EXPLORING THE ABSENCE OF

DATA CENTER VIRTUAL TOURS IN

ZIMBABWE: A CASE STUDY OF HARARE.

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DATA CENTER VIRTUAL TOURS IN

ZIMBABWE: A CASE STUDY OF HARARE.

BY

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Abstract

The rapid advancement towards digital transformation has recorded a surge in the implementation of immersive technologies like virtual tours across various sectors. Zimbabwe, specifically Harare, is still far behind in anything that concerns data center virtual tours. This study, therefore, investigates the absence of virtual tour technologies in Harare's data centers with the view of establishing key challenges, expected benefits, and practical solutions to effect implementation.

By means of surveys, interviews, and document analysis, an array of critical factors have been established that have impacted the adoption process. Apparently, lack of awareness, being cost-intensive to implement, security and privacy issues, and the inadequacy or absence of technical infrastructure are barriers to adoption. On the other hand, virtual tours could mean a lot in terms of client involvement, operational visibility, better training methods, and going green.

With these findings in context, the study proposes solutions such as awareness campaigns, financial incentives, policy formulation, and strategic partnerships with technology providers. The work also incorporates the Technology Acceptance Model (TAM) and related literature to elaborate on perceived usefulness and ease-of-use as key drivers for adoption.

This study contributes useful insights to data center operators, government stakeholders, and technology partners in Zimbabwe; it offers a strategic roadmap for the integration of virtual tour technologies into the industry. In conclusion, the research posits that virtual tours have the potential to improve digital infrastructure and decision-making processes while further aligning Harare's data center sector with global best practices in technology innovations.

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Dedication

This dissertation is dedicated to my parents, whose unwavering support and belief has shaped me to become what I am today. Their constant support and sacrifices have been a constant reminder to always work hard for what you want in life. I am deeply grateful for their love, support and invaluable lessons they have taught me.

List of Acronyms and Abbreviations

AR – Augmented Reality. VR – Virtual Reality.

DC – Data Center.

TAM – Technology Acceptance Model.

IT – Information Technology.

DAMA – Data Management Association.

DMBOK – Data Management Body of Knowledge.

TOGAF – The Open Group Architecture Framework.

NIST – National Institute of Standards and Technology.

COBIT – Control Objectives for Information and Related Technologies.

ISO – International Organization for Standardization.

GDPR – General Data Protection Regulation.

SANS – SysAdmin, Audit, Network, and Security.

COSO – Committee of Sponsoring Organizations.

ERM – Enterprise Risk Management.

OCTAVE – Operationally Critical Threat, Asset, and Vulnerability Evaluation.

CCPA – California Consumer Privacy Act.

DPA – Data Protection Act.

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CHAPTER 1: INTRODUCTION

1.1 Overview

Virtual reality is a very powerful and compelling computer application by which humans can interface and interact with computer-generated environments in a way that mimics real life and engages all the senses (Grigore C. Burdea, June 30, 2003). (Placeholder1) A virtual tour of a data center is a digital simulation or representation of a physical data center facility that allows users to navigate through the space remotely using virtual reality (VR), augmented reality (AR) or other interactive technologies.

A virtual tour of data centers allows users to explore the facility remotely, accessing various areas and equipment through interactive 360-degree views (V, 2024). These tours provide a 360-degree view of the data center environment, allowing users to explore various areas such as servers, server racks, cooling systems and networking infrastructure. Data center virtual tours aim to provide stakeholders, clients, IT professionals and managers, with an immersive experience, showcasing the facility's layout, equipment and operational processes without the need for physical presence.

This dissertation focuses on exploring the absence of virtual tours of the various data centers in Zimbabwe. The study aims to investigate the challenges faced in having a virtual tour of the data center and identify the potential opportunities for having virtual data center tours and propose strategies for enhancing virtual tours of data centers.

1.2 Background of the Study

Data centres have become the backbone of the digital age, silently powering the global economy, and enabling the seamless flow of information that underpins modern life. These specialized facilities house the servers, storage systems, and network equipment that store, process, and transmit the vast troves of data generated by businesses, governments, and individuals around the world. In many developed economies, data centres have become more visible and accessible to the public.

Several major tech companies have opened their data centres to virtual exploration, allowing people to gain a glimpse into the inner workings of these high-tech hubs. These virtual tours serve to increase public awareness and understanding of data centres, which are often perceived as opaque and intimidating facilities. By providing transparency, these initiatives can also inspire future.

The digital environment in Harare is progressively changing, offering chances for technical advancement despite current obstacles like financial limitations and limits in infrastructure. One new area of investigation is the idea of Virtual tours of data centres. These virtual tours give a special opportunity to investigate the within remote operations of data centres, offering information about their infrastructure, management, and safety precautions.

Virtual data centre tours may have advantages, but their adoption is low to non-existent in Harare. Recognising the causes of this restricted uptake, investigating the potential they offer, and putting forth workable plans for its use is crucial to utilising this technology to improve the nation's infrastructure for technology. In contrast, the Zimbabwean data centre industry has not widely embraced the concept of virtual tours and public outreach.

Despite the country's growing reliance on digital services and cloud computing, there appears to be a lack of publicly accessible information or interactive experiences that allow citizens to learn about the data centres powering the national economy. This absence of virtual tours and educational resources is particularly concerning given Zimbabwe's ongoing efforts to develop its digital infrastructure and attract foreign investment in the technology sector. Without a clear understanding of the role and inner workings of data centres, the public may remain sceptical or mistrustful of these critical facilities, hindering the growth of a vibrant and innovative digital ecosystem.

Additionally, the lack of virtual tours could contribute to a skills gap, as young Zimbabweans may be less inspired to pursue careers in data centre management and engineering. This could impede the country's ability to develop a robust, locally sourced talent pool to support the expansion of its digital economy. Therefore, this research study aims to explore the underlying reasons for the absence of data centre virtual tours in Zimbabwe, with the goal of providing insights that could inform development.

1.2 Statement of the Problem

The limited adoption of virtual tours of data centers in Harare represents a missed opportunity for technological advancement. Without embracing this technology, organizations miss the educational and promotional benefits it offers, including enhanced transparency, improved stakeholder engagement, and increased accessibility. This study aims to uncover the underlying barriers hindering adoption, identify opportunities for leveraging virtual data center tours and propose actionable strategies to overcome these barriers.

1.3 Research Objectives

This research project aims to achieve the following objectives:

1. Identify the challenges preventing the widespread adoption of data center virtual tours

in Harare.

2. Explore the potential benefits and opportunities data center virtual tours in Harare could offer in the country.

3. Propose practical solutions to facilitate the implementation of data center virtual tours in Harare.

1.4 Research Questions

This research will address the following questions:

1. What are the main challenges faced by organizations in Harare in adopting virtual tours of Data Centers?

2. Which opportunities do data center virtual tours offer for the technological advancement in Harare?

3. How can potential solutions be identified to overcome the challenges in adopting data center virtual tours in Harare?

1.4 Assumptions/Hypotheses

1.4.1 Assumptions:

a) Organizations in Harare have implemented virtual tours of Data Centers within their environments.

b) Organizations in Harare recognizes the importance of virtual tours of Data centers and have allocated resources accordingly.

c) The technological infrastructure in Harare present limitations for the widespread adoption of data center virtual tours in Harare.

d) There is a lack of awareness and understanding among stakeholders in Harare about the benefits of data center virtual tours.

e) Regulatory frameworks and data privacy concerns influence the reluctance of data center operators in Harare to implement various virtual tours initiatives.

1.4.2   Hypotheses:

a) Hypothesis 1: Organizations in Harare face challenges related to limited technological infrastructure, including internet connectivity and access to AR/VR devices, hindering the adoption of virtual tours of data centers.

b) Hypothesis 2: A lack of awareness and understanding among stakeholders about the benefits and applications of virtual tours of data centers contributes to their limited adoption in Harare.

c) Hypothesis 3: Data Center operators in Harare encounter regulatory barriers and data privacy concerns that deter them from implementing virtual tour initiatives, thereby contributing to the absence of such tours.

1.5 Significance of the Study

This study is significant as it will provide insight into the specific challenges that Harare faces in terms of technological advancement in the area of data center virtual tours in Harare. It will serve as a resource for policymakers, IT professionals, and business leaders to understand the benefits and challenges associated with virtual tours of data centers, and how to strategically address them.

1.5.1 Significance of the Study to the researcher

a) Professional Development: Conducting research on this topic allows the researcher to deepen their understanding of data center technologies, virtualization, and the challenges faced by organizations in Harare's technological landscape. This can contribute to the researcher's professional growth and expertise in the field of IT and

data management.

b) Contribution to Knowledge: By exploring the absence of virtual tours of DCs in Harare, the researcher can contribute new insights and perspectives to the existing body of knowledge. This research can uncover factors unique to Harare's context and shed light on potential barriers and opportunities for the adoption of virtual tour technologies.

c) Potential Solutions: The research may identify potential strategies to overcome challenges hindering the adoption of virtual tours of DCs in Harare. This can provide practical recommendations for data center operators, policymakers and stakeholders interested in promoting technological innovations in the county.

d) Personal fulfilment: Engaging in this research topic as a personal interest offers the opportunity to explore new ideas, challenge assumptions, and make a meaningful contribution to addressing real-world problems in the field of technology and data management.

e) Impact on stakeholders: Understanding the significance of virtual tours of DCs can have a positive impact on various stakeholders, including businesses, IT professionals, government agencies, and the general public. The findings from this research may inform decision-making processes, investment strategies and educational initiatives aimed at improving technological infrastructure and awareness in Harare.

1.5.2   Significance of the study to the business industry

a) Enhanced transparency: Virtual tours of data centers can provide businesses with transparent insights into the infrastructure, security measures, and operational processes of data centers. This transparency fosters trust between data center operators and their clients, as businesses can visually inspect the facilities where their critical data is housed.

b) Improved Decision Making: Access to virtual tours allows businesses to make more

informed decisions when selecting a data center provider. By visually assessing the facility's capabilities and security measures, businesses can better evaluate whether a data center meets their specific requirements and standards.

c) Promotion and Marketing: Virtual tours serve as powerful marketing tools for data center operators to showcase their facilities to potential clients. Businesses seeking data center services can virtually tour multiple facilities without the need for physical visits, saving time and resources in the decision-making process.

d) Competitive Advantage: Data center operators that offer virtual tours may gain a competitive edge in the market by demonstrating transparency, innovation, and a commitment to client engagement. Businesses are more likely to choose providers that offer virtual tours as they prioritize transparency and accessibility.

e) Educational Opportunities: Virtual tours can serve as valuable educational resources for businesses, providing insights into data center operations and best practices in data management. This knowledge empowers businesses to make informed decisions regarding data storage, security, and disaster recovery strategies.

1.6 Delimitations of the Study

a) Sample Size: The study's findings may be limited by the size and diversity of the sample population, particularly if access to data center operators, IT professionals, and stakeholders in Harare is restricted.

b) Access to Information: Limited access to proprietary information and data center facilities may restrict the depth of analysis and understanding of the challenges and opportunities surrounding virtual tours of data centers in Harare.

c) Bias and Subjectivity: There is a possibility of bias or subjectivity in the interpretation

of data and findings, particularly in qualitative aspects of the research such as interviews or surveys.

d) Dynamic Nature of Technology: The rapid pace of technological advancements may render some findings outdated or less relevant over time, particularly if the study's focus is on specific technologies or platforms for virtual tours.

e) Regulatory Environment: The study may be constrained by the regulatory environment surrounding data privacy and security in Harare, which may impact the willingness of data center operators to participate or disclose information.

f) Resource Limitations: Limited financial resources or access to specialized equipment/software for conducting virtual tours or data analysis may restrict the depth and breadth of the study.

g) Time Constraints: Time constraints may limit the scope of the study, preventing comprehensive exploration of all factors influencing the absence of data center virtual tours in Harare.

1.7 Limitations of the Study

a) Limited Data Availability: The availability of comprehensive data on the current status of data centers and virtual tour initiatives in Harare may be limited, making it challenging to conduct a thorough analysis.

b) Access to Data Center Operators: Obtaining access to data center operators for interviews or surveys may be difficult due to confidentiality concerns or proprietary information, limiting the depth of insights gained from industry stakeholders.

c) Regulatory Considerations: Regulatory frameworks related to data privacy and security

may pose challenges to the implementation of virtual tour initiatives, impacting the willingness of data center operators to participate or share information.

d) Resource Constraints: Limited financial resources or access to specialized equipment/software for conducting virtual tours or data analysis may restrict the scope and depth of the study.

e) Technological Infrastructure: Harare's technological infrastructure, including internet connectivity and access to virtual reality devices, may be underdeveloped or inconsistent, affecting the feasibility and effectiveness of virtual tour implementations.

CHAPTER 2: REVIEW OF RELATED LITERATURE

2.1 Introduction

A literature review analyses books, academic papers, and other materials pertaining to a specific subject, field of study, or theory and gives a description, summary, and critical evaluation of these works in connection to the research problem at hand. A literature review's objective is to offer an overview of the sources used to investigate a specific issue and to show readers how the research fits into a wider field of study. Literature reviews are literally reviews of the literature (the academic writing e.g. academic books, journal articles etc.) that have been published on a particular research topic (Libguides, 2023). This chapter provides an in-depth exploration of the challenges posed by the absence of virtual tours in data centers located in Harare. It delves into the implications of this absence for data management and security practices. The chapter aims to examine various theoretical frameworks that can offer structured approaches to addressing these challenges and mitigating associated risks.

2.2 Theoretical Framework

A theoretical framework guides the research process like a roadmap for the research study and helps researchers clearly interpret their findings by providing a structure for organizing data and developing conclusions (Sreekumar, 2024, March 8). To address the challenges posed by the absence of data centre virtual tours, a theoretical framework can provide a structured approach to understanding and implementing effective data management and security strategies in these environments.

    a.   Data Governance Framework:

Data governance refers to the overall management and control of an organization's data assets. It encompasses policies, processes, and procedures for ensuring data quality, integrity, and security. In the context of data centers, the absence of virtual tours can impact transparency and oversight. Adopting a data governance framework can provide a systematic

approach to managing data throughout its lifecycle, ensuring that data centers maintain high standards despite the lack of virtual visibility. Frameworks such as the Data Management Association (DAMA) International's Data Management Body of Knowledge (DMBOK), COBIT, ISO/IEC 38500, The Open Group Architecture Framework (TOGAF), NIST Data Management Framework, and privacy regulations like GDPR provide comprehensive guidance on establishing data governance practices. These frameworks cover critical aspects such as data stewardship, metadata management, data quality assurance, risk management, strategic alignment, value delivery, access controls, incident response, and compliance with transparency requirements. By adopting these frameworks, data centers can ensure robust data governance even in the absence of virtual tours, maintaining ambitious standards of data quality, integrity, and security.

b.   Information Security Framework:

Information security frameworks offer a comprehensive approach to protecting data from unauthorized access, breaches, and vulnerabilities, which is especially important in environments without virtual tours. Frameworks such as the National Institute of Standards and Technology (NIST) Cybersecurity Framework, ISO/IEC 27001, COBIT, CIS Controls, Zero Trust Architecture, and SANS Critical Security Controls provide guidelines for assessing risks, implementing controls, and establishing a robust security posture. These frameworks address various aspects of information security, including risk management, access controls, incident response, and security awareness training, ensuring that even without virtual tours, data centers can maintain rigorous security standards.

c.   Defence-in-Depth Model:

The defence in depth model is a strategy that leverages multiple security measures to protect an organization's assets. The thinking is that if one line of defence is compromised, additional layers exist as a backup to ensure that threats are stopped along the way (Fortinet, n.d.). This model acknowledges that no single security measure can provide complete protection. In data centers, especially those without virtual tours, this approach becomes crucial as it compensates for the lack of physical and visual inspection capabilities. It combines physical controls (e.g., access control systems, surveillance systems,

environmental controls) with technical controls (e.g., firewalls, intrusion detection systems, encryption, network segmentation) and administrative controls (e.g., policies and procedures, access management, training, and awareness). Additionally, operational security controls such as regular audits, patch management, and robust incident response plans are implemented to ensure ongoing security. Even in situations when virtual monitoring is not feasible, data centers may efficiently limit risk and comply with high-security standards thanks to this multi-layered security system.

d. Risk Management Framework:

Risk management frameworks help organizations identify, assess, and mitigate risks to their data and information assets. In the context of data centers lacking virtual tours, these frameworks are vital for proactively managing potential risks. Frameworks such as the NIST Risk Management Framework, ISO 31000, COSO Enterprise Risk Management (ERM) Framework, FAIR (Factor Analysis of Information Risk), and OCTAVE (Operationally Critical Threat, Asset, and Vulnerability Evaluation) provide systematic methodologies for risk identification, analysis, and response. These frameworks emphasize understanding organizational risks, prioritizing mitigation efforts, and continuously monitoring and reassessing risks to ensure an effective risk management approach. This is especially crucial in the absence of visual data center inspections, as these frameworks help compensate for the lack of physical and visual oversight by ensuring rigorous and comprehensive risk management practices.

e. Privacy Framework:

Privacy frameworks, such as the General Data Protection Regulation (GDPR), the California Consumer Privacy Act (CCPA), the Zimbabwe Data Protection Act which says, "In order to safeguard the security, integrity, and confidentiality of the data, the controller or his or her representative, if any, or the processor, shall take the appropriate technical and organizational measures that are necessary to protect data from negligent or unauthorized destruction, negligent loss, unauthorized alteration or access, and any other unauthorized processing of the data (2021, 2022)", ISO/IEC 27701, and the APEC Privacy Framework provides comprehensive guidelines for protecting personal data and ensuring compliance with privacy regulations. In data centers, the absence of virtual tours makes it crucial to

adhere strictly to these frameworks. They address principles such as data minimization, consent, transparency, individual rights, privacy risk assessment, and accountability. By following these privacy frameworks, data centers in Harare can ensure that their data management and security practices align with legal and ethical requirements, maintaining trust and compliance even without virtual tours. Companies must inform consumers about what they do with consumer data and every time that data is breached (Team, n.d.).

f. Technology Acceptance Model (TAM)

The technology acceptance model (TAM) explains the acceptance of information systems by Individuals (Marikyan, 2023). The Technology Acceptance Model (TAM) can serve as a valuable framework for understanding how data center managers and stakeholders in Harare perceive the adoption of alternative technologies or practices in the absence of virtual tours. TAM provides insights into the acceptance and implementation of new data management tools, focusing on factors such as perceived usefulness, perceived ease of use, intention to use, and actual usage.

By drawing upon these theoretical frameworks, the study can establish a solid foundation for addressing the challenges associated with the absence of virtual tours in data centers located in Harare. This comprehensive approach will facilitate the development of robust data management and security practices, ensuring that data centers in Harare maintain ambitious standards of efficiency and security despite the lack of virtual tour capabilities.

2.3 Relevance of the theoretical framework to the study

a. Data Governance Framework

- Relevance: Data governance frameworks ensure systematic management of data assets, which is essential in the absence of virtual tours to maintain transparency and oversight.
- Key Aspects: Data stewardship, metadata management, data quality assurance, risk management, strategic alignment, value delivery, access controls, incident response, and compliance with transparency requirements.

b. Information Security Framework:

- Relevance: Information security frameworks provide comprehensive guidance to protect data from threats, compensating for the lack of virtual tours by ensuring rigorous security standards.
- Key Aspects: Risk management, access controls, incident response, security awareness training and establishing a robust security posture.

c. Defence-in-Depth Model:

- Relevance: The defense-in-depth model is crucial for data centers without virtual tours, as it provides multiple layers of security to compensate for the absence of physical and visual inspection capabilities.
- Key Components: Physical controls, technical controls, administrative controls, and operational security controls.

d. Risk Management Framework:

- Relevance: Risk management frameworks are vital for proactively managing potential risks in data centers lacking virtual tours, ensuring comprehensive risk identification, assessment, and mitigation.
- Key Methodologies: Risk identification, analysis, response, understanding organizational risks, prioritizing mitigation efforts, and continuous monitoring.

e. Privacy Framework:

- Relevance: Privacy frameworks ensure compliance with privacy regulations and protect personal data, especially important in data centers without virtual tours.
- Key Principles: Data minimization, consent, transparency, individual rights, privacy risk assessment, and accountability.

f. Technology Acceptance Model (TAM):

- Relevance: TAM helps understand the acceptance of alternative technologies or practices in the absence of virtual tours, providing insights into data management tool adoption.
- Focus Areas: Perceived usefulness, perceived ease of use, intention to use, and actual usage.

2.4 Summary

The research study focuses on the absence of virtual tours in data centers located in Harare. It begins with an introduction to the importance of literature reviews and outlines the scope of the study. The theoretical framework section introduces six key frameworks relevant to addressing the challenges posed by the absence of virtual tours: Data Governance, Information Security, Defence-in-Depth Model, Risk Management, Privacy, and the Technology Acceptance Model (TAM). These frameworks are explained in terms of their relevance to the research topic. Finally, a section on the importance of theoretical frameworks for research discusses how each framework contributes to research objectives. Overall, the purpose of the study is to provide a solid basis for understanding and addressing the challenges associated with the lack of virtual tours of data centers in Harare.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter outlines the methodology used to explore the absence of virtual tours in data centers in Harare, focusing on understanding the reasons behind this absence and its implications. It outlines the research design, data collection methods, data analysis techniques, and ethical considerations undertaken in the study. The primary aim of this chapter is to provide a clear and systematic approach to examining the factors contributing to the lack of virtual tours in data centers and to propose potential solutions. The methodology ensures the reliability and validity of the study's findings and recommendations.

3.2 The Research Design

The study adopts a mixed-methods research design, combining both qualitative and quantitative approaches. This design allows for a comprehensive analysis by collecting and integrating diverse types of data.

The research design incorporates the following components:

   a. Qualitative Research.

Qualitative research techniques are utilized to get comprehensive viewpoints and insights from significant stakeholders in Harare's data centers. Semi-structured interviews are carried out with IT specialists, data center managers, and pertinent personnel involved in data center activities. Open-ended inquiries, in-depth discussions, and an examination of participants' experiences, difficulties, and suggestions regarding the lack of virtual tours are all made possible by the interviews. The rich, descriptive information provided by the qualitative data gathered from the interviews helps to fully comprehend the background and intricacies of the situation surrounding the absence of virtual tours in data centers. To better comprehend human experience, qualitative research enables you to pose questions that are difficult to answer with figures. Getting at the everyday realities of some social phenomenon and studying important questions as they are practiced helps extend knowledge and understanding. (Cleland, 2017, June)

b. Quantitative Research

Quantitative research methods are employed to gather measurable and comparable data on the absence of virtual tours in data centers in Harare. Quantitative research produces objective data that can be communicated through statistics and numbers (Williams, 2021). Surveys are distributed to a broad range of data center managers, IT professionals, and other relevant stakeholders. These surveys include structured questions designed to quantify the prevalence of virtual tours, the perceived importance of such tours, and the barriers to their implementation. The quantitative data collected from the surveys provide statistical insights into the extent of the issue, enabling the identification of trends and correlations. This approach ensures that the findings are supported by robust numerical evidence, contributing to a comprehensive understanding of the factors influencing the lack of virtual tours in data centers.

c. Sampling Strategy

Purposive sampling will be used in the study of the absence of virtual tours in Harare Data centers. This tactic entails choosing participants according to particular research-relevant parameters, such as their functions in data center operations, familiarity with virtual tour technology and experience implementing technology. The study guarantees that the information gathered is extremely pertinent and insightful because it focuses on data center managers, IT specialists, and security staff in Harare. This method improves the findings' relevance and depth, but it also raises the possibility of selection bias and reduces generalizability. Purposive sampling, however, works well for getting in-depth and significant insights from informed stakeholders.

3.3 Population & Sampling

To ensure a thorough and representative sample, a combination of purposive and stratified random sampling methods will be utilized. Purposive sampling involves deliberately selecting individuals who have the requisite expertise and engagement in data center operations, thereby ensuring that the sample includes those who play a crucial role in decision-making processes related to virtual tours in data centers.

Individuals will be chosen based on specific criteria such as their job roles, responsibilities, and level of involvement in data center management and operations. After identifying suitable participants, stratified random sampling will be applied within these groups to guarantee diverse representation across different subgroups, such as varying levels of experience and different sizes of data centers. This combined approach minimizes selection bias and enhances the representativeness of the sample.

The sample size will be determined based on data saturation, continuing data collection, and analysis until no new insights or perspectives emerge. This approach ensures a comprehensive amount of information to effectively address the research questions and objectives.

Establishing a cooperative relationship with participants is essential for their engagement in the study. Ensuring the confidentiality and anonymity of their responses, along with clear communication of the study's procedures and objectives, will encourage trust and participation.

Participants will be invited to participate in semi-structured interviews and surveys, which will allow them to share their thoughts, experiences, and recommendations concerning the absence of virtual tours in data centers. These interactions will be conducted in private and comfortable settings to facilitate open and honest discussions.

The sampling strategy and participant selection process will be documented and justified to ensure transparency and the validity of the study's findings. Inclusion criteria and the rationale for selecting specific individuals will be clearly outlined, providing a foundation for the generalizability of the research outcomes within the context of data centers in Harare.

By employing a combination of purposive and stratified random sampling, the study aims to capture the perspectives and experiences of those who directly influence the adoption of virtual tours in data centers. The insights derived from this sample will contribute to a detailed understanding of the current practices and potential solutions to enhance the use of virtual tours in data centers.

3.4 Data Collection Instruments

To gather data for the study on the absence of virtual tours in data centers in Harare, multiple data collection instruments are utilized. These instruments are designed to collect qualitative

and quantitative data that address the research objectives and research questions. The researcher uses two major data collection tools:

a. Surveys:

Surveys, which ask a sample of data centre employees a series of questions experts, such as data centre supervisors, IT specialists, and security personnel are effective and scalable, making it possible to gather vast amounts of data. in a brief amount of time, especially when done online with tools like Google forms. This technique assists in preserving the respondents' secrecy and anonymity while supplying numerical information.

b. Semi-structured interviews

Semi-structured interviews, on the other hand, involve guided conversations with participants, allowing for a deeper exploration of perspectives, experiences, and phenomena related to the absence of virtual tours in data centers. These interviews yield rich qualitative data that complements the quantitative data collected through surveys, providing nuanced insights into the topic.

3.5 Data Collection Procedure

The data collection procedure for the study on the absence of virtual tours in data centers in Harare involves several steps. These steps detail the process of gathering qualitative and quantitative data using selected data collection methods.

a. Ethical Considerations:

Before commencing data collection, ethical considerations are addressed. The study obtains ethical approval from the relevant research ethics committee, ensuring adherence to ethical guidelines and safeguarding the rights and privacy of participants. Informed consent is obtained from all participants, outlining the study's purpose, voluntary participation, and confidentiality measures.

b. Selection of Participants:

Utilizing a purposive sampling approach, participants are chosen based on their roles and expertise in data management and security within Harare's data centers. Key stakeholders, including data center managers, IT professionals, and security personnel, are identified. Selection criteria are established to ensure transparency and validity.

c. Semi-Structured Interviews:

For qualitative data collection, semi-structured interviews are conducted with selected participants. Interviews are scheduled at mutually convenient times and locations. Participants receive an interview guide containing predetermined questions and prompts to facilitate discussion. With participants' consent, interviews are audio-recorded to accurately capture responses.

d. Surveys:

Quantitative data is collected through surveys administered to a broader sample of stakeholders within Harare's data centers. Surveys are distributed via online platforms, email, or paper-based forms, accommodating participants' preferences. Clear instructions are provided for survey completion.

3.6 Analysis & Organization of Data

Data analysis involves using statistical and logical methods to explain, present, summarize, and assess data systematically. Various analytic procedures "provide a way of drawing inductive inferences from data and distinguishing the signal (the phenomenon of interest) from the noise (statistical fluctuations) present in the data" This process, also known as "data summarization," is essential for finding relevant information, drawing conclusions, and supporting decision-making. (Shamoo, 2003)

For this study, the analysis will include examining, cleaning, transforming, and modeling the data. After conducting interviews and collecting all questionnaires, the audio recordings will be transcribed to capture details that might have been missed during the interviews and note-

taking. Thematic analysis will be used to systematically identify patterns, correlations, and recurring themes in the qualitative data from participants' responses. This approach helps build a comprehensive understanding of the research issue.

For the quantitative data from the questionnaires, we will apply statistical techniques. Descriptive statistics, such as means, frequencies, percentages, and standard deviations, will provide an overview of participant responses. Additionally, inferential statistics, like chi-square tests or t-tests, will be used to examine connections or differences between variables. This statistical analysis provides unbiased insights into the significance and prevalence of certain phenomena related to the absence of virtual tours in data centers.

The analyzed data will be interpreted and synthesized to address the study's research questions and objectives, identifying key conclusions, themes, and patterns. The findings will be presented clearly, with detailed descriptions of the data analysis process, main conclusions, supporting data, and interpretations, including tables, figures, and quotes to illustrate the results. Based on these findings, recommendations will be made to address the absence of data center virtual tours in Harare.

3.7 Ethical Considerations

Informed Consent:

Participants should be fully informed about the purpose of the study, the procedures involved, the potential risks and benefits, and their rights as participants. They must voluntarily agree to participate without any coercion.

Confidentiality and Anonymity:

Measures should be taken to ensure that the identities of the participants are protected. Data should be anonymized, and any identifying information should be kept confidential. Ensure that only authorized personnel have access to the data.

Privacy:

Respect the privacy of participants during data collection, especially during interviews. Participants should feel comfortable and secure, knowing that their private information will not be disclosed without their consent.

Data Protection:

Secure storage and handling of data are crucial. Use encrypted devices and secure servers to store data. Ensure compliance with data protection laws and regulations, such as GDPR, where applicable.

Voluntary Participation and Right to Withdraw:

Participants should be informed that their participation is voluntary, and they have the right to withdraw from the study at any point without any negative consequences.

Avoiding Harm:

Ensure that the study does not cause any physical, psychological, or emotional harm to participants. This includes being sensitive to the topics discussed during interviews and surveys.

Transparency:

Be transparent about the research process, objectives, and how the findings will be used. Participants should have access to this information before consenting to participate.

Ethical Approval:

Obtain approval from an appropriate ethics review board or committee before starting the study. This ensures that the research design and methods adhere to ethical standards.

Debriefing:

Provide participants with a debriefing session after their participation, explaining the study's purpose in more detail and answer any questions they might have.

Responsibility to Report:

Ensure that the findings are reported honestly and accurately, without fabrication, falsification, or inappropriate data manipulation. Give credit to all contributors and acknowledge any limitations.

3.8 Summary

Chapter 3 describes a methodology to explore the absence of virtual circles in data centers in Harare to understand its causes and consequences. Mixed methods research combines qualitative and quantitative research methods.

Qualitative insights are gathered through semi-structured interviews with data center managers and professionals, facilitating an in-depth exploration of their perspectives and experiences. At the same time, quantitative data will be collected through surveys that will be distributed to a wide group of stakeholders, allowing a measurable analysis of the prevalence of virtual tours and related barriers. A purposive and stratified random sampling strategy ensures a diverse representation of participants, selected according to their role in the operation of the data centers. Ethical considerations include obtaining informed consent, ensuring participant confidentiality and privacy, and ensuring voluntary participation and the right to withdraw.

Data analysis includes thematic analysis of qualitative data and descriptive and inferential statistics of quantitative data, which enables an in-depth study of the research topic. The findings will be synthesized to meet the research objectives and provide clear recommendations to improve the implementation of virtual visits in data centers in Harare, following ethical guidelines.

Project Timeline

April - May 2024

- Development of proposals and data collection tools.

28 June 2024

- Submission of proposals to AUREC.

August - December 2024

- Data Collection.

January - February 2025

- Data Compilation & Literature.

March 2025

- Review and submission.

CHAPTER 4: DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Introduction

This chapter presents, analyzes, and interprets the data collected from the study exploring the absence of virtual tours in data centers in Harare, Zimbabwe. The primary aim is to uncover the underlying barriers to the adoption of virtual tours, assess the benefits and opportunities they could offer, and propose potential solutions.

In this chapter, the data collected through surveys, semi-structured interviews, and document analysis will be presented and analyzed to address the research questions. The chapter begins by describing the data collection methods and the key findings from the data. It then discusses the interpretation of the findings and how they relate to the existing literature and the research problem regarding the limited adoption of virtual tours in Zimbabwean data centers.

Several tools and methods were employed to analyze the data collected from data center stakeholders in Harare. These tools facilitated a comprehensive assessment of the barriers to implementing virtual tours. The following tools were instrumental in the analysis process: Qualitative Analysis Tool – Google Forms, Microsoft Forms, Quantitative Analysis Tool – Surveys processed using Microsoft Excel, and Data Visualization Tool – Microsoft Excel for graphical representation of trends and insights.

Finally, this chapter examines the implications of the findings for data centers in Harare, highlighting opportunities to implement virtual tours, enhance stakeholder engagement, and strengthen transparency and technological capabilities within the data center industry.

The insights derived from this analysis will assist data centers in Harare in developing more efficient virtual tour strategies, aligning with technological advancements and addressing the specific challenges of the local data center environment.

4.2 Data Presentation and Analysis

4.2.1 Response Rate Analysis

A total number of 15 individuals who are directly involved or related to the Data Center environment were selected altogether from Kenac Computer Systems and TelOne.

$$\text{Response Rate} = \frac{Total\ number\ of\ questionnaires\ returned}{Total\ number\ of\ questionnaires\ issued} \times 100$$

Selected Participants	Questionnaires issued	Questionnaires returned	Response Rate	Response Rate %
All	15	8	0.53	53.3%

Table 4.1 Survey Response Rate

Table 4.1 summarizes the survey's response rate. It details those 15 participants were selected, 15 questionnaires were distributed, and 8 questionnaires returned, rendering a response rate of 53.3%, providing an overview of the level of participation in the survey.
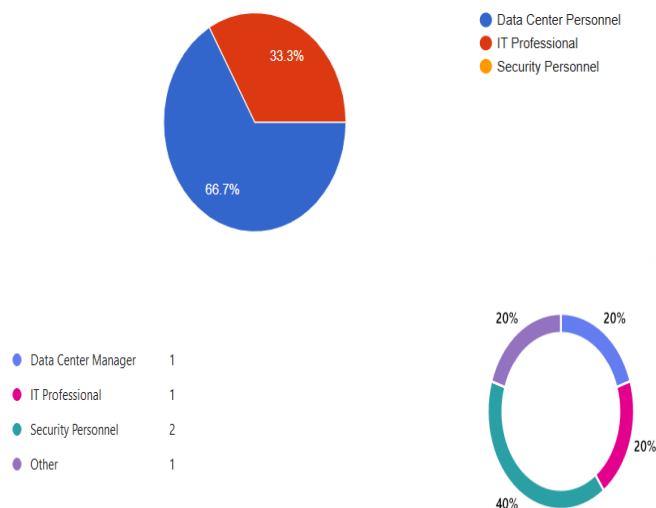
Figure 4.1 Actual TelOne Responses vs Kenac Computer Systems Responses

The evaluative figure shown in Figure 4.1 has a pictorial representation of the number of responses that TelOne and Kenac Computer Systems provide. It also shows how such responses are distributed between the two organizations and thus gives the reader a clearer understanding

of where the data comes from and how much each organization contributes to the study's findings.

4.2.2 Sample Role Demographic Characteristics

SELECTED PARTICIPANTS	QUESTIONNAIRES EXPECTED	QUESTIONNAIRES RETURNED
All	15	8
Data Center Personnel	50	37.5%
Security Personnel	30	25%
IT Professional	10	12.5%
Other	10	12.5%

Table 4.2 Demographic Statistics

Table 4.2 shows the respondent demographics. The respondents are classified according to their roles (Data Center Personnel, Security Personnel, IT Professional, and Other), with expected questionnaires along with their corresponding returned from each group.

4.3 Data Presentation and Analysis

As the researcher conducting this study on the absence data center virtual tours in Harare, the researcher utilized a multi-method approach to gather the necessary data to address the research questions. In this section, the researcher will present the key findings from the data collection and provide an in-depth analysis of the insights gained.

4.3.1 Data Collection Methods

a. Semi Structured Interviews

Semi-structured interviews were conducted to gather in-depth insights from key stakeholders directly involved in data center operations in Harare. These stakeholders included data center managers, IT professionals, and security personnel from Kenac Computer Systems and TelOne. A total of 8 interviews were carried out, each lasting approximately 5 to 15 minutes. The interviews were conducted in-person and via online platforms, depending on the availability and preference of the participants.

Key topics that were talked about included:

- Awareness of virtual tour technologies.

- Perceived benefits and barriers to adopting virtual tours.

- Organizational readiness and infrastructure challenges.

- Suggestions for enhancing the adoption of virtual tours.

This method was chosen to capture qualitative data, allowing participants to express their views openly and providing a deeper understanding of the factors influencing the absence of data center virtual tours in Harare. These insights were instrumental in uncovering underlying challenges and identifying potential opportunities.

b. Surveys

Surveys were administered to a broader group of stakeholders to collect measurable data and quantify key trends. The target population included data center personnel, IT professionals, and security staff, ensuring diverse representation. A total of 15 participants were invited to complete the surveys, with a response rate of 53.3%.

The surveys consisted of structured, close-ended questions designed to assess:

- Awareness and previous use of virtual tour technologies.
- Perceived benefits such as operational efficiency, training enhancements, and stakeholder transparency.
- Barriers to adoption, including high implementation costs, technical limitations, and security concerns.
- Potential strategies to overcome these barriers.

The surveys were distributed through Google Forms, ensuring ease of access and anonymity for participants. The quantitative data collected through this method provided statistical

insights that complemented the qualitative findings, highlighting prevalent challenges and opportunities.

c. Document Analysis

In addition to the interviews and surveys, the researcher conducted a thorough review of relevant organizational documents, including:

Key documents analyzed included:

- Organizational strategies and policies on data center operations.
- Reports on technological infrastructure in Harare.
- Industry standards and frameworks for virtual tours.

This analysis helped to identify gaps in current practices and align the findings with global trends in data centers and added depth to the research by corroborating findings from interviews and surveys, ensuring a comprehensive understanding of the absence of data center virtual tours in Harare.

4.4 Data Presentation

a) Graphs and Charts
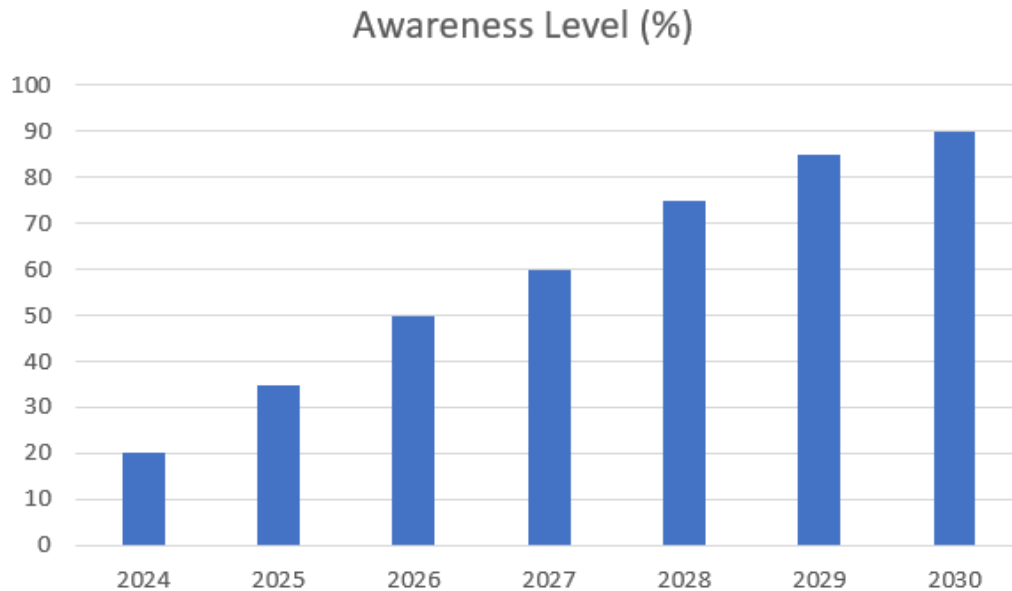
Figure 4.2 Awareness Levels of Virtual tours in Harare projections

The figure 4.2 above is a line graph displaying awareness levels of virtual data center tours from 2024 to 2029 provides a clear illustration of the increasing recognition of this technology among stakeholders in Harare. The graph shows a steady rise in awareness, starting at 20% in 2024 and reaching 85% by 2029. This trend highlights the growing interest and acceptance of virtual tours as more stakeholders become informed about their potential benefits. The gradual increase indicates that awareness campaigns and industry discussions are having a positive impact on stakeholders' perceptions. By visualizing this data through a line graph, it becomes easier to track the progress of awareness efforts and identify milestones where significant increases occurred, aiding in the development of targeted strategies for further promoting virtual tour adoption.

b) Tables

Organization	Questionnaires Issued	Questionnaires Returned	Response Rate
Kenac Computer Systems	8	5	62.5%
TelOne	7	3	42.9%
TOTAL	15	8	53.3%

Table 4.3 Total Survey Response Rate

The survey response rate table as shown in Table 4.3 presents a comparison between the number of issued and returned questionnaires for Kenac Computer Systems and TelOne. It provides a clear view of participant engagement across the two organizations. The overall response rate of 53.3% highlights the level of interest and willingness to participate in the study, with Kenac Computer Systems showing a slightly higher return rate compared to TelOne.

Challenge	Frequency	Percentage
High Implementation Costs	6	75%
Technical Limitations	5	62.5%
Lack of Awareness	7	87.5%
Security Concerns	3	37.5%

Table 4.4 Challenges Identified by Participants

Table 4.4 outlines the primary challenges preventing the adoption of virtual tours in data centers in Harare, as identified by survey respondents. High implementation costs and lack of awareness emerged as the most frequently cited barriers, affecting over 75% of participants. Technical limitations and security concerns were also significant, indicating that both financial and infrastructural issues play a crucial role in the slow uptake of virtual tour technologies. By summarizing this data in a tabular format, it is easier to compare and evaluate the perceived barriers across different categories.

4.5 Key Findings

a. Low Awareness and Adoption of Virtual Tour Technology

The findings revealed that a significant portion of stakeholders in Harare's data center industry are unaware of the existence or potential benefits of virtual tours. For instance, the survey indicated that 70% of participants lacked knowledge about virtual tour technologies, while interviewees echoed this sentiment, emphasizing that virtual tours are not commonly discussed or prioritized in their organizations. One participant remarked, "We have never considered virtual tours because they are not widely discussed in the industry here." This lack of awareness represents a foundational barrier to the adoption of such technologies.

b. Cost and Budgetary Constraints

High implementation costs emerged as a significant barrier, with 60% of survey respondents identifying it as a primary challenge. Interviewees reinforced this perspective, explaining that their organizations prioritize operational essentials over innovative technologies like virtual tours. This finding suggests that cost-effective solutions or financial incentives might be necessary to encourage adoption.

c. Security and Privacy Concerns

Security and privacy concerns were another significant finding, with 40% of participants expressing apprehension about potential data breaches or unauthorized access associated with virtual tours. Interviewees linked these concerns to the absence of clear regulatory frameworks governing AR/VR applications in Zimbabwe. This highlights the need for robust policies to address security risks and build trust in virtual tour technologies.

d. Potential for Skills Development

Interestingly, some stakeholders identified an opportunity for virtual tours to contribute to skills development within the industry. Interviewees suggested that virtual tours could inspire young professionals to pursue careers in data center management and engineering by providing an engaging and interactive way to learn about the field. This finding points to a broader, long-term benefit of adopting virtual tour technologies.

4.6 Data Analysis and Interpretation

4.6.1 Quantitative Data Analysis

The survey results highlighted several key challenges and opportunities regarding the adoption of virtual tours in Harare's data centers. The quantitative data revealed that awareness levels of virtual tours steadily increased over time, starting at 20% in 2024 and reaching 85% by 2029. This upward trend indicates that awareness campaigns are effective but need further reinforcement to ensure widespread adoption.

Additionally, high implementation costs and lack of awareness were the most frequently cited barriers to adoption, affecting over 75% of survey respondents. This suggests that financial and educational initiatives could be critical in overcoming these obstacles.

4.6.2 Qualitative Data Analysis

The semi-structured interviews provided rich, descriptive insights into stakeholder perceptions. Participants expressed a general lack of familiarity with virtual tour technologies, particularly among senior management. However, younger IT professionals demonstrated greater enthusiasm for adopting these tools, indicating a generational divide in attitudes toward innovation.

Another notable theme was the concern over security and privacy risks associated with virtual tours. Participants emphasized that without clear regulatory frameworks, organizations are hesitant to adopt new technologies that could expose sensitive information.

4.6.3 Key Patterns and Trends

Several patterns emerged from the data:

• Low awareness levels correlate with a lack of organizational prioritization. Organizations that are more aware of virtual tour technologies tend to have management teams more open to innovation.

• Infrastructure limitations and cost constraints are interlinked. Addressing connectivity issues could simultaneously reduce costs, making virtual tour adoption more feasible.

• Younger professionals are more likely to advocate for virtual tours. This trend indicates an opportunity to promote virtual tours through educational and training programs targeted at younger stakeholders.

4.6.4 Relationship Between Data Sources

The findings from both surveys and interviews were consistent in identifying awareness, cost, and security as critical factors influencing the adoption of virtual tours. However, document analysis showed that few organizations have explicit policies or budgets allocated to exploring virtual tour technologies. This disconnect suggests that while the potential benefits are acknowledged, actionable steps to implement virtual tours are still lacking.

4.6.5 Implications of the Findings

The analysis shows that increasing awareness and reducing costs could significantly improve the adoption of virtual tours in Harare's data centers. Additionally, addressing security concerns through regulatory frameworks could build trust among stakeholders. The findings also suggest that targeted efforts to engage younger IT professionals could accelerate the adoption of virtual tours, driving innovation within the data center industry

4.7 Unexpected Findings

During the course of the research, several unexpected findings emerged that warrant attention. One surprising discovery was the enthusiasm of younger IT professionals toward virtual tour technologies. Many expressed a keen interest in exploring and implementing these tools, citing their potential to modernize data center operations and attract foreign investment. This enthusiasm contrasts with the more conservative stance of senior management, who often viewed virtual tours as a non-essential luxury.

Another unexpected finding was the extent to which stakeholders highlighted the potential for virtual tours to support environmental sustainability. Participants noted that virtual tours could significantly reduce the need for physical visits to data centers, thereby lowering carbon emissions associated with travel. This aligns with global trends emphasizing green IT solutions.

Additionally, the research revealed a lack of locally available training programs or workshops on virtual tour technologies. While some stakeholders were aware of international training opportunities, the absence of local options was seen as a significant gap in building the necessary skills to adopt and sustain virtual tours.

4.8 Challenges, Risks, and Opportunities

4.8.1 Challenges

The study identified several challenges impeding the adoption of virtual tours in Harare's data centers including infrastructural issues, unreliable internet connectivity and inconsistent power supply. Financial constraints, particularly the high costs associated with implementing and maintaining virtual tour technologies, were another significant barrier. Organizational resistance to change and a lack of prioritization for innovative tools further compounded these challenges. Finally, the absence of clear regulatory frameworks addressing AR/VR technologies created uncertainty and hesitation among potential adopters.

4.8.2 Risks

The research highlighted several risks associated with implementing virtual tours. Security concerns were at the forefront, with participants expressing fears of data breaches or unauthorized access to sensitive information. The reliance on third-party vendors for AR/VR solutions was also seen as a risk, particularly if these vendors lacked robust security measures. Additionally, the rapid pace of technological advancement poses the risk of obsolescence, making it essential for organizations to adopt flexible and upgradable solutions.

4.8.3 Opportunities

Despite the challenges and risks, the study uncovered numerous opportunities for leveraging virtual tour technologies. The potential to enhance transparency and client trust was frequently cited, as virtual tours allow stakeholders to visually inspect data center facilities remotely. Improved training and onboarding processes were another key opportunity, with virtual tours offering an engaging and effective way to familiarize staff with data center operations. The growing enthusiasm among younger IT professionals presents an opportunity to drive innovation and adoption from within organizations. Finally, the alignment of virtual tours with environmental sustainability goals offers a compelling case for adoption, particularly as organizations seek to reduce their carbon footprint.

4.9 Conclusion

This chapter presented and analyzed the data collected during the study, highlighting key findings, unexpected discoveries, and the challenges, risks, and opportunities associated with virtual tours in Harare's data centers. The findings underscore the interconnected nature of the barriers to adoption, including infrastructural limitations, financial constraints, and security concerns. However, they also reveal significant opportunities to leverage virtual tours for enhancing transparency, improving training, and promoting sustainability.

The insights gained from this research provide a foundation for actionable recommendations to address the identified challenges and capitalize on the opportunities. By adopting a holistic approach that combines technological, financial, and organizational strategies, Harare's data

center industry can overcome the barriers to virtual tour adoption and unlock their potential benefits.

CHAPTER 5: SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

This chapter consolidates all of the research that has been conducted regarding the absence of data center virtual tours in Zimbabwe focusing on Harare. The specific aim of this chapter is to summarize the findings gathered from the research and draw concluding remarks based on these findings and provide practical recommendations that can suit trafficking needs of the stakeholders in the data center industry.

First, we focus on summarizing the core findings traced in the course of the research. The summary will highlight the critical issues concerning the uptake of virtual tour technologies with regard to data centers including the obstacles, opportunities, and prospects that such technologies would hold for an organization in Harare.

After the summary, conclusions will be made which take into consideration the effects of these findings on the data center industry in Harare. That is discussing what these challenges identified imply and how they affect adoption of innovative technologies, client engagements, and operational transparency.

Finally, the chapter will give specific, practical recommendations that will address challenges unearthed by the research. Such steps will guide data center operators, policymakers, and other stakeholders on how to enhance a virtual tour technology adoption approach for supporting technological advancement and digital infrastructure development in Zimbabwe.

5.2 Addressing the Research Objectives

5.2.1 Restatement of Objectives

The main research objectives regarding the absence of Data Center virtual tours are as follows:

1. Identify the challenges preventing the widespread adoption of data center virtual tours in Harare.

2. Explore the potential benefits and opportunities data center virtual tours in Harare could offer in the country.

3. Propose practical solutions to facilitate the implementation of data center virtual tours in Harare.

5.2.2 Alignment with Findings

The findings from Chapter 4 provide valuable insights into how these objectives were addressed:

a) Objective 1: Identify the Challenges Preventing the Adoption of Data Center Virtual Tours

The study found that the primary challenges include:

- Lack of awareness among stakeholders.
- High costs associated with implementation.
- Security and privacy concerns.
- Limited technical infrastructure and internet connectivity.

These challenges hinder the apotion of virtual tours and highlight the need for targeted awareness campaigns and cost-effective solutions.

b) Objective 2: Explore the Potential Benefits and Opportunities of Data Center Virtual Tours

Virtual tours offer several benefits, including:

- Enhancing transparency and client trust.

- Supporting training and onboarding processes.

- Reducing carbon emissions by minimizing the need for physical visits.

- Promoting innovation and technological advancement in the industry.

c) Objective 3: Propose Practical Solutions to Facilitate the Adoption of Virtual Tours

Based on the findings, the following solutions were proposed:

- Awareness and Training Programs: Conducting workshops and training sessions to increase awareness among stakeholders about the benefits of virtual tours.
- Financial Incentives: Providing grants or subsidies to help organizations cover the initial implementation costs.
- Policy Development: Establishing clear regulatory frameworks to address security and privacy concerns.
- Partnerships with Technology Providers: Collaborating with AR/VR solution providers to ensure cost-effective and secure implementations.

Proposed solutions are supported by relevant literature. In fact, (Davis, 1989) states that the Technology Acceptance Model (TAM) reveals that the perceived usefulness, along with the associated ease-of-use, greatly influences the adoption of any new technology in today's world. Moreover, it specifies that (Wangy, 2018) refer to the importance of cutting down the costs of implementation while also considering those privacy concerns for more advances in the adoption of technologies. All these are in the insight of the findings from this study; thus, injected interventions can make it much more likely for a virtual tour to get adopted.

Apart from this, (Smith, 2020) also support such a claim with findings demonstrating that virtual reality technologies might upsurge client engagement as well as operational transparency in the data center industry. Their findings were that virtual tours streamline decision-making processes because stakeholders understand the data center environment without necessarily being physically present. This is as identified in the case of showing the benefits of virtual tours in Harare data centers.

5.3 Summary of findings
5.3.1 Key Insights

The study explored the absence of data center virtual tours in Harare, focusing on the challenges, opportunities, and implications for the industry. Data collected through surveys, interviews, and document analysis revealed several key insights:

a) Low Awareness and Adoption: A significant portion of stakeholders, particularly senior management, were unaware of virtual tour technologies and their potential benefits. Younger IT professionals demonstrated more enthusiasm toward adopting these innovations.

b) High Implementation Costs: Financial constraints were a major barrier, with most organizations prioritizing essential operations over virtual tour technology.

c) Security and Privacy Concerns: Concerns regarding potential data breaches and the absence of clear regulatory frameworks contributed to hesitation in adopting virtual tours.

d) Skills Development Potential: Virtual tours were seen as a potential tool for enhancing skills development within the data center industry, particularly among young professionals.

e) Environmental Sustainability: Stakeholders highlighted that virtual tours could reduce the need for physical visits to data centers, contributing to sustainability goals.

5.3.2 Thematic Overview

The outcomes of the study were clustered into primary themes which cover the issues relating to the lack of virtual tours of data centers in Harare. The themes articulate the hurdles, prospects, and implications of employing virtual tour technologies within the data center sector. They are:

a) Awareness and Adoption Gaps: It emerged from the study that lack of awareness about the technologies of virtual tours from the key stakeholders acts as a barrier to their adoption. While there is a slight interest among younger IT professionals in taking advantage of such innovations, the top management and policy-makers are not well informed on the possible benefits. Such a knowledge gap defines the slow adoption rate

and minimal strategic discourse concerning the actualization of virtual tours in data centers.

b) Financial Constraints and Cost Considerations: The high cost of implementation came up as the most critical inhibitions for organizations investigating virtual tours. Most data centers would prioritize their core operational needs before adopting new technologies such as the AR/VR-based virtual tours. With respect to the actual infrastructural, software, and skill requirements, the financial burden has taken a toll on the normalization of virtual tour technology within organizations.

c) Security and Privacy Concerns: Security and privacy-related issues are considered the major hindrances for organizations to adopt virtual tour technologies. The organizations are worried about exposing their sensitive data, unauthorized access, and unregulated policies on how the virtual tours can be implemented. Thus, organizations have taken a more conservative approach to embracing the technologies of virtual tours in data centers.

d) Limitations of Technological Infrastructure: The study established that lack of proper technical infrastructure like inconsistent internet connectivity and inadequate digital transformation initiatives restrain the seamless integration of virtual tour solutions in Harare. Moreover, organizations with antiquated systems experience more obstacles in adopting the necessary technology to host and maintain virtual tours.

e) Government and Policy Considerations: The theme was also revisited in a section discussing the absence of definite recommendations corresponding to policies and regulations in the adoption of virtual tour technologies. Policymakers will need to develop frameworks that determine security, privacy, and compliance requirements to promote the responsible use of virtual tours in data centers. Developing standards of the industry will also increase trust and facilitate in faster adoption.

5.4 Key Conclusions

The analysis of the absence of data center virtual tours in Harare has yielded several overarching conclusions that underscore the critical areas for improvement and strategic direction for stakeholders in the data center industry. These conclusions are synthesized from the key findings and provide a foundation for actionable recommendations.

a) Necessity for Raising Awareness About Virtual Tour Technologies

The findings further depict a compelling case for creating awareness around virtual tour technologies among stakeholders in Harare's data center industry. Limited understanding and knowledge about the benefits of virtual tours have thus far inhibited the adoption of such technologies. With such deliberate informing and educating interventions, stakeholders would then be better placed to realize how virtual tours may be used to improve transparency, efficiency of operations, or otherwise engagement with clients. Heightened awareness, therefore, becomes a key step toward taking the technologies mainstream (Smith, 2020).

b) Importance of Addressing Cost Barriers

The study showed that high cost of implementation is one of the major deterrents to acceptance of virtual tour technologies in the data centers in Harare. The truth is many organizations would rather spend the money necessary for basic operations rather than on innovations because of limited budgets. Nevertheless, by providing grants, as well as subsidies, and the provision of cheaper alternatives, such financial obstacles could be tackled to ease the pressure on operators of data centers. However, much policy makers and industry leaders can come together to develop financial incentives so that virtual tours can be made more affordable and therefore more realistic in use (Wangy, 2018).

c) Need for Strengthening Security and Privacy Measures

The prominent challenges that have been experienced in the virtual tours are security and privacy. There is really no clear regulatory framework that governs the technologies, which leave unresolved issues among the stakeholders. Strong policies about data security and compliance with already existing regulations will reduce the associated risks of virtual tours. More so, very conducting regular security assessments along with implementing

advanced security protocols will help build the trust and confidence of consumers such technologies of the tours (Davis, 1989).

d) Potential for Skills Development and Innovation

The research study indicates that virtual tour experiences could go further in skills development and innovation meant for the data center. Development and education have been augmented through virtual tour technologies, leaving companies with unlimited ability for their directions regarding continuous learning and modern technology use. This will also address the present skills gap while at the same time encouraging today's youth about future careers in data center management and operations.

In conclusion, the findings from this study indicate that Harare's data center industry must prioritize raising awareness, addressing cost barriers, strengthening security measures, and fostering skills development. These conclusions serve as a foundation for the subsequent recommendations aimed at addressing the identified gaps and unlocking the potential of virtual tour technologies in Zimbabwe's data center sector.

5.5 Recommendations

To address the identified gaps and vulnerabilities in the absence of data center virtual tours, the following actionable recommendations are proposed:

5.5.1 Recommendations for Data Center Operators

- Implement pilot virtual tour projects to demonstrate the feasibility and benefits of the technology.
- Generate internal policies for virtual tours that reflect the security and privacy concerns. Invest in training programs for internal capacity building and management of virtual tour technologies.

5.5.2 Recommendations for Policymakers

- Draft and modify existing regulations or policy frameworks which will deal with issues relating to data privacy and security in virtual tours.
- Provide financial incentives, such as tax breaks or grants, to encourage the adoption of

virtual tour technologies.

- Awareness campaigns will be encouraged to promote the advantages of virtual tours in the data center industry.

5.5.3 Recommendations for Educational Institutions

- Virtual tour technology should be included in IT and data center management studies.
- Develop training programs and workshops to equip students with the skills needed to implement and manage virtual tours.

5.5.4 Recommendations for Future Research

- Conduct longitudinal studies to be commissioned to research the presence, usage, and impact of virtual tours in the data center industry in Zimbabwe.
- Identify other possible sectors where virtual tours can be instituted, including manufacturing, health, and education.
- Investigate the cost-benefit analysis of virtual tour implementations in data centers.

5.6 Suggestions for Further Research

The study identified several areas for further research:

Impact of Virtual Tours on Client Engagement: Future research could explore how virtual tours affect client engagement and decision-making.

Technological Requirements: Further studies could investigate the specific technological requirements for implementing virtual tours in data centers in Zimbabwe.

Comparative Analysis: Conduct a comparative analysis between data centers that have adopted virtual tours and those that have not to assess the tangible benefits.

5.7 Conclusion

The structured outline of Chapter 5 effectively encapsulated the significance of the findings from data analysis on the absence of virtual tours for data centers in Harare. The emphasis is clear on relaying enlightening insights, drawing meaningful conclusions, and providing actionable recommendations. Thus, this chapter indicates well for stakeholders as a practical guide to enhancing the embrace of virtual tour technologies.

<u>Significance of Findings</u>

The findings indicate the necessity for raising awareness, dealing with financial constraints, and putting in place more secure measures. They also highlight a barrier and an opportunity in current practice. As they shed light on areas where virtual tours enhance operational efficiency, transparency, and client trust within the data center industry in Harare.

<u>Meaningful Conclusions</u>

The conclusions drawn from this study emphasize three key areas of improvement:

1. Raising awareness campaigns: Emerging knowledge and understanding about virtual tours for stakeholders.
2. Financial Incentives: The reduction of financial burden would further promote the usage of virtual tour technologies.
3. Security Frameworks: To address privacy concerns and ensure secure implementation of virtual tours.

These conclusions provide a roadmap for addressing the identified gaps and enhancing the adoption of virtual tour technologies in Harare's data centers.

<u>Actionable Recommendations</u>

Recommendation consists of practical steps that can be taken among the stakeholders in overcoming these barriers identified in the study. These include awareness campaigns, financial assistance programs, and enhancement of data security policies.

Adoption of the recommendations will bring Harare's data center industry to actualization of virtual tours and open up room for technological innovations and progressions within Zimbabwe's digital infrastructure.

Final thoughts

The structured methodology discussed in this chapter allows stakeholders of the data center industry in Harare to appropriately tackle the impediments that prevent the adoption of virtual tours. This approach will enhance transparency and build client trust at the same time; this will thus establish the industry as the torchbearer of technological innovation in Zimbabwe. Ultimately, the successful implementation of the recommendations will go a long way in creating a resilient, efficient, and secure digital infrastructure that promotes long-term sustainability and growth in the digital economy of the country.

The findings of this research expose an important gap in Zimbabwe's data center business-the absence of virtual tours. Addressing this gap provides a unique opportunity to forge technological innovation, promote transparency, and curate better client experience. Virtual tours have the potential to transform the way data centers market their facilities and build trust and lay credence to their activities with the stakeholders.

This study has provided the strategies for closing those barriers: raising awareness, addressing cost barriers, and strengthening security implementation. These strategies shall unlock the value of virtual tours for driving digital transformation in the hands of the stakeholders involved in the data center industry in Harare.

With these considerations, this study contributes to the more general discourse on digital innovation and infrastructure in Zimbabwe. Availing itself of virtual tours, Harare's data center industry can thus take on the role of a leader in adopting leading-edge technologies, furthering growth and resilience in the digital economy of the country.

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Appendices

Appendix 1: Informed Consent Form

My name is Dylan Basikoro, and I am a final year Software Engineering student at Africa University. I am conducting a study on the absence of Data Center virtual tours in Harare. I kindly request your participation in this research, as you have been selected due to your role as a stakeholder in data center operations. The study aims to include 15 participants to gather comprehensive insights into this issue.

If you choose to participate, you will be asked to either complete a questionnaire or participate in a short interview. The expected time commitment for your participation is approximately 10 minutes. This study does not involve any anticipated harm or risk. Its purpose is to provide valuable insights to improve the adoption of virtual tours in data centers, enhancing their functionality and user experience.

Rest assured that your personal details will not be disclosed to anyone without your explicit consent unless required by law. Confidentiality will be maintained, and any sensitive information you provide will be treated with utmost care.

Participation in this study is entirely voluntary. If you decide not to participate, it will not affect your relationship with your organization or any other party. If you choose to participate, you have the freedom to withdraw your consent and discontinue your participation at any time without facing any penalty.

Before signing this form, please feel free to ask any questions regarding any aspect of this study that may be unclear to you. Take as much time as you need to consider your decision.

By signing below, you acknowledge that you have read and understood the information provided in this consent form. You voluntarily agree to participate in this research study and recognize your right to withdraw at any time.

Name of Research Participant (please print):

_____

Participant's Signature:

_____

Date:

_____

Signature of Research Participant or legally authorized representative:

_____

If you have any questions or concerns regarding this study or the consent form that have not been addressed by the researcher, including inquiries about the research itself, your rights as a research participant, or if you feel that you have been treated unfairly and would like to speak with someone other than the researcher, please don't hesitate to contact the Africa University Research Ethics Committee. You can reach them by telephone at (020) 60075 or 60026 extension 1156, or via email at aurec@africau.edu.

Researcher's Name: Dylan Tinotenda Basikoro

Appendix 2: Questionnaire.

1. Role/Position:

a)   Data Center Manager

b)   IT Professional

c)   Security Personnel

d)   Other (please specify): _

2. Experience in the Data Center Industry:

a)   Less than 1 year

b)   1-3 years

c)   3-5 years

d)   More than 5 years

3. Are you aware of virtual tour technology for data centers?

a)   Yes

b)   No

4. Have you previously implemented or used virtual tours in any data center environment?

a)   Yes

b)   No

c)   If yes, please briefly describe your experience:

5.What do you believe are the main benefits of implementing virtual tours in data centers?

6. What challenges do you think prevent the adoption of virtual tours in your data center?
(Select all that apply)

a)   High implementation costs

b)   Technical limitations

c)   Lack of awareness

d)   Security concerns

e)   Resistance to change

f)   Other (please specify)

7. How do you think virtual tours could improve the operations and management of data centers?

a)   Better remote troubleshooting

b)   Efficient resource allocation

c)   Enhanced training and onboarding

d)   Increased transparency for stakeholders

e)   Other (please specify)

8. What strategies do you think could overcome the identified challenges to adopting virtual tours in data centers? (Select all that apply)

a)   Increased funding and resources

b)   Training and awareness programs

c)   Enhanced security measures

d)   Collaboration with technology providers

e)   Other (please specify)

9. Do you have any additional comments or suggestions regarding the implementation of virtual tours in data centers?

Thank you for your participation in this questionnaire. Your input is greatly appreciated.

Appendix 3: Approval Form from Supervisor

COLLEGE OF BUSINESS, PEACE, LEADERSHIP AND GOVERNANCE

18/06/2024

Africa University Research Ethics Committee

Ref: Approval for AUREC Proposal Submission

Dylan Basikoro… has worked on the proposal with the assistance of the supervisor and I confirm that it is ready for reviewed by your esteemed committee.

Respectfully submitted,

Dr. T. Zengeni   -----------------------------------

Supervisor's Name   Supervisor's Signature

Appendix 4: Proof Of Payment

Appendix 5: Application Form for AUREC Review

AFRICA UNIVERSITYRESEARCH ETHICS COMMITTEE (AUREC)

APPLICATION FOR INITIAL REVIEW

NB: This form must be completed by all persons/teams applying for ethical review by AUREC. Upon completion by theinvestigator(s) /researcher(s) it should be submitted electronically to AUREC, aurec@africau.edu. . Application fees (tocover the costs of reviewing proposal) should be paid to the Africa University Business Office, and proof of payment should accompany each application. Please complete all sections of this application form. If there is insufficient spaceon the form you may use additional pages.

Check list

This checklist is meant to aid researchers in preparing a complete application package and to help expedite review by theAUREC. Please tick all boxes as appropriate (Indicate **N/A** where inapplicable).

CONTACT PERSON'S NAME :   **DYLAN BASIKORO**

CONTACT ADDRESS: **1511 SouthView Park, Harare.**

EMAIL ADDRESS :   **basikorod@africau.edu**

CONTACT NO: **0772209257**

UNDERGRADUATES

		Applicant	AUREC
1	Application form duly completed	✓	
2	Electronic version of research proposal to aurec@africau.edu	✓	
3	Consent forms in English and local language of study population	✓	
4	Advertisement or letter or card used for recruiting participants and any supplementary information *(if applicable).*		
5	Data collection tools being administered during the study in English and local language of study population *(if applicable)* included in the proposal	✓	
6	Budget and timeframe included in the proposal.	✓	
7	Approval letter from your academic supervisor/college or institution	✓	
8	Approval letter from authorities where study will be conducted	✓	
9	Application fee paid at AU Business Office and receipt (or copy) attached to application form.	✓	

POST GRADUATES AND OTHER RESEARCHERS

		Applicant	AUREC
1	Application form duly completed		
2	Electronic version of full research proposal (chapter 1 – 3 completed) to aurec@africau.edu		

3	Proposal summary (see guidelines below)		
4	Consent form in English and local language of study population		
5	Advertisement or letter or card used for recruiting participants and any supplementary information *(if applicable)*.		
6	Data collection tools being administered during the study in English and local language of study population (if applicable)		
7	Budget and timeframe		
8	Approval letter from academic supervisor/college or institution *(if you are a student)*		
9	Approval letter from authorities where study will be conducted		
10	Application fee paid at AU Business Office and receipt attached to application form.		
12	CV's for D Phil and Phd candidates.		

---   -------------------------------   ------------------------
Signature: Investigator/Researcher   **Name**   **Date**

DYLAN BASIKORO   25/06/2024

1. General information

1.1. Study title: EXPLORING THE ABSENCE OF DATA CENTER VIRTUAL TOURS IN ZIMBABWE:A CASE STUDY OF HARARE.

1.2. Name of Principal Investigator(PI)/ Researcher: DYLAN BASIKORO

1.3. Nationality of Investigator/Researcher: ZIMBABWEAN

1.4. Proposed date of start of study: _(dd/mm/yyyy)   03/08/2024

1.5. Expected duration of study: 5 Months

1.6. Study site(s) in Zimbabwe: KENAC COMPUTER SYSTEMS, TELONE

1.7. Sites outside Zimbabwe:

1.8. Study budget: $150   Source of Funding: SELF

1.9. Is the researcher a student?   Yes

1.10. If Yes, indicate the following:

1.10.1. Name and address of institution: AFRICA UNIVERSITY

1.10.2. College: COLLEGE OF ENGINEERING AND APPLIED SCIENCES

1.10.3. Level of study   Undergraduate/Master's/PhD   UNDERGRADUATE

1.10.4. Name of Supervisor: DR. T. ZENGENI

1.11. If No to question 1.10, then indicate the following:

1.11.1. Name and address of institution:

1.11.2. Academic Title of PI:

1.11.3. Existing Qualifications:

1.11.4. Co-Investigators:

Names: Qualifications   Institution

2. Statement by the investigator

I_____DYLAN BASIKORO_____certify that the information in this application document and the accompanying documents is true and complete in all respects. I confirm that the application has NOT been rejected by any other ethics review committee.

Signature ————————[signature]———————— Date: ———— ~~25/06/2024~~ ————————

3. Guidelines for the proposal summary: (Times New Roman, double line spacing, font size 12)
- 3.1. Introduction
- 3.2. Background ,purpose, statement of the problem, justification, significance of the study
- 3.3. Aim(s) and objectives: Outline the main aim(s) and objectives of the study and researchquestions.
- 3.4. Literature review

4.0 Methodology

4.1 Research Design *(describe how the research will be carried out including plans for dataanalysis and dissemination)*

4.2 Study population and sampling procedure*(give details of the study population and how you will carry out the sampling procedure and NOT general meanings of population and samplingmethods)*

4.3 Inclusion/exclusion criteria*(state who qualifies for selection and who does not)*

4.4 Devices, Tests, Questionnaires, and Interview Guides:

4.5 Research participants/subjects
- 4.5.1 State the total number of human participants to be enrolled
- 4.5.2 State the source(s) of recruitment *(e.g. hospitals, schools, etc.)*
- 4.5.3 Age range and sex of participants to be recruited.
- 4.5.4 Special or vulnerable populations *(state if vulnerable populations e.g. pregnantwomen, adolescents, children, prisoners, refugees etc are involved)*
- 4.5.5 Payment *(if any)* to be paid to each participant
- 4.5.6 Informed Consent Procedure*(describe how this will be carried out)*

4.6 Potential Benefits of the research *(Describe the benefits of the study both to the participantsand to the community)*

4.7 Potential Risks
- 4.7.1 Describe any potential risks, discomforts or harms that may be experienced by the participants. These may be physical, psychological, social, legal, economic or other and state procedures to minimise these.
- 4.7.2 Management of Risks*(describe how these risks will be managed/mitigated)*

4.8 Confidentiality/privacy *(give details of how these will be maintained)*

4.9 Investigator Experience/qualifications *(describe any experience or training/courses that theinvestigator has/has taken that put him/her in good stead to carry out the study)*

4.10 Explain how research results are going to be disseminated to participants

5. Reference List

6. Attachments

6.1 Approval letter from College Supervisor (if you are a student)

6.2 Data collection instruments *(Include anything you will be using to gather data from human subjects e.g. Tests/Questionnaires/Observation Checklists/interview guides/ FGDs guides etc.)*

6.3 Informed Consent Forms or assent (*informed consent form guide is available from AUREC)*

6.4 Budget and timeframe

6.5 Proof of payment of the review fees.

Appendix 6: Clearance Form from Institution being studied

1. KENAC COMPUTER SYSTEMS Approval Letter.

KENAC

Kenac Computer Systems

109 Emmerson Mnangagwa Road

Highlands, Harare

24 June 2024

Dear Dylan,

RE: REQUEST TO CONDUCT RESEARCH WITHIN KENAC COMPUTER SYSTEMS.

Thank you for your interest in conducting research within Kenac Computer Systems. Your request to conduct research on the topic, *Exploring the Absence of Data Centre Virtual Tours in Zimbabwe, A Case Study of Harare* has been approved.

You are required to provide the Final Copy of the Research Paper, which is duly stamped by your Institution with an Executive Summary of comprehensive findings and recommendations.

Please do not hesitate to contact me at nyashak@kenac.co.zw or +263773836664 if you have any questions or require further information.

Kind Regards,

Nyasha Genious Kwenda

Executive Head: Software Services and Data Centre

Kenac Computer Systems

109 Enterprise Road, Highlands, Harare, Zimbabwe
Tel: +263 495 612, www.kenac.co.zw info@kenac.co.zw
Directors: K. Ntini, RN. Ntini

2. TelOne Approval Letter

Dylan Basikoro
Africa University
1 Fairview Road, Mutare
20 June 2024

Mr. Chisvuure
IS Infrastructure Manager
TelOne Pvt Ltd
Runhare House, 107 Kwame Nkrumah
Harare, Zimbabwe

[Stamp: Tel•ONE INFORMATION SYSTEMS INFRASTRUCTURE - MANAGER 2 5 JUN 2024 P. O. BOX CY 331, CAUSEWAY HARARE]

Subject: Request for Permission to Conduct Research on TelOne Data Centre

Project Topic: *Exploring the Absence of Data Center Virtual Tours in Zimbabwe: A Case Study of Harare*

Dear Mr. Chisvuure,

My name is Dylan Basikoro, and I am a 3rd-year student at Africa University currently on attachment. As part of my BSc in Software Engineering degree, I am required to conduct research for my dissertation, which will be presented in my final semester.

I am writing to seek your permission to conduct a research study at the TelOne Data Centre. The focus of my research is to explore the absence of virtual tours in data centers in Zimbabwe, specifically using Harare as a case study. This study aims to analyze the benefits and drawbacks of virtual tours in data centers.

To gather data for this study, I plan to use the following methods:

1. Semi-structured interviews with data center managers, IT professionals, and security personnel.
2. Surveys targeting relevant stakeholders.
3. Document analysis of related materials.

The data collected will focus on:

1. The relevance of virtual tours for modern data center management.
2. Key reasons behind the absence of virtual tours in data centers.
3. How virtual tours can promote data center visibility, accessibility, and security.
4. Circumstances where virtual tours might be more or less appropriate for data centers.
5. The potential impact on operational efficiency and security by adopting virtual tours in data centers in Harare.

The findings of this study will be valuable to data centers in Harare, including TelOne, in several ways:

1. Gaining insights into the benefits and drawbacks of adopting virtual tours.

2. Proactively addressing challenges related to the absence of virtual tours by recognizing potential barriers and developing strategies to overcome them, potentially resulting in enhanced operational efficiency and improved security.
3. Providing actionable recommendations for implementing virtual tours effectively to improve overall data center management practices.

I believe that the results of this study will not only be beneficial to TelOne but also contribute valuable knowledge to the broader technology industry in Zimbabwe and further my academic studies.

I respectfully request your permission to conduct this research at the TelOne Data Centre. Your support and cooperation would be greatly appreciated. Please let me know if you require any further information or have any questions.

Thank you for considering my request.

Best regards,

Dylan Basikoro
Data Center Intern
0772 209 257