research, which allowed the conversations to be replayed multiple times to provide more accurate transcription.

Mugenda (2019) pointed out that conformability establishes the trustworthiness of qualitative research. This occurs once credibility, transferability, and dependability have been established (Thomas & Magilvy, 2011). Flick (2007) indicated that reliable studies exhibit data transparency, which offers recognizability between interviewee statements and researcher interpretation. In this study, the quotations of the interviewees' statements are provided in italics. Quoting the interviewees statements along with the researcher's interpretation provides conformability that the findings are grounded in the interviewees' data, not solely the researcher's point of view.

In research, ethical considerations are essential as they make sure that all the stakeholder of the study are not negatively affected by the study for instance the participants, the researcher and the organisations at large. In this study, research ethics were adopted from its inception and mostly in the data collection and analysis phase. The researcher first of all attained permission from the authorities of the hotel to undertake the study. Further, the consent of the respondents was

ensured without using threats or lies. During the data collection phase, the privacy of the respondents was ensured, and the researcher made sure the private space of the participants was not bombarded. Further, the researcher did not temper with the data during analysis to influence results.

This research methodology chapter of the study is the research methodology and it showed the way the study seeks to gather and analyse data that can help build a framework to enhance the engineering practices in the hospitality sector in Zimbabwe. The study adopted mixed methods to achieve the set objectives and employed a combination of interviews and Delphi study with experienced practitioner in Zimbabwe who have expertise in engineering. The next chapter of the study is data analysis and presentation.

CHAPTER 4
INHERENT UNDERSTANDINGS AND PERCEPTIONS OF SUSTAINABLE ENGINEERING PRACTICES IN REVITALIZATION OF INFRASTRUCTURE IN THE HOSPITALITY SECTOR

In the previous chapter, the study presented the research methodology and showed how it aims at gathering and analysing data that responds to the research questions. Before the initial analysis of data collected, the study presents this fourth chapter, which aims at understanding the phenomenon to which a framework will be built upon. This chapter therefore looks at understanding and perception of sustainable engineering practices in revitalization of Infrastructure in the hospitality sector. The chapter specifically presents body of knowledge that is in line with the adoption of sustainable engineering practices in revitalising infrastructure in the hospitality sector.

The participants were selected based on their experience and qualification in the phenomenon of revitalizing infrastructure. This was key in making sure the data gathered was accurate and rich because of their knowledge, expertise, and tenure in the field. Majority of the participants were structural engineers, and it was made sure that the respondents' identity was kept anonymous. The demographic details of the respondents are provided in Table 4.1 below.

Table 4.1: Demographics *(Primary data, 2024)*

ID	Participant's position	Years of industrial experience	Years of engineering experience	Type of interview
R1	Structural engineer	<5 years	<5 years	Face to face
R2	Structural engineer	6-10 years	6-10 years	Face to face
R3	Electrical engineer	6-10 years	<5 years	Face to face
R4	Structural engineer	< 5 years	<5 years	Face to face
R5	Civil engineer	11-15 years	6-10 years	Face to face
R6	Electrical engineer	11-15years	6-10 years	Face to face
R7	Civil engineer	6-10 years	< 5 years	Face to face
R8	Electrical engineer	>21 years	6-10 years	Face to face
R9	Structural engineer	<5 years	< 5 years	Face to face
R10	Electrical engineer	11-15 years	6-10 years	Face to face
R11	Civil engineer	16-20 years	6-10 years	Face to face
R12	Civil engineer	16-20 years	<5 years	Face to face
R13	Electrical engineer	11-15 years	6-10 years	Face to face
R14	Structural engineer	16-20 years	6-10 years	Face to face
R15	Structural engineer	>21 years	6-10 years	Face to face
R16	Electrical engineer	6-10 years	< 5 years	Face to face

R17	Civil engineer	11-15 years	6-10 years	Face to face
R18	Structural engineer	6-10 years	<5 years	Face to face
R19	Structural engineer	11-15 years	<5 years	Face to face
R20	Electrical engineer	< 5 years	< 5 years	Face to face
R21	Structural engineer	<5 years	<5 years	Face to face
R22	Structural engineer	11-15 years	6-10 years	Face to face
R23	Electrical engineer	6-10 years	< 5 years	Face to face
R24	Civil engineer	6-10 years	<5 years	Face to face
R25	Civil engineer	<5 years	<5 years	Face to face
R26	Structural engineer	11-15 years	6-10 years	Face to face
R27	Electrical engineer	16-20 years	6-10 years	Face to face
R28	Civil engineer	16-20 years	6-10 years	Face to face
R29	Electrical engineer	<5 years	< 5 years	Face to face
R30	Structural engineer	11-15 years	< 5 years	Face to face

The above results in Table 4.1 showed the demographic characteristics of the respondents who are staff members at Hwange Safari Lodge. Results showed that majority of the respondents were structural engineers. These were followed by electrical engineers and civil engineers in the organization who were all responsible for revitalising infrastructure hands on.

The results also showed that majority of the respondents have had a working experience of over 5 years in the industry and the firm, majority of the respondents had been working for a period less than 5 years and it translates to short term tenure. A short-term tenure is associated with innovation and risk taking but it is also associated with less knowledge and experience (Kuratko, 2020).

This section of the study is presenting the findings, which were extracted in line with the topics related to the research questions. The respondents were specifically asked to express their views pertaining the phenomenon understudy through responding to the research questions.

It was believed in the study that it is of great significance to first have an insight on the sustainable engineering practices that can be adopted in the organisation to revitalize infrastructure. That is at the beginning of the interview's session, the questions that were designed in the study were designed to allow the respondents describe the engineering practices that are deemed to be sustainable and can enhance the improvement of the quality of infrastructure used by the organization. This was also key in determining their understanding on the phenomenon of sustainable engineering practices.

The interviews showed that the respondents had different views on the sustainable engineering practices that could be adopted in the organisation. Some of the

participants believed that the only sustainable practice is the renovating of infrastructure on short regular intervals and did not have vast knowledge on other practices such as green practices that are environmentally friendly and the adoption of advanced technologies. One of the participants said:

> *"I think the only sustainable engineering practice at our disposal is to regularly check for irregularities in the infrastructure such as cracks and make quick amends before they get worse"- R1.*

Below is a Table 4.2 shows a list of the relevant sustainable engineering practices that were mentioned by the respondents that could be adopted in the organisation. The list of relevant practices includes regular renovations, technology adoption and adoption of environmentally friendly equipment.

Table 4.2 Summary of sustainable practices (*Primary, 2024)*

Practice	Mentioned by Interviewees
Regular checks and fixing	Saves costs (R1, R3, R6, R26, 28), keeps infrastructure intact (R2, R12, R13, R14, R21)
Technology adoption	Saves costs (R1, R4, R5, R8), improves standards (R7, R9, R10, R15, R29, R30)
Environmentally friendly equipment	(R4, R16, R17, R8, R19, R20, R22, R25)

The interviews revealed that the adoption of regular check and fixing of problems on the infrastructure is the major sustainable engineering practices and it helps to save costs. By regularly checking for discrepancies, the problem is quickly determined when it is still small, and it will not be expensive to solve (Law, 2020). In that manner, the interviews postulated that when a problem is left to grow, it is expensive to fix hence regular checks helps to fix it whilst it is cheap, and it saves costs. Interviewee 3 was recorded saying;

> *"Well, I always believe that we should always check on our infrastructure on a monthly basis so that we determine engineering problems as they arise. The earlier we do so, the cheaper it becomes to fix, and it also helps to make sure the infrastructure remains strong"-R3.*

This was evidence that the regular checks do not just lead to determining and fixing a problem in no time before it grows but also helps to save costs for the firm. Regarding that, one electrical engineer points out that;

> *"Replacing electricals in the building is cheaper when it is done without any problem occurring. It only takes a proactive approach to know some cables and assets are overdue and need to be replaced before they cause problems to the entire building"- R6.*

Despite the relevance of cost-cutting or saving costs, another dimension that emerged was that regular checks and fixing are key in ensuring that the infrastructure remains intact of the foreseeable future. Several participants agreed that by regularly checking and fixing emerging complications, the infrastructure

will not be left to deteriorate or experience a fall in standards which entails sustainability. The respondents said the following;

> *"It is essential to make sure that the hotel building does not lose colour or have cracks on it. This can only be done through proactive approaches to determine and fix problems before they grow"-R2.*
> *"Regular fixing of emanating problems on the infrastructure help to make sure that that standard is maintained for the foreseeable future,"- R12.*
> *"Sustainability is derived only from ensuring that we regularly check for areas that need attention and fix the problems before they grow or become any worse. Through that, we make sure the building maintains its standard and attracts more customers"-R13.*
> *"It should always be done on a monthly basis, we check for changes on the infrastructure and come up with measures to fix the problem when they are still small to ensure longevity."-R14.*

On the other hand, there were also a bunch of respondents who pointed out that technology adoption is a key sustainable engineering practices that can be adopted in the organization. Technology is key in several ways in the engineering domain as it helps to detect problems and to fix them at a faster and low-cost manner (Gould, 2021). The use of advanced technological tools and assets helps to detect an engineering problem on the infrastructure for instance electrical engineers to detect quickly electrical challenges in the infrastructure and fix it with no time. One electrical engineer was quoted saying;

> *"Most electrical faults are hard to determine physically and takes time which may further make the fault worsen if not solved quickly. Therefore, adoption of technology in the practice will always help us to determine the electrical faults earlier to ensure sustainability in the business."-R14.*

In support of that, other respondents also pointed out that technology adoption is a key engineering practice that helps to ensure a quick solving of the engineering problems faced efficiently and effectively. Technology adoption ensures that engineering work is done with speed hence saving time and ensuring efficiency and saving costs (R1, R4, R5, R15). In specific, one structural engineer said;

> *"The adoption of technology in refurbishment of the infrastructure is key in putting in place advanced designs through the use of CAD "-R15*

Another point that emerged from the interviews was the adoption of environmentally friendly engineering practices that does not lead to pollution or over exploitation of natural resources. The respondents pointed out that they are now aware of the existence of green and environmentally friendly engineering practices hence can be undertaken for the foreseeable future. According to Muriel (2022), green practices that do not lead in over exploitation of natural resources are key engineering practices that are sustainable and can be adopted for the foreseeable future efficiently. In that context, some of the respondents said;

"There has been the adoption of green engineering practices in countries such as Sweden and these are environmentally friendly, they ensure preservation of natural resources and helps to make sure we have enough for the future"-R14.
"Green engineering practices entails forgoing the use of equipment and fossil fuels that pollutes the environment. It involves the use of assets such as solar systems that are environmentally friendly and helps to enhance sustainability"-R17.

Therefore, the above analysis showed that the respondents point out that 3 major sustainable engineering practices can be adopted in the organisation to revitalise the infrastructure. These includes continuous checking and fixing of problems as they arise, the adoption of technology and environmentally friendly equipment.
The contribution of sustainable engineering practices in enhancing infrastructure sustainability.

The study by attaining the general idea of contribution of sustainable engineering practices in enhancing infrastructure sustainability was key in determining the impression of the respondents on the eagerness to adopt sustainable engineering practices. Figure 4.1 below shows the views of the respondents regarding contribution of sustainable engineering practices.

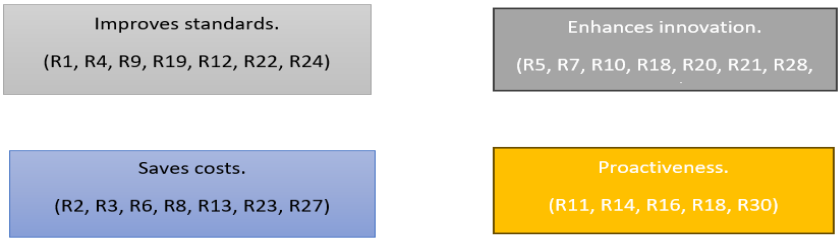

Figure 4.1: Contribution of sustainable engineering practices *(Primary data, 2024).*

Based on these above benefits, participant's understanding pertaining the benefits of sustainable engineering practices was in line with the view of Gordon (2021) who posits that sustainable engineering practices comes with a various benefit that leads to sustainability and development of infrastructure such as saving costs, fostering innovation and future orientation. In the interviews, the first point that was raised was that sustainable engineering practices helps to continuously improve standards of the infrastructure (R1, R4, R9, R19, R12). The first respondent, a structural engineer in the organisation points out that through sustainable engineering practices such as technology adoption, the standard of the infrastructure continues to improve, and it helps to compete at international level.

"Through engineering practices, we are able to look out for new ways to improve the outlook of the infrastructure and it helps to improve the standards of the infrastructure as well as the services provided in the hotel"-R1.

From the above view, other respondents pointed out that standards can be improved by sustainable engineering practices through the development of new advanced designs or technologies that can be instilled on the infrastructure. Some of the respondents said;

> *"The adoption of technology in revitalizing hotel infrastructure is key in instilling advanced technologies that helps to improve the standards of the hotel such as automated doors"-R4.*
> *"There is need to modernise the infrastructure to meet international standards and this can be enhanced by continuously adopting technology and green engineering practices in revitalizing the hotel infrastructure"-R19.*

That point was also closely related to the good view of other group of respondents who pointed out that sustainable engineering practices are the mother of all innovation in revitalizing hotel infrastructure (R5, R7, R10, R18 and R20). The respondents were in line with the earlier view of Morris (2021) who alludes that through continuously checking for areas to improve on the infrastructure helps to come up with new advanced ideas that helps to improve the overall performance of the hotel. A civil engineer in the organization said something interesting;

> *"Innovation enhances continuous improvement of infrastructure, and it should be enhanced by everyone starting with us engineers. Through sustainable practices such as continuously looking for areas to improve, triggers innovation in a bit to improve determined aspects and the infrastructure continues to improve"-R5.*

In that matter, another key point that emerged was that innovation was enhanced through the adoption of sustainable engineering practices such as technology adoption. In most literature, innovation and technology are used interchangeably (Casillas, 2018; Morris, 2018; Kuratko, 2020). Hence, as a result, adopting sustainable engineering practices in form of technology adoption is important in enhancing innovation that helps to improve the standards of the hotel's infrastructure.

> *"Technology adoption translates to innovation or enhances innovation at ease, and it helps to improve the longevity of the infrastructure"-R10.*
> *"Innovation and technology adoption works hand in hand and the adoption of the former in engineering activities such as checking designing new ways to improve the infrastructure leads to developing new ways that improves the stature and appeal of the infrastructure"-R18.*

The aspect of saving costs was also strongly mentioned by the respondents as they allude that the adoption of sustainable engineering practices. Through continuous checking and fixing of faults on the infrastructure before they get worse off, makes it cheaper for the organisation who can then use extra funds available to invest in other aspects that improves the infrastructure such as purchasing new technologies (Becker, 2021). According to one structural engineer in the organisation;

"The fact that sustainable engineering practices ensure that challenges are solved before they get off saves costs. You do not have to act with desperation to improve the infrastructure when you are desperate which is costly as new problems start to emerge too."-R2.

It was also supported by other respondents that agreed that saving costs through sustainable engineering practices is helpful to make sure the firm has extra funds to invest in other pressing matters.

"The engineering practices that save costs are essential in the overall development of infrastructure. They help the business to have more funds to invest in technology and environmentally friendly equipment"-R6.

"Saving costs that come from fixing larger problems is important in ensuring we have more funds to purchase new technologies key in improving the buildings"-R8.

Therefore, the above analysis showed the great benefit that comes from adopting sustainable engineering practices to the infrastructure. The costs saved are key in making sure the business can fund other important factors that helps to achieve the same goal of revitalising the infrastructure.

Another key contribution that emerged was the ability to be proactive hence making sure that the infrastructure is developed in a manner that meets international standards. Through practices such as technology adoption which allows research and development (R&D), the engineers can come up with new ways and aspects to adopt or instill on the building that meets international standards (R11, R14, R16, R18). According to a civil engineer in the organization;

"The major factor is that sustainable engineering practices are future oriented hence they help the organization to always be on the lookout of new and advanced aspects to add on to the infrastructure to meet international standards"-R11.

In that manner, being proactive was also determined as a major factor that leads to continuous improvement on the infrastructure at the hotel driven by sustainable practices such as technology adoption. Adoption of technology as well as continuous checking and fixing faults is a proactive way that helps to make sure the infrastructure is always being developed and improved to match expected standards (Coleman, 2021). Some of the respondents were recorded saying;

"Technology adoption is key in doing researches on the new advanced aspects that can put infrastructure to meet advanced standards of the hotel as a whole in all aspects"-R14.

"Future orientation is enhanced by adoption of technology which allows us to research on the new aspects that are in international hotel infrastructure and try to adopt them here "-R16.

With that, it was noted that indeed adoption of sustainable engineering practices help to ensure sustainability of infrastructure. Through practices such as

technological adoption and green equipment, innovations emerge, costs are reduced, and standards are improved continuously which leads to sustainability.
The potential of sustainable engineering practices in facilitating the redevelopment of infrastructure in the hospitality sector.

After determining the contribution of sustainable engineering practices on enhancing sustainability of the hotel infrastructure, the respondents were asked to show their view regarding the potential of sustainable engineering practices in facilitating the redevelopment of infrastructure. This question was specific to Hwange Safari Lodge considering all its resources including human resources, the space or location of the hotel, available technologies, and finances. The extracted remarks that emerged from the interviews in that regards were presented first in Table 4.3.

Table 4.3: Potential of sustainable engineering practices in facilitating redevelopment of infrastructure *(Primary data, 2024)*

Engineering practice	Mentioned by respondents
Technology advancement	Innovation & benchmarking (R1 R2, R5, R6, R12, R18, R21, R27, R29)
Continuous checking and fixing	Continuous improvement & proactiveness (R3, R7, R10, R11, R13, R20, R23, R25, R30)
Green equipment; technology advancement	Enhance international standards (R4, R8, R13, R14, R16, R17, R19, R22, R26)

The respondents provided an insight on how the mentioned sustainable practices of engineering have a potential or influence redevelopment of infrastructure at Hwange Safari Lodge. It was pointed out that each of the sustainable practices has a potential of enhancing redevelopment of infrastructure through various ways as per the resources that the company have. Coming up with new ideas to implement on the infrastructure such as designs possess a great potential of redeveloping infrastructure everywhere around the globe (Martinez, 2023).

In that regard, various respondents from Hwange Safari Lodge allude that adoption of advanced technology in engineering has a greater potential of enhancing innovation through R&D and benchmarking. Some of the respondents said the following;

> *"I believe if we make it a culture to adopt advanced technology in engineering here at the Safari Lodge, we will achieve greater staff in redeveloping the infrastructure. We will*

have the more access to information pertaining development in other hotel infrastructure across the world and benchmark with them"-R1.
"The adoption of advanced technology in engineering has potential to enhance redevelopment of infrastructure through innovation. I think technology will be key in R&D and in making sure we refurbish the hotel with advanced tools that does an excellent job compared to human hands"-R5.
"We could benefit more from advanced technology adoption due to its known advantages across the globe of enhancing ease infrastructure redevelopment. It all comes through innovation and benchmarking"-R6.

Further, the respondents also showed the potential of engineering practices to ensure redevelopment of infrastructure through continuous improvement (R3, R7, R10, R11, R13, 20). In that essence, the major point that emerged was that through practices such as continuous checking and fixing, there is continuous improvement and having a future orientation on the infrastructure that leads to redevelopment. Some of the respondents were recorded saying the following;

"I also strongly believe that through continuous checking of faults and fixing them can lead to continuous improvement on the infrastructure sustainably. We can come up with future plans on how best the problems can be solved now and forever at the same time ensuring improvements on the building both the interior and outside"-R3.
"I think that also being able to continuously fix small problems as they emerge helps can help in the redevelopment of infrastructure. This is because we can also look into the future and see how best the problems can be fixed and develop new aspects that can help in redeveloping hotel infrastructure"-R10.

Therefore, the above analysis also showed that through continuous checking and fixing faults and problems on the building, there is greater potential of redeveloping infrastructure. It can be noted that the engineering practice helps also to be future oriented hence coming up with plans that helps to improve the overall outlook or appearance of the hotel.

The other aspect that emerged was that the adoption of technology and green equipment also helps to enhance redevelopment of infrastructure through meeting international standards (R4, R8, R13, R14, R16, R17, R19). The two engineering practices when merged, allows the Safari Lodge to be able to apply methods that are being applied in the first world countries hence improving their own standards in the redevelopment and refurbishment of the hotel infrastructure. In that regard, one structural engineer pointed out that;

"The adoption of green equipment is now in overdrive in countries such as Sweden and the United States of America. If we adopt the same and encompass advanced technologies, we have a greater chance of achieving big goals regarding redevelopment of the infrastructure"-R19.

With that being said, it also emerged that the adoption of green equipment and technology saves costs hence the hotel can have enough funds to also invest in

more equipment and hire more staff to ensure the hotel infrastructure is revitalised efficiently and effectively. Below are some of the respondents' remarks;

> *"Using green equipment and technology is a cheaper way of doing activities in the organization. It will leave us with enough or extra cash to invest in other aspects such as manpower development which is also important in redeveloping the infrastructure"-R8.*
> *"We can enhance redevelopment at ease through the use of green equipment and technology. It helps to save costs and also hire more employees with expected skills to ensure the infrastructure is improved"-R14.*

Therefore, the above results also showed that redevelopment of the hotel infrastructure can be enhanced through the adoption of technology and green equipment. The two aspects helps to save costs and help the organisation to invest in other aspects such as developing workforce or hiring more workforce in the revitalisation of the hotel. Above all, the results showed that adopting sustainable engineering practices has a greater potential of enhancing the redevelopment of hotel infrastructure at Hwange Safari lodge.

Therefore, the results shown above led to the creation of the framework for the adoption of sustainable engineering practices in the hospitality sector. The framework was however subject to review by the experts in the study to either confirm or deny its relevance to the hospitality sector regarding the points or factors picked in the interviews. The framework is diagrammatically shown below in Figure 4.2.

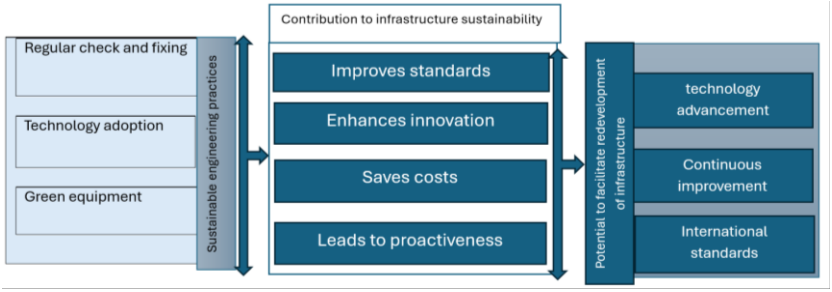

Figure 4.2: *Framework for sustainable engineering practices in the hospitality sector.*

This chapter of the study helped to build an understanding on the phenomenon to which a framework was built. This chapter therefore provided an insight of the respondents at Hwange Safari Lodge on their understanding and perception on sustainable engineering practices in revitalization of Infrastructure in the hospitality sector. The chapter specifically presented a body of knowledge that is in line with the adoption of sustainable engineering practices in revitalising

infrastructure in the hospitality sector. The interviews showed various opinions of the respondents which through answering the research questions. The findings in this chapter were deemed not enough to build the framework of sustainable engineering practices hence motivating the study to carry out a Delphi study with experts in the industry and the field of engineering which was undertaken in the next chapter of the study.

CHAPTER 5
RESULTS OF DEPHI STUDY

INTRODUCTION

In the previous chapter, the study provided an insight into the framework of sustainable engineering practices that was advocated for by the staff at Hwange Safari Lodge through the interviews. The framework provided information on aspects such as the actual practices that can be adopted, their contribution and their potential to enhance sustainability in the business' infrastructure. This fifth chapter therefore sought to get an insight of experts in the hospitality sector and also engineers with regards to the proposed framework. The Delphi study was undertaken with an objective to examine the level of agreement from the expert panelists s to determine the sustainable engineering practices that could be adopted on the infrastructure. The results from the Delphi study led to the formation of a comprehensive framework integrating the sustainable engineering practices that can be adopted at Hwange Safari Lodge. Therefore, the chapter starts by showing the profiles of the panelists s followed by the results and findings of the Delphi survey, and the reliability examination. Finally, the findings of the Delphi surveys will be summarised.

Profile of the panelists

A total of 10 experts formed the panelists from which the study gathered data for the Delphi study from the panelists. These panelists included experts who were construction project owners, electrical engineers, civil engineers, structural engineers and EMA. 2 potential participants from each group were approached and all of the potential panelists s expressed their interest and agreed to participate. Therefore, a 100% participation rate was attained in the Delphi study. The participants represented a wide spectrum of the construction industry. The distribution of the panel was shown below in Figure 5.1:

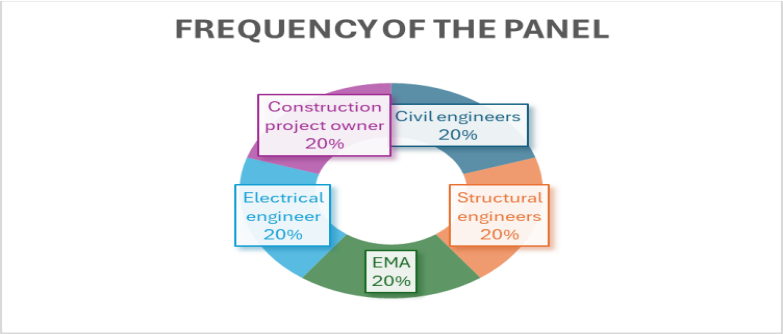

Figure 5.1: Composition of panellists *(Primary data, 2024).*

The panellists of the study had different experiences and had at least 5 years up to 21 years' experience in the construction sector. Eight of the panellists s had at least 10 years' experience in infrastructure projects. Regardless of D5 having minimal experience in the engineering field, this panellist had in depth research background and knowledge in engineering related studies. Table 4.1 below provides a summary of the demographics of the panellists.

Table 5.1: Demographic profile of the panellists *(Primary data, 2024)*

Panel ID	Position	Years of experience in the engineering sector	Years of experience in construction projects	Professional Body membership	Advanced degree
D1	Project manager	7	6	Yes	Pending
D2	Electrical engineer	20	13	Yes	Yes
D3	EMA	7	5	Yes	Pending
D4	EMA	9	6	No	Pending
D5	Structural engineer	5	5	Yes	Pending
D6	Project manager	17	11	Yes	Yes
D7	Electrical engineer	14	12	Yes	Yes
D8	Structural engineer	12	9	Yes	Yes
D9	Civil engineer	10	8	Yes	Yes
D10	Civil engineer	8	6	No	Yes

The study undertook a Delphi study in which in the survey, 15 items from 3 questions were classified under category 1 as shown in Table 4.2 below. The study considered every item under this category relevant to their respective questions and that the results they attained where also relevant. This was based on the agreement from a majority of the panellists. In the study, consensus was reached for all items, and these were agreed as being relevant in creating the framework for sustainable engineering practices. This was perceived as a sign of agreement between the panellists because there was significant improvement in the number

of items that reached consensus. The study therefore presents the results of the Delphi study separately for each of the questions. Two types of corresponding tables summarise the results for each question; rating the results with the value of interquartile range and level of agreement for each item in Round and the mean rating results by sub-group.

The Table 5.2 below illustrates the results from the expert panellists and shows their rating for the engineering practices that they deemed to be sustainable and that can also enhance sustainability of the infrastructure at Hwange Safari Lodge. The results showed that majority of the practices that were illustrated by the staff at the lodge were deemed important by the expert panellists s as the level of agreement was more than 60%. The agreement level was highest on the practice of continuously checking for faults and problems on the infrastructure and fix them at their infancy.

Table 5.2: Rating results for sustainable engineering practices adopted in the framework *(Primary data, 2024)*

Item		IQR	Level of agreement %		Consensus was reached?
			Not agree	Agree	
ROUND 1					
1	Regular checks and fixing	1.0	12%	80%	Yes
2	Technology adoption	2.0	20%	74%	Yes
3	Green equipment	1.0	13%	68%	Yes

Table 5.3 shows results of the mean rating and the rankings of the items. The overall rating showed that 2 of the practices were highly rated (mean ≥4.0): regular checks and fixing as well as technology adoption. It therefore showed that these two practices are within the reach of the lodge and are expected to be implemented more often in the refurbishment of the infrastructure.

Table 5.3: Mean rating of the sustainable engineering practices from the panellists *(Primary data, 2024)*

Item	All panellists		EMA		Structural engineer		Civil engineer		Electrical engineer		Project managers	
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
Regular checks and fixing	4.28	1	3.33	2	4.38	1	4.22	2	4.71	1	4.80	1
Technology	4.20	2	3.22	3	4.28	2	4.89	1	4.53	2	4.62	2
Green equipment	3.88	3	4.78	1	3.22	3	3.82	3	4.21	3	4.11	3

As shown above, the staff at EMA ranked the adoption of green equipment as the most significant sustainable engineering practice while the other panellists s ranked it lowed than any other practice. This is because EMA is more into environmental protection and sustainability hence, they advocate more for equipment that does not pollute the environment.

On the other hand, the structural engineer, electrical engineer and the project managers reflected those regular checks and fixing of the infrastructure as the most important factor. This is because the engineers believe that doing so is key in making sure that costs are saved and that the detected problems are solved before they become worse which is key in making sure the infrastructure remains strong and even improve.

Also, the civil engineer ranked adoption of technology on number 1 while the structural engineer and the electrical engineer ranked it second on the list. This was because the use of technology is key in supporting the two other practices through enhancing innovation and efficiency in revitalising or renovating infrastructure of the lodge.

This study also explored the contribution of sustainable engineering practices in enhancing infrastructure sustainability. This followed the study had explored the key sustainable engineering practices that can be adopted on the infrastructure of the lodge. This subsection therefore discusses the sustainable engineering practices

contribution to infrastructure sustainability through showing of the panellists' agreement on the four advantages that were found from the staff members at Hwange Safari Lodge. Thus, the Table 5.4 below shows the panellists' ratings of the contribution of sustainable engineering practices in enhancing infrastructure sustainability. All of the items attained absolute agreement and managed to gain consensus.

Table 5.4: Rating results for contribution of sustainable engineering practices in enhancing infrastructure sustainability *(Primary data, 2024)*

Item		IQR	Level of agreement %		Consensus was reached?
			Not agree	Agree	
ROUND 1					
1	Improves standards	1.0	15%	84%	Yes
2	Saves costs	2.0	23%	70%	Yes
3	Leads to innovation	1.0	10%	82%	Yes
4	Proactiveness	1.0	20%	72%	Yes

As shown above, the panellists reached a consensus on all the items. The fact that the engineering practices enhances improved standards of the infrastructure was agreed most by the panelists s as it is driven by practices such as technology adoption and continuous fixing of small problems. This was also followed by innovation which is driven mostly by technology adoption and helps to make sure the engineers in the lodge are bringing in new aspects to refurbish the infrastructure. On the other hand, Table 5.5 below shows distribution of the panellists' views by sub-groups and the results showed that improved standards were the feature that majority of them deemed to be the key driver of infrastructure sustainability driven by sustainable engineering practices.

Table 5.5: Mean rating on contribution of sustainable engineering practices in enhancing infrastructure sustainability *(Primary data, 2024)*

Item	All panellists		EMA		Structural engineer		Civil engineer		Electrical engineer		Project managers	
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
Improves standards	4.80	1	3.88	2	4.72	1	4.50	1	4.66	1	4..74	1
Innovativeness	4.77	2	3.42	3	4,60	2	4.34	2	4.32	2	3.20	4
Proactiveness	4.62	3	3.21	4	3.65	4	3.58	3	3.82	3	4.11	2
Saves costs	4.50	4	4.20	1	4.20	3	3.20	4	3.60	4	3.89	3

The above results showed that four out of five ranked top the fact that sustainable engineering practices contributes improved standards of the infrastructure of the lodge. This is because when the lodge is revitalized using practices such as regular checking and fixing, small problems are fixed before they become big hence ensuring that the infrastructure stays in good shape and quality. On the other hand, it was also shown that innovativeness was ranked 2nd by three of the panellists s and this is mostly driven by the adoption of technology in the engineering processes when revitalising the infrastructure. Innovation is key in introducing new and advanced aspect on the infrastructure now and in the future therefore driving sustainability.

The aspect of saving costs was however ranked 1st only by panellists s from EMA and the other groups either rank it 3rd or 4th. This is because they pointed out that implementing the sustainable engineering practices may be expensive for instance purchasing new technologies and doing regular checks on the infrastructure requires financial backing. But they did not have an insight on the fact that the expenses are mostly incurred in the short run, in the introductory stages and once the practices are being implemented, costs are saved as the infrastructure is kept in good conditions. That is, in the long run, the adoption of sustainable engineering practices helps to save costs and the firm is left with more funds to its disposal to invest in advanced aspects that helps to improve the standards of the hospitality they provide to customers.

The study also sought to get the confirmation from the panellists pertaining the potential of sustainable engineering practices in facilitating the redevelopment of infrastructure in the hospitality sector. The panellists in their majority agreed that sustainable engineering practices have a strong potential to facilitate the redevelopment of infrastructure through the same aspects that were pointed out by the staff at Hwange Safari Lodge. The most advocated practice was enhancing international standards through technology and green equipment adoption. The results were shown first in Table 5.6.

Table 5.6: Rating for potential of sustainable engineering practices in facilitating the redevelopment of infrastructure in the hospitality sector *(Primary data, 2024)*

Item		IQR	Level of agreement %		Consensus was reached?
			Not agree	Agree	
ROUND 1					
1	Meets international standards	1.0	15%	80%	Yes
2	Benchmarking	1.0	23%	72%	Yes
3	Continuous improvement	1.0	10%	78%	Yes
4	Proactiveness	2.0	20%	68%	Yes

The results showed that the panellists reached consensus on all the items that shows how the sustainable engineering practices. Most of the panellists agreed that through sustainable engineering practices, the facilitation of the redevelopment of infrastructure in the hospitality sector is done with international standards and this is enhanced mostly by technology adoption. The results also showed that sustainable engineering practices helps to enhance benchmark with advanced facilities, and it helps to improve the outlook of the infrastructure as well as the internal aspects such as in guest rooms, the conference rooms, dining areas and the bars amongst others.

The rankings shown below in Table 5.7 shows the distribution of the panellists' views by sub-groups. The results showed that meeting international standards was the top ranked followed by continuous improvement.

Table 5.7: Mean rating on the potential of sustainable engineering practices in facilitating the redevelopment of infrastructure in the hospitality sector *(Primary data, 2024)*

Item	All panellists		EMA		Structural engineer		Civil engineer		Electrical engineer		Project managers	
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
International standards	4.80	1	4.50	1	4.92	1	4.92	1	4.82	1	4..68	1
Continuous improvement	4.22	4	3.88	2	4,60	2	4.64	2	4.32	2	4.20	2
Proactiveness	4.36	3	3.28	3	3.65	4	3.20	4	3.82	3	4.13	3
Benchmarking	4.50	2	4.22	4	4.20	3	3.88	3	3.60	4	3.89	4

The results in Table 5.7 above showed that most of the panellists ranked the notion that international standards are enhanced by sustainable engineering practices most because through adoption of technology, research is done to show how other 5-star facilities are being redeveloped. Further, the results proved that continuous improvement is also enhanced through sustainable engineering practices such as the regular checking and fixing of the problems on the infrastructure.

The aim of the research after the Delphi study was recognizing the items where consensus recognise the items were consensus. The panellists provided responses that were variable and had differing opinions therefore, the Delphi study was designed and adopted to attain a holistic agreement on the topic understudy. The Delphi study have the panellists the chance to review the relevance of collective responses which was key on construct validity. This is known as self-validating mechanism, and this was done through selecting panellists due to their expertise and experience in the engineering sector.

Therefore, the consistency of the panellists s rating was examined for the Delphi study using the interrater reliability which shows the variation of the raters measured the same factors (Li, 2016). In this study it was used to describe how the responses of each panellists were strong and resembled each other. It was adopted to assess the consistency of the responses which made by different

experts and measuring the same item. According to Cicchetti (1994), the ICC values that are less than 0.4 shows poor agreement and values that are between 0.49 and 0.59 shows a fair agreement. Further, values that are between 0.60 and 0.74 shows a good agreement and the values that are 0.75 and above reflects an excellent agreement. An ICC estimate and their 95% confidence interviews in this study was calculated based on the mean rating, absolute-agreement and a 2-way mixed effects model. This was shown in the Table 5.8 below and a fair-good agreed was attained in the Delphi study as the average measure of the ICC was 0.624 with a 95% confidence interval therefore showing that the Delphi's results were valid.

Table 5.8: ICC value for each round of Delphi survey *(Primary data (2024)*

Delphi round	ICC	Confidence interval	
		Lower bound	Upper bound
1	0.624	0.533	0.732

Therefore, the above showed that the results from the Delphi study were valid as proven by the ICC of 0.624. With that regard, the study found that the framework that was developed by the staff members in the organization shown in Figure 4.2 above was agreed to by the experts in the engineering phenomenon hence no changes were made in the study but rather the framework was reinforced by the experts.

This fifth chapter therefore aimed at attaining insight of experts in the hospitality sector and also engineers regarding the proposed framework. The Delphi study was undertaken to examine the level of agreement from the expert panellists to determine the sustainable engineering practices that could be adopted on the infrastructure. The results from the Delphi study led to the formation of a comprehensive framework integrating the sustainable engineering practices that can be adopted at Hwange Safari Lodge.

Therefore, the chapter started by showing the profiles of the panellists followed by the results and findings of the Delphi survey, and the reliability examination. Finally, the findings of the Delphi surveys were summarised. The next chapter presented the discussions of the results and the conclusions

CHAPTER 6
DISCUSSION OF RESULTS, CONCLUSIONS AND RECOMMENDATIONS

This entire study sought to develop a framework to adopt sustainable engineering practices in the revitalisation of infrastructure in the hospitality industry in Zimbabwe. The previous 5 chapters were the general introduction to the study, the literature review, research methodology, understanding and perception of sustainable engineering practices in the revitalisation of infrastructure in the hospitality sector and a Delphi study which were all key in developing the framework. After gathering and analysing primary data from staff members from Hwange Safari Lodge using interviews and carrying out a Delphi study with experts, this study reaches this sixth and final chapter which seeks to show the discussions of the results and provide conclusions and recommendations. The chapter then concludes with an area for future study that is related to this study that other scholars can adopt.

This section of the study presents a discussion of the study results from both the interviews and the Delphi study. It was guided by the research questions that were asked of the respondents to which data analysis was carried out.

During the interviews, the respondents described sustainable engineering practices as the driver of corporate performance in the hospitality sector hence the need to apply or adopt them religiously. This followed the question which asked the respondents to provide an insight into their perception of sustainable engineering practices. When asked which practices can be adopted in the revitalization and redevelopment of Hwange Safari Lodge, they first pointed out in their majority that there is a need to regularly check and fix problems on the infrastructure. This practice was deemed to be the most important and basic as it allows the engineers to determine problems when they are still not significant and come up with strategies to mitigate them before they grow big. The notion here is that fixing a problem early is cost-effective and helps to keep the infrastructure in good shape. These findings were also in line with the view of Sushilawati (2018) who pointed out that the adoption of engineering practices should be an ongoing process and is key in making sure that costs are cut as the fixing is done when the problem is still infant.

It also allows to make sure innovation and improvements are enhanced especially when the problem reoccurs multiple times and there is a need to fix it once and for all. In that regard, this sustainable engineering practice was also in line with Dissiter's Law of Fives which is key in explaining the maintenance of infrastructure. The theory alludes that not fixing a problem as it occurs leads to the emergence of many other problems which become expensive to the owners of the buildings or infrastructure (Borris, 2022). It was also confirmed in the Delphi study as the expert panellists ranked the regular checks and fixing of the infrastructure as the most important sustainable engineering practices that can be adopted in the hospitality sector.

Further, the study found that the adoption of technology is another key sustainable engineering practice that needs to be implemented in the hospitality sector. The notion here is that technology is key in determining new and modern ways in the engineering field that are effective and efficient. The key point raised was that technology adoption helps to carry out an R&D which helps to bring to the surface the new trends in the revitalisation of infrastructure in developed countries and 5-star hotels which can also be adopted at Hwange Safari Lodge. In that regard, technology is key in developing the infrastructure in a unique way that human hands cannot attain by first detecting the problem and fixing it with efficiency. In the same context, the results from the Delphi study with the experts' panellists also showed that technology adoption was ranked 2nd as an important sustainable engineering practice that should be adopted in the hospitality sector in Zimbabwe.

Lastly, the results from the interviews pointed out that the other key sustainable engineering practice that can be adopted is green equipment that are environmentally friendly hence bringing the element of longevity. In that regard, it was shown that the engineers should let go of old and traditional ways of revitalizing and developing infrastructure which leads to pollution and degradation but rather choose a new and different path that conserve the environment. A major point that was raised was the increase us in solar power especially in Zimbabwe were power cuts are a common feature and the solar should be used to support all the functions of the lodge that requires power to function and let go of the use of generators. The Delphi study had the experts from EMA also pointing out on the need to adopt green equipment and benchmark with countries such as Sweden and the United States that have been able to introduce

environmentally friendly engineering practices in building and maintaining infrastructure.

In addressing this research question, it was key for the researcher to understand how the adoption of engineering practices also helps to enhance sustainability of the Hwange Safari Lodge's infrastructure. In that that regard, the points that were raised by the interviewees showed that the adoption of sustainable engineering practices enhances innovation and improves the standards of the infrastructure which is a key element in the hospitality industry. Through the adoption of technology and innovation the novelty that is put on the infrastructure leads to sustainability driven by continuous improvements. From the views of the respondents, as the problems on the infrastructure are solved through innovation and continuous improvement, the infrastructure remains intact, and it leads to sustainability. This was also corresponding to the view of Sekhota (2019) who posits that through the adoption of sustainable engineering practices, continuous improvement and innovation are enhanced therefore helping the business to also achieve positive performance.

Another key factor was that sustainability of infrastructure is achieved through the adoption of sustainable engineering practices driven also by proactiveness. This means that that the engineering practices of regular checking and fixing as well as technology adoption helps the engineers to be future oriented and, in the process, come up with future ideas that helps to make sure that that buildings improve over time and continues to change to meet up with international standards as the Hwange Safari Lodge is home to locals and tourists from all over the world.

The aspect of cost saving also comes into the picture and according to the staff at the Hwange Safari Lodge, it is driven be the ability to fix problems on the building when they are still infant which is cheap and helps to save funds. Saved funds can be used in other key areas such as the revitalisation of the lodge's interior, making it more modern and in line with other international hotels from across the globe thereby also improving the rating of the Hwange Safari Lodge. This notion also corresponds to the view of the five laws theory by Dessiter (Owen, 2020).

The potential of sustainable engineering practices in facilitating the redevelopment of infrastructure in the hospitality sector. In this regard, during the interviews, it was pointed out that the adoption of sustainable engineering practices has a huge potential to facilitate the redevelopment of infrastructure in

the hospitality industry in Zimbabwe. In a nutshell, the respondents allude that once the sustainable engineering practices are in play, the first thing that is achieved is innovation which leads to continuous improvement of the infrastructure through redevelopment. Further, the redevelopment is driven by benchmarking with other infrastructure is the hospitality sector that is in 5-star facilities across the globe and this according to the interviewees can be done conveniently through technology driven R&D programs.

It was also taken note that above all, sustainable engineering practices helps to enhance international standards which are only achieved through redevelopment of the infrastructure. International standards help the business to be attractive to customers and also enhance sustainable when positive performance is achieved in aspects such as finance and in the market. Some respondents pointed out that this should be one of the major strategic objectives of the business and is achieved mostly through the adoption of sustainable engineering practices. However, there is also an element of huge investments needed in adopting sustainable engineering practices which may hinder their potential to redevelop infrastructure. But it can be noted that the investment is worthwhile as in the long run the business can make profits from the improved standards and competitiveness in the hospitality industry in the country. Mugebi (2021) in their study concluded that sustainable revitalization of infrastructure in the hospitality sector is enhanced mostly by the adoption of sustainable engineering practices. The study had its major aim on making sure the modification of hotels in the country with the aim to have hotels that meets international standards to serve effectively the 'Visit Rwanda' mantra that lures tourists and investors into the country.

In the above discussion, the major conclusion that is made in the study is that sustainability engineering practices framework in the hospitality sector's infrastructure is something that is major and helps to improve the performance of the sector. Hence the need to make sure that the stated engineering practices; continuous checking and fixing, technology adoption and the use of green equipment is vital in the hotel are adhered to. The study concludes that the sustainable engineering practice of continuous checking and fixing helps to make sure that the infrastructure remains in good shape and does not lower its standards for example from leaking pipes and electrical faults. Thus, the engineers at the Hwange Safari Lodge and the expert panelists reached a consensus that this is the most important sustainable engineering practices that can be adopted in the hospitality sector.

The study also concludes that the adoption of sustainable engineering practices is key in driving sustainability of the infrastructure. This came because of the ability

of the engineering practices to make sure that the problems on the infrastructure are fixed when they are still new and small with the aid of technology and green equipment hence leading to strengthening the building and improving their overall appearance from both inside and outside. Sustainable infrastructure is key in serving generation and contributes in helping the business to be perpetual thereby achieving its purpose, vision.

The study then makes strong recommendations directed to the management of Hwange Safari Lodge to ensure that sustainable engineering practices are put in place religiously. The top-level management was the major target for the recommendation because they are the crafters of winning strategies and leads from the two hence the need to make sure that they do so for sustainable engineering practices. Therefore, the first recommendation is that the top-level management invest funds and other resources for sustainable engineering practices. In order to instill the developed framework effectively, there is need to have resources in place to make sure that technologies are purchased, engineers are further trained and developed, and R&D is undertaken. Therefore, there is need for the management to liaise with the shareholders to attain retained profits to be used as funds that support the adoption of sustainable engineering practices. Further, another recommendation is for the management and the engineers to foster engagement in matters related to the adoption of sustainable engineering practices. The management therefore should include the engineering who are experts in the field to also put their insight and opinions in the process of crafting winning strategies in the organisation. This is key in making sure that there is consensus between the groups and everyone in the organization therefore the same goals can be achieved through collaborations. The engagement is also crucial in enhancing motivation of everyone involved and they can put extra effort to make sure the sustainable engineering practices are instilled with excellence in the business and the ultimate goal of sustainability is achieved.

More so, it is crucial also to for Hwange Safari Lodge to benchmark with other 5-star hotels globally with regards to sustainable engineering practices. Benchmarking entails determining first the sustainable engineering practices adopted in other advanced hotels, how they are being adopted and with which resources before also putting them in place here in Zimbabwe.

This also requires good research skills and also the ability to ensure that the skills of the engineers are advanced at the costs of the organisation to make sure they are competent enough to put in place the practices especially from first world countries.

This study concludes with a recommendation for an area for future study which should be a continuation of this study. The study should be on the effectiveness of the sustainable engineering practices framework on enhancing corporate performance at Hwange Safari Lodge. The study should have its main objective to determine if the adopted framework has helped to improve the financial performance of Hwange Safari lodge in aspects such as costs and profitability. Therefore, a mixed method study should be undertaken and the management in the organization should be included as respondents who will provide the data related to the performance of the organisation.

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Synopsis

Revitalization and redevelopment of infrastructure has become a significant factor in the hospitality sector in Zimbabwe and beyond. The country has a mantra of 'Zimbabwe is open for business' that attracts tourists and investors from all over the world, hence, the first thing they look for is good accommodation in hotels. The hotel infrastructure is expected to meet and exceed the high standards demanded by customers, both from Zimbabwe and foreign countries. This is the major reason why hotel infrastructure is revitalized and redeveloped to be able to meet the international standards. This study aimed at developing a framework for sustainable infrastructure engineering practices in the hospitality sector: a case of Hwange Safari Lodge. The study had three main objectives that were to identify engineering practices that can be adopted in infrastructure development in the hospitality sector, to develop a framework for sustainable engineering practices in the refurbishment of infrastructure in the hospitality sector and to evaluate the proposed framework with expert validation in the engineering sector. To achieve those goals, the study gathered data from staff members mostly engineered in the hotel through interviews and also from external experts in the refurbishment of infrastructure who provided data through a Delphi study that evaluated the framework that was developed from the insight of the staff of the hotel. The study found that the major sustainable engineering practices that can be adopted in the framework are: continuous checking and fixing of faults on the infrastructure, technology adoption and the use of green equipment that preserves the environment. Further, it was also found that sustainable engineering practices will help the infrastructure to be sustainable and also meet international standards at a relatively low cost in the long run. The framework was key in helping the hotel improve its performance through being attractive and gaining competitive advantage.

About the Author

Raymond Mudehwe holds multiple professional qualifications, including MRICS, PMP, AREIZ, MZIRUP, REA, RV, an MBA, and an MSc. An Associate member of the Real Estate Institute of Zimbabwe (REIZ) and also a registered planner with the Zimbabwe Institute of Regional and Urban Planners (ZIRUP). A member of the Royal Institute of Chartered Surveyors. With over a decade of extensive experience in the real estate industry, including more than seven years in managerial roles, Raymond has established himself as a leader in the field.

Currently, Raymond serves as the Real Estate Executive for African Sun Limited, one of the largest tourisms and hospitality companies in the country. His professional journey includes key roles such as Chief National Housing Officer at NBS Bank and Property Development Manager at Dawn Properties. He has successfully managed complex real estate projects exceeding $10 million, demonstrating his deep understanding of industry best practices and regulatory requirements.

Raymond is known for his adaptability, eagerness to learn, and ability to thrive under pressure. He excels in working with people from diverse cultures and at corporate levels, consistently seeking new ideas to improve working environments. Passionate about his work, Raymond believes that increased responsibilities enhance his performance. His goal is to succeed and excel in every endeavour, driven by his willingness to learn and go the extra mile.