

https://dspace.org/

Loadshedding challenges and adoption of ICT solutions by SMEs in South Africa

Masilela, Senzi Michael

2024
University of the Witwatersrand, Johannesburg
https://hdl.handle.net/10539/43947
Masilela, Senzi Michael . (2024). Loadshedding challenges and adoption of ICT solutions by SMEs in South Africa [Master's dissertation, University of the Witwatersrand, Johannesburg]. WireDSpace.

Downloaded from a DSpace repository. https://dspace.org/

Loadshedding challenges and adoption of ICT solutions by SMEs in South Africa

Senzi Michael Masilela

2026529

Supervisor:

Dr Jabulile Msimango-Galawe

A research report submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Management in the field of Digital Business

Johannesburg, 2024

C2 General

ABSTRACT

Small and medium-sized enterprises are regarded as important contributors to improving the employment rate in South Africa. Unfortunately, loadshedding is severely affecting enterprises across different industry verticals. ICT is one of the enablers of collaboration, improved business processes, production and so forth. Companies rely on electricity as it underpins and enables the continuous running of business operations.

Primary data was collected through one-on-one semi-structured interviews that were conducted with participants in the ICT space in the Gauteng province of South Africa. Majority of the participants who took part in the study work for organisations in and around Johannesburg and Pretoria. The collected data was analysed through thematic analysis where similarities were drawn, and suggestions put forward.

It was discovered that some organisations run their IT services from physical hardware hosted on-premises while some are evolving and have since adopted newer ways of running IT services. Organisations running IT from on premises had to put down standby power generators and UPS systems to make sure that they are not negatively affected by loadshedding. Most smaller companies unfortunately were not able to afford backup power solutions because of them being so exorbitant from a cost perspective. Due to loadshedding challenges, some moved their infrastructure to third-party data centres and ran them remotely from there. Some have fully migrated to cloud computing.

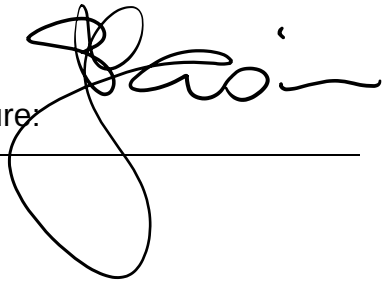
Key words: Loadshedding, adoption, cloud computing, colocation, data center, ICT, virtual hosting, SME

C2 General

DECLARATION

I, Senzi Michael Masilela, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Management in the field of Digital Business at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Name: Senzi Michael Masilela Signature:



Signed at: Kempton Park

On the 15th day of February 2024

C2 General

DEDICATION

Let me firstly take this opportunity and thank GOD the Almighty for seeing me through this journey. To my wonderful wife and kids who have always been there for me despite me not always being there with them. Thanks again for your words of encouragement when things were tough on my side. You always reminded me that it shall be completed one day.

To my parents, in-laws, siblings, and friends, you have given me immeasurable support and I will always be grateful for that. Others used to ask me, “until when are you going to study?”

A special dedication to my late grandmother, may her soul continue to rest, who instilled in me a culture of learning and endurance when things seemed impossible.

To my colleagues and all who made contributions, thanks for your support.

You all rock!!!

C2 General

ACKNOWLEDGEMENTS

Words do not begin to describe the gratitude I feel in me for this attainment, and this wouldn't have been possible if I was on this journey by myself.

To my employer, Vodacom S.A., I will always be indebted to you for financing this degree and making it possible for me to pursue my career and developmental goals and aspirations.

My supervisor Dr Jabulile Galawe-Msimango, thank you for your guidance with this research study else this journey would have been bleak. Your leadership and coaching style are unique, you are a natural. Thanks for being who you are (your honesty though!) and loving what you do. Continue positively changing lives.

To all the interview participants who took part in the study, without you this research wouldn't have been successful. Thanks for your valuable contributions and sharing your lived experiences including your expert knowledge.

My wife, kids, parents, brothers, sisters, friends, and everyone who has played a significant role and supported me, I thank you in abundance.

God Bless

C2 General

Table of Contents

ABSTRACT……..**ii**

DECLARATION……...**iii**

DEDICATION…….. **iv**

ACKNOWLEDGEMENTS…….…….. **v**

List of Tables……..……..……**ix**

List of Figures……..……..…….**x**

List of Abbreviations…….. **xi**

CHAPTER 1. INTRODUCTION……..……1

1.1 STATEMENT OF PURPOSE 1
1.2 BACKGROUND OF THE STUDY 1
1.3 RESEARCH PROBLEM 3
1.4 RESEARCH QUESTIONS AND OBJECTIVES 4
1.5 RATIONALE 5
1.6 DELIMITATIONS OF THE STUDY 6
1.7 DEFINITION OF TERMS 8
1.8 ASSUMPTIONS 9
1.9 STRUCTURE OF THE REPORT 9

CHAPTER 2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK11

2.1 INTRODUCTION 11
2.2 BACKGROUND DISCUSSION 12
2.3 LOADSHEDDING EFFECTS ON SMES 13
2.3.1 LOADSHEDDING 14
2.3.2 ON-PREMISES HOSTING 14
2.3.3 PROPOSITION 1 15
2.4 ALTERNATIVE POWER SOURCES 15
2.4.1 STANDBY POWER – GENERATORS 16
2.4.2 UNINTERRUPTIBLE POWER SYSTEMS (UPS) 16
2.4.3 PROPOSITION 2 17

C2 General

2.5 ALTERNATIVE ICT HOSTING 17
2.5.1 THIRD-PARTY HOSTING – COLOCATION 17
2.5.2 PROPOSITION 3 19
2.6 CLOUD COMPUTING AS A SOLUTION 20
2.6.1 CLOUD COMPUTING 20
2.6.2 SUMMARY OF CLOUD COMPUTING BENEFITS 20
2.6.3 CLOUD COMPUTING DEPLOYMENT MODELS 21
2.6.4 CLOUD COMPUTING SERVICE MODELS 22
2.6.5 PROPOSITION 4 23
2.7 ANALYTICAL FRAMEWORK 24
2.8 CONCLUSION OF LITERATURE REVIEW 26

CHAPTER 3. RESEARCH METHODOLOGY 29

3.1 INTRODUCTION 29
3.2 RESEARCH APPROACH 29
3.3 RESEARCH DESIGN 30
3.4 DATA COLLECTION METHODS 31
3.5 POPULATION AND SAMPLE 32
3.5.1 POPULATION 32
3.5.2 SAMPLE AND SAMPLING METHOD 32
3.6 THE RESEARCH INSTRUMENT 34
3.7 PROCEDURE FOR DATA COLLECTION 35
3.8 DATA ANALYSIS STRATEGIES AND INTERPRETATION 36
3.9 POSSIBLE LIMITATIONS AND CHALLENGES OF THE STUDY 37
3.10 TRUSTWORTHINESS 37
3.10.1 *TRANSFERABILITY* 38
3.10.2 *CREDIBILITY* 38
3.10.3 *DEPENDABILITY* 39
3.11 ETHICAL CONSIDERATIONS 39
3.11.1 CONSENT FORM 39
3.11.2 PROTECTING PARTICIPANT'S IDENTITIES 39
3.11.3 DATA COLLECTION 40
3.11.4 DATA PROTECTION 40

CHAPTER 4. PRESENTATION OF FINDINGS 41

4.1 INTRODUCTION 41
4.2 PARTICIPANTS PROFILES 41
4.3 PRESENTATION OF RESEARCH FINDINGS 43
4.3.1 FINDINGS BASED ON PROPOSITION 1 44
4.3.2 FINDINGS BASED ON PROPOSITION 2 45
4.3.3 FINDINGS BASED ON PROPOSITION 3 47
4.3.4 FINDINGS BASED ON PROPOSITION 4 50

C2 General

4.4 CHAPTER SUMMARY: 51

CHAPTER 5.DISCUSSION OF FINDINGS.....54

5.1 INTRODUCTION 54
5.2 DISCUSSION PERTAINING TO PROPOSITION 1 54
5.3 DISCUSSION PERTAINING TO PROPOSITION 2 56
5.3.1 BACKUP GENERATORS AND UPS SYSTEMS COST 56
5.3.2 ESCALATING DIESEL COSTS 57
5.4 DISCUSSION PERTAINING TO PROPOSITION 3 57
5.4.1 THIRD-PARTY DATA CENTRE HOSTING – COLOCATION 57
5.4.2 HYBRID HOSTING METHODS 58
5.5 DISCUSSION PERTAINING TO PROPOSITION 4 59

CHAPTER 6.CONCLUSION AND RECOMMENDATIONS.....62

6.1 INTRODUCTION 62
6.2 CONCLUSIONS REGARDING RESEARCH QUESTION 1 63
6.3 CONCLUSIONS REGARDING RESEARCH QUESTION 2 64
6.3.1 STANDBY GENERATORS 64
6.3.2 UNINTERRUPTIBLE POWER SYSTEMS 65
6.4 CONCLUSIONS REGARDING RESEARCH QUESTION 3 66
6.4.1 COLOCATION 66
6.4.2 HYBRID HOSTING 67
6.5 CONCLUSIONS REGARDING RESEARCH QUESTION 4 68
6.5.1 BENEFITS 68
6.6 RESEARCH REPORT RECOMMENDATIONS 70
6.6.1 BACKUP POWER FOR SMES 71
6.6.2 ALTERNATIVE ICT SOLUTIONS FOR SMES: 71
6.6.3 RECOMMENDATIONS FOR ICT SERVICE PROVIDERS 72
6.7 CONCLUSION 73

REFERENCES.....75

APPENDICES..... 83

C2 General

List of Tables

Table 1:Cloud deployment models 21

Table 2: Interview participants' profile..... 42

Table 3: Themes relating to the study 43

Table 4: Summary of findings against research questions and propositions 52

C2 General

List of Figures

Figure 1: On-premises and colocation hosting 18

Figure 2: Cloud computing service models..... 23

C2 General

List of Abbreviations

AC/DC	Alternative Current to Direct Current Rectifier
AI	Artificial Intelligence
CAPEX	Capital Expenditure
CEO	Chief Executive Officer
CRM	Customer Relationship Manager
CTO	Chief Technology Officer
DC/AC	Direct Current to Alternative Current Inverter
DC-DC	Direct Current to Direct Current Booster
DOI	Diffusion of Innovation
HR	Human Resources
IaaS	Infrastructure as a Service
IBM	International Business Machines Corporation
ICT	Information and Communication Technology
ISV	Independent Software Vendors
IT	Information Technology
OEM	Original Equipment Manufacturer
OPEX	Operational Expenditure
NERSA	National Energy Regulator of South Africa
NIST	National Institute of Standards and Technology
PaaS	Platform as a Service
ROI	Return on Investment
RQ	Research Questions
SaaS	Software as a Service
SME	Small and Medium-sized Enterprises
SMME	Small, Medium and Micro Enterprises
TAM	Technology Acceptance Model
TB	Tera Byte
TOE	Technology, Organisation, and Environmental
UPS	Uninterruptible Power Systems

C2 General

CHAPTER 1. INTRODUCTION

1.1 Statement of purpose

The purpose of this study was to explore challenges caused by loadshedding to small and medium-sized enterprises (SME) in the Gauteng Province of South Africa and the impact it had on their Information Technology (IT) systems' availability from an uptime perspective. This study also aimed to figure out how these challenges have potentially accelerated the adoption of Information and Communication Technology (ICT) solutions like off-premises hosting and other forms of virtual hosting including cloud computing by SMEs to circumvent the loadshedding predicament and how these improved productivity or service availability.

1.2 Background of the study

Loadshedding, as defined by dictionary.com, is a deliberate shutdown of electric power in a part or in parts of a power-distribution system to prevent the failure of the entire system when the demand strains the capacity of the system.

During the loadshedding period when the electricity supply is temporarily interrupted, organisations need to make sure that they have means to power up their hosting facilities by using backup power in the form of backup generators (Jamie McKane, 2018).

Some organisations still prefer to keep their physical server hardware or IT infrastructure hosted locally on their premises because of less reliance on high-speed internet access links which may come at exorbitant cost and the fact that they get to own the hardware infrastructure or kit which they can access locally on premises without the need for internet access connectivity (Morefield, 2022).

Like the availability of high-speed connectivity links, electricity availability is also critical and key in ensuring that IT systems are always powered on when at the on-premises server rooms (ScienceDirect, 2013).

It is further recommended that hosting facilities or server rooms be connected to redundant power networks provided by two independent power utilities (where possible) and in addition be backed up by batteries coupled with Uninterruptible Power Systems (UPS).

Another reason for companies hosting their IT systems on premises is around security. There is a general belief that IT infrastructure is more secured when hosted on-premises as compared to when hosted off-premises or in the cloud. Systems not hosted on-premises are perceived to be more susceptible to the outside world where they can be hacked into. From a security perspective, access to on-premises hosted IT environment is restricted to certain individuals within the organization and therefore understood to be more secure (Morefield, 2022).

Organisations need to buy backup generators needed to power up hosting facilities during power failures. These generators can be classified as either *prime rated* or *standby rated* generators. The type of generators to be used by these organisations is dependent on how frequent the backup generators would be run when there is no utility power available. In countries where there are fewer power interruptions, standby rated generators will suffice to supply power to hosting facilities in case of power failures.

It is however a different case in a South African context where we experience more regular power cuts. As a result of more frequent power cuts in South Africa, organisations are needed to supply backup power using high-spec or prime rated generators which are expensive and the fact that these are run more often, the cost of diesel to refuel these further escalates the running costs (Jamie McKane, 2018).

C2 General

For these generators to be kept in good operational conditions, regular maintenance schedules are necessary and needed to enable them to be used as alternative sources of power during the loadshedding.

The importance of the study is to help understand the impact of loadshedding on SMEs needing for them to device means of ensuring business continuity during loadshedding and keep their IT systems remotely accessible during the power cuts. There is currently no clear indication as to how long will we continue to experience the rolling blackouts in South Africa.

1.3 Research problem

Looking back in history, companies deployed traditional hosting methods where they used to run their IT Infrastructure in server rooms within self-owned building facilities. This method of running IT services has its own disadvantages ranging from excessive cost of capital needed to buy or build and support such facilities, obtain physical hardware infrastructure, and IT engineers needed to support the environment. The continuous supply of adequate cooling for the server rooms and making sure that the maximum uptime of the IT infrastructure hosted in these facilities is always kept (Duncan Clubb, 2022).

From an IT strategy perspective, businesses are using different ICT solutions like virtual hosting and cloud computing as a transformation mechanism to achieve or realize, amongst others, benefits such as improved efficiencies and reduced IT spend (Alkawsi, Mahmood & Baashar, 2015). Other companies adopt hybrid cloud models where they have a part of their IT services running from their own on-premises facilities and other services running off-site from third-party data centres.

With public cloud providers like Amazon, Microsoft, IBM, and Google coming into and having presence in South Africa, companies have also considered running part or, sometimes all their IT workloads in these new public cloud hosting environments. Donepudi, (2016) has also shown that the evolution in technology over the years has brought about changes in how organisations do business i.e., how they run their IT environments. The adoption of ICT solutions including the use of cloud computing deployment models by businesses has resulted in multiple benefits to these organisations like keeping maximum systems up-time, simplifying business operations, and changing from CAPEX to OPEX business models.

1.4 Research questions and objectives

The objective of this study is to investigate the challenges businesses face especially in the ICT space where their IT infrastructure is affected by loadshedding and how this could have triggered the adoption of newer technologies and ways of running IT services.

Below are the main research questions that the study aimed to answer to achieve the study's objectives:

a) What challenges does loadshedding bring to small and medium-sized businesses who are running their IT services on-premises in South Africa?
b) What means did organisations employ to keep their businesses running and operational during loadshedding?
c) Which ICT solutions, if any, did organisations consider as an alternative to hosting their IT infrastructure on premises?
d) How did cloud computing, if used as a workaround or an alternative solution, help support IT systems availability and keep them accessible from anywhere?

C2 General

1.5 Rationale

South Africa is currently experiencing a lot of power cuts because of Eskom implementing loadshedding across the country. This is done with the aim of preserving electricity and avoiding a total collapse of the power system. Loadshedding exists because of the power utility not being able to cope with servicing the demand for electricity (load) with the current electricity generation capacity (NERSA, 2008).

Through engaging literature, it was discovered that a similar study titled "*Loadshedding and its influence on South African Small, Medium and Micro Enterprise (SMME) profitability, liquidity, efficiency and solvency",* was done in South Africa. This study, however, focused mainly on investigating the effect that loadshedding had on the profitability, liquidity, solvency, and efficiency of SMMEs (Independent researchers & Business Re-Solution, 2021). This study did not necessarily focus on how loadshedding could have led to the adoption of alternative ICT solutions by these organisations.

Another comparable research study titled "*The economic impact of loadshedding: The case of South African retailers*" was conducted and it examined the unstable supply of electricity and the effects it has on the South African retailers. The study zoomed in on the challenges faced by retailers due to loadshedding and sought to quantify the cost of the impact in estimated monetary terms (Goldberg, 2015).

One of the studies that was also conducted in South Africa is titled "*Effects of Loadshedding on the performance of Small, Medium and Micro Enterprises in Gqeberha, South Africa"*. This study was submitted to the Nelson Mandela University. It mainly was limited to Gqeberha in the Eastern Cape and explored the effects of loadshedding to SMMEs (predominantly in the food industry) in that region and how it affected the quality of products and services given by these SMMEs (Olajuyin et al., 2022).

C2 General

Various other studies were performed in other countries outside the borders of South Africa e.g., Zambia, titled "*The Socio-economic effects of loadshedding on Poor Urban households and Small Business Enterprises*". This specific study looked at issues encountered by households from a livelihood perspective and the positive or negative turns their lives had to take. Small businesses like bakeries**,** bars, butcheries, hair salons, and other local supermarkets were engaged as part of the research and investigated (Umar et al., 2019)

This research topic is aimed at and focused more on SMEs that have IT hardware infrastructure hosted and used from on-premises. The research emphasis is more on the challenges loadshedding has on the SME businesses and potentially looking at solutions being considered or already adopted by these businesses to alleviate such.

The findings of this study may be used as learnings or reference ideas that can bring awareness to other organisations on how to deal with the effects of loadshedding by adopting and having workaround mechanisms and other alternative solutions. This will also enlighten or supply different viewpoints that can be used as inputs to how best can organisations adopt technological means that will help them transition and transform their businesses in as far as running IT services is concerned.

1.6 Delimitations of the study

This study mainly explores how loadshedding led to SMEs adopting newer ways of running IT services paying attention to alternatives like off-premises or remote hosting of physical IT hardware infrastructure. It also further explored whether hybrid hosting models where both on-premises and off-premises hosting methods were considered as other hosting platform options.

C2 General

Lastly the study looked to check if organisations considered virtual hosting or cloud computing to minimize the impact of loadshedding on their business operations. The study did not explore other value-added benefits such as big data analytics and artificial intelligence that could have been unlocked and derived by using cloud computing and potentially other similar digital ICT platforms available in the market.

From a sample perspective, this study focused more on the small and medium-sized enterprises within the South African context and will not cover the larger enterprises like multinationals who have points of presence in other countries outside the borders of South Africa.

The study was conducted based on selected interview participants from different SMEs within the Gauteng province and not the national South Africa footprint. Interviews with the selected and willing participants from different organisations in the ICT space were conducted.

The participants that were interviewed hold senior positions, as per below, in various organisations they work for:

i. Business Owners
ii. Executive Head of Departments
iii. IT Managers
iv. Business Architect Leads
v. Technology Services Manager
vi. CEOs
vii. Enterprise and Solution Architects

C2 General

1.7 Definition of terms

Data centre is the physical facility providing the compute power to run applications, the storage capabilities to process data, and the networking to connect employees with the resources needed to do their jobs (Rochlin, 2022).

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and other services) that can be rapidly provisioned and released with minimal management effort or service provider interaction (NIST, 2011).

Colocation means renting out physical space to multiple tenants for housing their own physical servers in a shared building (Guo et al., 2017).

UPS is a system that serves as a backup power supply providing constant voltage and constant frequency for load through energy storage devices and transformers (Shuo Li et al., 2019).

Hybrid cloud is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (NIST, 2011).

C2 General

1.8 Assumptions

Herewith are the assumptions that were made when conducting this study:

- The stakeholders are influencers and, in some cases, even decision makers in organisations they work for within the South African SME market.
- The information collected as part of the interviews will be used by other organisations or researchers to influence future strategic decisions in those organisations.
- The participants were quite honest when sharing their real-life experiences with the researcher during the interviews.
- Vital information that is believed to be useful to this research study was not withheld.
- There is a possibility that participants could have been wary of sharing important and valuable information as it might have been considered or classified as too confidential and proprietary.

1.9 Structure of the report

This research report is made up of 6 chapters and each chapter is outlined in a bit more detail as per below:

Chapter 1 gives a brief introduction of the topic being researched, its main purpose and factors that informed why this research study had to be conducted. The research questions that needed to be answered. The study was limited to identified and selected SMEs within the Gauteng province as mentioned in the delimitations section above. A few assumptions about the data collection method, the stakeholders that were engaged and then interviewed as part of the data collection process were also made.

C2 General

Chapter 2 focuses on different literature that was engaged and reviewed relating to the topic being researched. This chapter gives context and positions the phenomenon in more detail. Literature in the form of articles, educational journals, etc from both local and international markets that was covered.

Chapter 3 outlines the research method that was used for conducting this study. In this chapter, we discuss the research approach, design and methods used for data collection. Furthermore, population sampling including sampling methods, research instrument and how the collected data was analysed. Lastly, which ethical considerations were made when conducting the study.

Chapter 4 is centred around the findings that were deduced from the data collected from the participants through the semi-structured interviews. The participants' profiles are also covered in this chapter. The focus area of this chapter is around the presentation of the research findings based on the propositions outlined earlier in chapter 2.

Chapter 5 goes deeper into the discussions or arguments around the findings presented in chapter 4. The research questions are mapped to the respective propositions and the findings of each research question are outlined here. The arguments coming from the collected data in the study are also compared to the literature that was reviewed in chapter 2.

Chapter 6 is the closing chapter of the study that deliberates on conclusions coming from the study with respect to the research questions and related propositions. Recommendations to the ICT service providers and the organisations who consume or looks to adopt newer methods of running ICT services are also put forward.

C2 General

CHAPTER 2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

This chapter looked at different literature articles available for research which give perspective on the challenges faced by small and medium-sized enterprises because of loadshedding. There are different views on how loadshedding affected the SMEs. Some of the challenges posed by loadshedding are lack of or reduced productivity resulting in less profitability and liquidity for business organisations (Business Resolution, 2021).

Loadshedding negatively affects smaller businesses more than it does larger corporates and businesses. Some larger businesses have financial muscles to obtain standby generators and other UPS systems to provide continuous power supply and keep the lights on during loadshedding (Banderker, 2022).

When loadshedding is implemented, small and medium-sized enterprises are severely affected due to their reliance on electricity from the national grid to run their operations. The unavailability of electricity to these SMEs translates to loss of productivity and subsequently, income. A lot of the smaller organisations cannot afford to buy backup power solutions in the form of generators, and this leaves them without income for the duration of the loadshedding period as they cannot work (Seinker, 2019).

Mitra et al., (2004) also argues that some businesses try and minimise the disruption of productivity by using generators while some use power inverters to ensure continued business operations during loadshedding and electricity supply disruptions due to faults experienced on the electrical infrastructure. These alternative means of supplying backup power, which could be explored by the small business, are very costly.

C2 General

The cost of buying the generators and ensuring that they are periodically serviced becomes a challenge for smaller enterprises. All these factors, regrettably, result in increased costs of running businesses making the smaller businesses' profitability very minimal.

Over and above the technological and organisational factors, environmental factors are also to be taken into consideration by companies who would like to adopt new ICT solutions like cloud computing in their operational space. The availability of electricity was highlighted as some of the reasons why organisations in countries like Zimbabwe and Tanzania would adopt ICT or not. Maphosa et al., (2022) refers to cloud computing as ICT. The availability of electricity is one of the drivers for businesses to adopt ICT solutions which enable remote working for these institutions. The availability of stable electricity supply ensures that there is always internet connectivity at disposal as the infrastructure will always have power. Availability of internet enables the organisations to always have remote access to the ICT infrastructure.

The deduction made from the above study is that the unavailability of electricity and stable internet connection hinders the adoption of ICT services for remote working. With respect to the research topic at hand, the above study does not fully apply as the focus in this study is on loadshedding where there is availability of electricity supply but intermittently so.

2.2 Background discussion

The background study and discussion of this topic aimed to explore the challenges brought by loadshedding on the small and medium-sized companies and how these perhaps accelerated or fast tracked the adoption of remote hosting and potentially, cloud computing platforms.

C2 General

There are organisations or enterprises that are still using the traditional ways of running IT systems whereby they keep the physical IT server infrastructure on-premises.

Privacy and security are some of the reasons being cited as data security concerns hence they feel the IT environments are more safe and secure when hosted on-premises than remotely or in the cloud (Morefield, 2022).

When IT infrastructure is hosted on premises, it poses a major challenge for most of the enterprises from a support and maintenance perspective because the enterprises need to make sure that the systems are well supported and always powered on from a power or electricity supply perspective (Ricardo et al., 2003). This attracts overheads in the form of technical support staff and hardware spares to swop out faulty modules on the IT infrastructure.

With the implementation of ongoing rolling blackouts in South Africa, enterprises are inconvenienced a lot because they are mostly reliant on the availability of electricity for the day-to-day operations of their systems from an uptime perspective (Business Resolution, 2021).

2.3 Loadshedding effects on SMEs

Small and medium-sized enterprises rely on electrical power to keep their IT infrastructure powered-up and operational all the time. Electricity is important for these businesses because it helps them continue running their operations and remain productive. The unavailability of electrical power affects IT infrastructure hosted on-premises resulting in downtime and hindrance of IT operations within these organisations (Doe, 2014). The unavailability of IT infrastructure could mean downtime and loss of production for some businesses because of their productions or applications which are running on such infrastructure.

C2 General

SMEs across the globe have a heavy reliance on electricity supply to keep their business operations functional and remain productive. When there is no electrical power, the SMEs are affected and literature is proving that SMEs in other countries outside South Africa are also experiencing operational challenges when there is no electricity as they have no form of backup or redundant power supply (Umar et al., 2019).

2.3.1 Loadshedding

Eskom is the main power utility provider in South Africa using several power generating stations and plants around the country. In the preliminary stages of 2008, Eskom experienced inadvertent outages at some of its generation plants which led to the reduction in the power generation capacity. The supply of electricity declined after these generation plants' outages, and this led to the demand of electricity being higher than what the power utility generation could supply. Eskom then resorted to scheduled power cuts at given points in time to ensure that they reduce the demand on the grid and reserve electricity to avoid a total blackout in the country (NERSA, 2008).

2.3.2 On-premises hosting

There exist enterprises who are not yet comfortable with running their IT applications off-premises or in the cloud as they still prefer to have these running from their own on-premises facilities.

Reasons, amongst others, cited by most of these organisations are the high cost of network connectivity from an internet access perspective and security vulnerability of these systems while hosted off-premises because they will be exposed to the internet and making it easier for hackers to gain unauthorised access and attack these systems (Morefield, 2022).

C2 General

With loadshedding amid the South African population and businesses, there are drawbacks associated with hosting IT services on-premises because if the businesses have not made provision for backup power, downtime is guaranteed during a power outage. This results in loss of productivity for businesses as the workforce is not able to continue and perform their daily work responsibilities. This has a negative impact on businesses in South Africa (Dewa et al.,2020).

2.3.3 Proposition 1

The challenge that loadshedding brings to organisations with IT hardware infrastructure hosted on-premises without backup power supplies is that the hardware infrastructure will not be operational during loadshedding. This negatively affects the productivity of the organisations since their operations will be dysfunctional when there is no utility power supply. Continuous power supply ensures maximum system availability and is necessary for IT infrastructure hosted on-premises.

2.4 Alternative power sources

Loadshedding is a problem not only experienced by South Africa, but other countries also have a similar challenge. Zambia also has a loadshedding challenge where residential households and business enterprises in the Zambian capital, Lusaka and other parts of the country needed to consider alternative means of power supply like standby generators and power inverters due to loadshedding.

These alternative means of power supply are however expensive, and most enterprises could not afford obtaining such (Umar et al., 2019).

In South Africa, there are enterprises that use backup power generators and Uninterruptible Power Systems (UPS) to reduce the loss of production due to loadshedding (Reporter, 2020).

C2 General

It has however been found to be a challenge for smaller enterprises or start-up companies to invest or put in place alternative means of backup power like generators. This is mainly because they cannot afford the capital needed to finance these backup generators since the cost of these is remarkably high (Dewa et al., 2020).

2.4.1 Standby power – Generators

Standby generators are the most used alternative sources of power during loadshedding. There are portable generators that can be used by households to just to keep the lights on and power up smaller appliances like Wi-Fi routers, TVs, and mobile phone chargers in residential properties or homes.

For businesses who have IT hardware server infrastructure that require excessive amounts of power, these small generators are not able to carry and power this kind of load. Bigger capacity standby generators must be used by businesses running server rooms and these are somewhat relatively expensive.

Typically, these generators would also need to have their own backup generators to help carry the load and ensuring that these server rooms are powered on for longer periods of time. The cost of running the generator hardware is also high which makes it exceedingly difficult to run standby power generation. In addition, there is also a cost of diesel and oil that comes into play when running generators (McKane, 2018).

2.4.2 Uninterruptible Power Systems (UPS)

An uninterruptible power system is necessary to ensure that there is continuous clean and regulated power supply to critical loads. IT systems like, amongst others, computers, printers, telecommunication networks and electrical equipment like machineries, also need protection against power interruptions.

C2 General

Uninterruptible power systems also protect these items from electricity spikes or surge damages when the electrical power restores (Modesto et al., 2015).

Traditional uninterruptible power systems come in two types. The first type is made up of the following components: AC/DC rectifier, batteries, DC/AC inverter, step-up transformer, and a filter.

The second type of UPS is made up of the same components but with an added DC–DC booster but excluding a step-up transformer (Chitra et al., 2019).

2.4.3 Proposition 2

The small and medium-sized enterprises who have IT hardware equipment running from on-premises may consider getting standby or backup generators and UPS systems to keep their systems powered up.

2.5 Alternative ICT hosting

2.5.1 Third-party hosting – Colocation

Data centres are complex facilities built to supply elevated levels of security for IT systems that are hosted in these facilities. The facilities also boast multiple layers of redundancy i.e., Standby generators, UPS systems and batteries that keep them running and functioning for hours during loadshedding (McKane, 2018). IT hardware hosted in data centre facilities continue being always operational and accessible to all that use them even during rolling blackouts.

It is generally a challenge for small and medium-sized enterprises to build their own ultramodern and fully fledged data centres considering the amount of CAPEX that is needed for the construction of these facilities.

C2 General

The easiest way for the smaller businesses to have access to reliable hosting facilities built or constructed in such a way to withstand electrical power outages, is using third-party data centres.

Smaller and medium-sized enterprises can lift and shift their IT hardware infrastructure from their own premises into these complex facilities. This model is also suitable for companies who still want to have control of their IT environments from an administrator perspective and not ready to fully migrate to cloud service providers in public cloud spaces (Ren et al., 2014).

In situations where small and medium-sized organisations run their IT infrastructure from their own premises, these organisations would be responsible for maintaining the on-premises hosting facilities ensuring that there is always power on the premises, enough cooling for the IT equipment or servers and backup power solutions for instances where the main electrical supply fails or is under loadshedding. The figure below depicts the difference of on-premises hosting versus colocation where IT infrastructure runs from a third-party data centre.

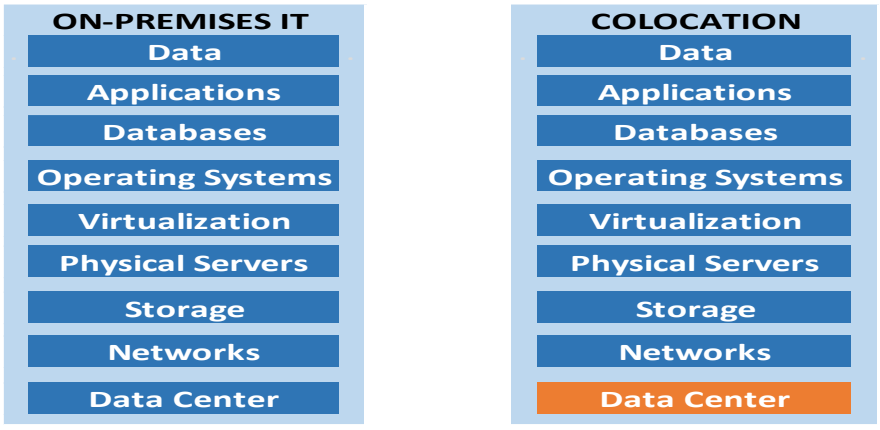


Figure 1: On-premises and colocation hosting

(Picture from Checkpoint website)

C2 General

For colocation, the IT infrastructure is hosted in a third-party data centre where the service provider oversees the data centre section ensuring physical security, cooling, and power supply (electrical power and backup power).

Reliable connectivity to third-party data center service providers is key in ensuring that the IT infrastructure that is collocated in these data centers is accessible through reliable network connectivity. To this effect, data center service providers offer redundant network connections to their facilities so that organisations using these colocation facilities can choose different connectivity links from multiple service providers giving them the redundancy required to ensure always-on access to the collocated infrastructure (Ren & Islam, 2014).

The links are also coupled with perimeter security solutions such as routers and firewalls to ensure much needed security for the IT hardware infrastructure collocated in these data centers. This is to make sure that there is no unauthorised access to the collocated IT infrastructure environments.

Leading IT organisations like Twitter have chosen not to build their own hosting facilities but have adopted the colocation method where they host their services in third-party data centres (Zhang et al., 2015).

2.5.2 Proposition 3

Businesses can consider hosting their IT hardware infrastructure with third-party data centre service providers and use the redundant design of these data centres affording them the maximum uptime for their IT services even during times when there’s no electrical power supply.

C2 General

2.6 Cloud computing as a solution

2.6.1 Cloud computing

For small and medium-sized businesses to remain relevant and competitive in the everchanging times of evolving technology, they need to have strategies that will take them into the desired future state. Businesses need to transform and transition to newer technologies to realise efficiencies that come with these newer technologies. Cloud computing uses the latest methods of hosting IT services compared to the traditional legacy methods where businesses would host and run their IT infrastructure e.g., servers, switches, routers, and databases at their own premises (Adane, 2018).

2.6.2 Summary of cloud computing benefits

Businesses who have adopted cloud computing platforms as new methods of running IT services realise benefits like agility, innovation, ease of scaling up/down, flexibility, quicker time to market, optimisation of IT environments and business processes.

The cost-effective way of doing business is one of the main benefits that small and medium-sized businesses are striving for. Cloud computing is one platform that has potential to deliver on this as organisations who have adopted it changed from the traditional CAPEX way of investment where they would buy physical IT equipment and run IT services on to renting cloud computing hosting services.

Cloud computing uses an OPEX business model where businesses rent IT resources from cloud computing service providers and only pay for what they consume in the cloud.

C2 General

With cloud computing, there is no need for organisations to be burdened about physical facilities like server rooms to host IT equipment, supply power and backup power to these facilities, purchase of hardware, and license software. Lastly, the maintenance of the IT environment and full ownership of the entire IT infrastructure estate will be the responsibility of the cloud computing service provider (Rashid,2019).

2.6.3 Cloud computing deployment models

Diverse kinds of literature show that cloud computing can be deployed in four models as defined and depicted in the below table (Armstrong et al., 2021).

Table 1:Cloud deployment models

Private Cloud The customer owns the cloud infrastructure. This infrastructure is run from their own premises. Only authorised users in the customer's domain will have secure remote access to the environment.	**Public Cloud** The service provider owns and hosts the infrastructure. Public customers can subscribe to the cloud services and access them remotely in a pay per use model.
Community Cloud A kind of cloud model where multiple organisations sharing similar services use one platform to access such.	**Hybrid Cloud** This is a combination of both public and private cloud. Customers can choose to run business critical applications in secure private cloud and less critical applications run in public cloud.

C2 General

2.6.4 Cloud computing service models

Cloud computing is a solution offered by service providers in different service models. Organisations can choose from the below service models depending on their preference and/or how far they are in their cloud transformation journey. Below are the 3 popular and mostly used cloud service models in cloud computing (Senyo et al., 2018).

Infrastructure as a Service (IaaS): This is a service model in cloud computing where cloud providers offer virtual server infrastructure to customers as an alternative to users buying and owning physical servers.

Virtual servers supplying compute and storage resources are made available to customers as a service. Cloud computing users can install the operating system of their choice but will not have control over the virtual server infrastructure.

Platform as a Service (PaaS): This service model provides users with a platform that is owned and supported by the cloud service provider. Independent Software Vendors (ISV) and developers can create test environments on these platforms for a period they require to evaluate the applications and shutdown the environments when no more in use for testing.

Software as a Service (SaaS): In this service model, the ownership and responsibility of hosting all applications is of the cloud service provider. The applications are provided to the customers as a service. Customers normally access these services through web interfaces, and they do not own the applications.

C2 General

The below figure shows the different service models and responsibilities between users and cloud service providers.

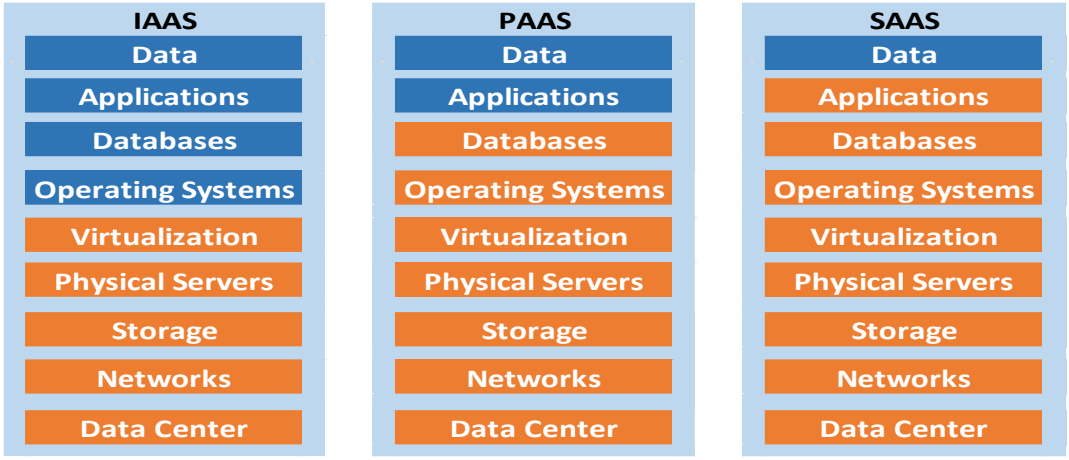


Figure 2: Cloud computing service models

(Picture from checkpoint website)

All the items highlighted in black colour are the responsibility of the cloud service provider while the rest of which are in blue are the responsibility of the customer or user.

2.6.5 Proposition 4

The adoption of cloud computing solutions helps position the small and medium-sized enterprises in a good competitive space within the markets they operate in. These organisations will realise, amongst others, benefits like cost savings, being agile and flexibility.

Companies who have made it part of their strategy to adopt cloud computing services are realising benefits such as their employees being enabled to work remotely using online and web applications. This makes collaboration between internal staff, suppliers or vendors and other stakeholders easier and efficient.

C2 General

More benefits realised by organisations who have adopted cloud computing are simplified business operations, ease of scaling up or down, no more huge capital investments needed to enable new IT or technological services. Organisations pay for these as monthly services through OPEX models (Donepudi, 2016) freeing up their cash flow.

There are more cloud computing benefits which are highlighted by Sithole and Ruhode, (2017) in that organisations who have adopted cloud services will also realise ease of IT systems management and reduction of IT costs as organisations are now only going be paying for what they have utilised.

There is however a downside of cloud computing that Maphosa et al., (2022) revealed. The main challenge is the contemplation of outages caused by cloud computing service failures either due to a planned maintenance going wrong or a random unexpected outage. In addition, bad network infrastructure and low return on investment were highlighted as some of the barriers that prohibit the adoption of ICT services including cloud computing.

2.7 Analytical framework

Based on the literature reviewed, the commonly used theoretical framework in the research for determinants of cloud adoption by enterprises is Technology, Organisational Environmental (TOE) framework which deliberates on technology, organisational environmental contexts that inspire organisations to adopt innovation in their environments. This framework may be used as a standalone or in conjunction to other theoretical frameworks like Diffusion of Innovation (DOI) and Technology Acceptance Model (TAM) where applicable.

The TAM theoretical framework mainly focuses on ICT acceptance or adoption at organisational level which is more focused and specific to ICT compared to other grounded adoption theories which does not have a specific focus on ICT.

C2 General

TAM is the most dominant and vigorous framework mainly used to assess the adoption of ICT services by organisations. This can be used in conjunction with the TOE framework (Hart et al, 2016).

DOI is another framework that gives conclusive explanations or predications around the adoption of innovations internally by organisations or users within organisations. Both the DOI and TAM frameworks focus on decisions for adoption of innovation based on factors relating mostly to technology. It has however been proven that not all decisions are based on technological reasons. Environmental and organisational factors are also some of the reasons that influence organisations to consider adoption. This is where TOE becomes useful in bridging the environmental gap that is not covered by the TAM and DOI adoption models (Amini & Bakri, 2015).

In the case of this research, the focus was more on the technological and organisational aspect of the theory where we looked at the small and medium-sized businesses together with the systems and technologies they have internally versus what is available externally in the market due to the evolution of technology and how this affects the availability of their IT infrastructure.

From an organisational context perspective, we looked at how the adoption of ICT solutions or lack thereof affected the financial position of the small and medium-sized enterprises.

The TOE framework serves as a guideline commonly used by enterprises or organisations when adopting latest innovation initiatives. The initiatives aimed at improving the organisations' innovation capability and position them better in different markets.

Tornatzky et al., (1990) developed this framework. In this research, emphasis and focus is around loadshedding or lack of reliable electricity supply as a determining factor for SMEs in adopting ICT solutions in South Africa.

C2 General

The study has further looked to show if there could still be other organisations who still believe that running IT infrastructure from on-premises has advantages either from a cost saving perspective or any other benefits.

Loadshedding, in this context, could be classified as an environmental aspect that is negatively affecting the small and medium-sized enterprises in South Africa.

This is because of an inability of the SMEs buying or providing alternative sources of power supply to keep their business operations running during loadshedding.

The findings of the study have also helped in confirming whether the SMEs in the Gauteng province have considered adopting cloud computing or other forms of ICT solutions like hosting with third-party data centre providers so to can sustain their business operations during loadshedding.

2.8 Conclusion of literature review

The literature review has given a good understanding in terms of the challenges experienced by businesses, not only in South Africa but, in various countries because of loadshedding and the common impact this has had on the sustainability of the small and medium-sized enterprises. Organisations in other countries such as Zambia and Delhi have considered backup power solutions and installed solutions like inverters, batteries, UPS and generators as the mostly used forms of backup power supply when there's loadshedding.

There are different alternatives available for the small businesses to choose from to position their businesses better from an operations perspective and ensuring organisational competitiveness including sustainability into the future.

C2 General

Proposition 1: IT Hardware infrastructure hosted on-premises without backup power supplies will not be operational during loadshedding. This will result in the productivity of the organisations being affected since their operations will be dysfunctional when there is no utility power supply.

Continuous power supply ensures that there is maximum system availability and is therefore necessary for IT infrastructure equipment hosted on-premises. Using IT hardware hosted on premises might have short-term benefits in that the organisations can use existing equipment without having to worry about variable costs as the investment capital would have been made already and they can just use the equipment to their maximum lifecycle but the disadvantages, amongst others, are that the hardware equipment is not easy to scale up, difficult/costly to maintain and also needs hardware refresh when it reaches its end-of-life span. The organisations will most likely require laying down huge capital paid for upfront to acquire physical hardware.

Proposition 2: The small and medium-sized enterprises who have IT hardware equipment running from on-premises can consider obtaining standby or backup generators and UPS systems to keep their system powered up when there is loadshedding.

Proposition 3: Businesses may consider hosting their IT hardware infrastructure with third-party data centre service providers and use the redundant design of these data centres affording them maximum uptime of their IT services even during times when there's no electrical power supply. The disadvantage of these kind of deployments is that organisations will need to budget for reliable connectivity linking them to the third-party data centers which is an additional cost that wouldn't have been incurred should they have kept their IT hardware infrastructure on-premises.

C2 General

Proposition 4: The adoption of cloud computing solutions helps position the small and medium-sized enterprises in a good competitive space within the markets they operate in. These organisations will realise, amongst others, benefits like cost savings, being agile and flexible.

The drawback of cloud computing in South Africa is around the lack of reliable internet connectivity which is required to enable remote access and increased productivity of the IT infrastructure hosted in the cloud. In case of using hyperscaler platforms, the volatility of the South African rand when matched against foreign currencies, especially the US dollar, is a concern as it makes it difficult to predict and run accurate monthly operation budgets.

C2 General

CHAPTER 3. RESEARCH METHODOLOGY

3.1 Introduction

The chapter focuses on the research methodology that was used to investigate and assess the impact that loadshedding has on SMEs in the Gauteng province of South Africa and whether this led to the adoption of cloud computing or other ICT solutions as workaround solutions. The chapter further outlines the procedure for conducting the research study considering the approach followed by the researcher to conceptualise the research problem.

This section touches, in detail, on the identification and selection of the population as this ensures the correct selection of participants earmarked to address the phenomenon. The chapter goes on to cover the formulation of the research questions that the study will need to answer. Methods used for the collection of data are streamlined and once data is collected, analysis and interpretation of such data is done. Lastly, the chapter looked to investigate and follow ethical guidelines to protect the participants and the actual data that has been collected.

3.2 Research approach

This study adopted a qualitative research approach. Busetto et al., (2020) explains that the qualitative research method is a better way to get interview participants' perspective on different discussion or research points. The data that is collected as part of this study is presented in the form of words which are transcriptions of the conducted interview audio recordings. The interviews were conducted with the different participants. This is an opposite when comparing quantitative research where data is presented in the form of numbers or statistics.

C2 General

This qualitative approach can produce reliable and concise information as the outcomes will be based and deduced from the participants' own viewpoints (Muzari et al., 2022).

3.3 Research design

There are three, out of the five, main dominant research types that are mostly used in qualitative research design. This study follows a phenomenology type because it describes and documents the lived experiences that the identified participants went through with respect to the phenomenon in question (Muzari et al., 2022). This will be first hand primary data collected through the one-on-one interviews. It is also customary practice in qualitative studies that data is collected through focus groups and, in some cases, surveys. The identified interview participants are individuals who are involved and responsible for controlling organisational IT infrastructure and operations management within the ICT industry were engaged through sectional interviews (Creswell, 2016).

The phenomenological method as described by Moser and Korstjens, (2018) was used to select participants because it was best suited for the selection of the participants based on their experience in the market. There's a strong belief that these participants gave credible and reliable information as they have been in the field for a while now and as such more qualified and experienced. Data collected from the interviews is deemed to be reliable on their experience and relevance in contributing to the study.

Unfortunately, this phenomenological method has got its own drawbacks. This method is deemed to be unsuitable for use in participants of observations and in focus group discussions (Moser and Korstjens, (2018).

A research instrument that will help guide the interviews was put together. This instrument consists of interview questions that will assist in answering research questions.

C2 General

Participants were asked deliberate and purposive interview questions through which primary data around this research topic was collected.

3.4 Data collection methods

There are some considerations to be made when planning for data collection like making an evaluation on whether already existing data can be used and what results can be drawn from the use of such data (Peersman, 2014). Going through literature, the researcher realised that there is not a lot of secondary data, especially in South Africa, relating to the topic, which could be explored and leveraged for one to come to a determination. This then informed the decision to take an approach of collecting data through one-to-one interviews that were conducted with the identified and willing participants. A research instrument as explained in section 3.6 has been developed. The interviews were conducted in-line and following the university's ethical guidelines.

The advantage of conducting interviews and collecting primary data compared to using secondary historical data is that, over time, there is a lot of changes that happen in the ICT space due to technological evolution and advancement.

The interviews helped with collecting the latest and relevant information as experienced by participants in the recent time (Peersman, 2014).

The interview participants were individuals from various small and medium-sized enterprises who are holding significant positions i.e., IT managers, directors, enterprise architects, executive heads of divisions, and technology services managers. The idea behind this approach was to consolidate different views from these individuals informed by their experience of working in the ICT industry.

C2 General

3.5 Population and sample

3.5.1 Population

The individuals that were interviewed are people who hold senior and executive positions in organisations they work for and are also experts in the ICT field.

The participants were a combination of experts from organisations who are IT service providers, and some from organisations that are in the data centre provider business space. The last type of participants were those individuals who are working for companies consuming their own inhouse IT infrastructure deployed and supported by their own internal IT technicians and/or engineers.

3.5.2 Sample and sampling method

In qualitative studies, sampling, which is a process that is used to find participants for responding to a specific phenomenon of interest, is deliberate. Qualitative sampling starts with the deliberate sampling of participants, the size of the sample is different for each study and is generally small.

Lastly, the sample is decided by the conceptual constraints meaning that the researcher needs to ensure that the selected sample is suitable, and the identified participants are enough to cover a good comprehension of the subject that is being studied (Moser & Korstjens, 2018).

For the purposes of this study, a non-probability sampling method has been used where the targeted participants were selected randomly based on their availability, willingness, and relevance to take part in the interviews were conducted (Banderker, 2022).

Their contributions to decision making about the IT transformation strategies within their respective organisations was also taken into consideration.

C2 General

The reason of the choice for participants in the Gauteng province is because this is a province with a lot of activity around ICT infrastructure transformation and where most companies have presence either from a headquarter or satellite branch perspective.

This sample size in this study was informed by the number of relevant potential interview participants known and accessible to the researcher and their suitability for the topic being researched. According to the definitions from Moser and Korstjens (2018), the method used in this study touches on both convenience sampling, where the researcher selects participants based on them being easily available, and purposive sampling, where participants are identified based on the researcher's judgement that they will be most informative in terms of giving meaningful contribution to the study.

Braun et al., (2019) mentioned that a good sample size in qualitative research can be between 6 and 16 participants. The sample size is however decided by the point at which saturation is reached meaning that there is a possibility that saturation can occur anywhere in between the two depending on whether there's repetition or similarities in the responses from participants being interviewed (Moser & Korstjens, 2018).

According to Braun and Clarke (2019), when saturation is reached, there's no relevant other information forthcoming from the interviews being conducted. When conducting interviews with participants, the researcher discovered that after 10 interviews, no added information was coming through from the participants and as such the interviews were stopped and capped at 10. With saturation being reached at 10 participants, no further interviews were conducted and only data that was collected from these participants was used for analysis.

C2 General

3.6 The research instrument

The most used research instruments in qualitative research are participant observations, interviews, and focus groups. Participant observations are scenarios where individuals or a group of participants are observed over a certain period and findings drawn from the observations.

In the case of focus groups, participants in a small group are given a subject of discussion and to be deliberated on. These focus group sessions are normally facilitated and driven by a moderator. In qualitative analysis, it is allowed to mix or use more than one method of data collection (Moser & Korstjens, 2018).

In this study, the researcher opted to conduct semi-structured interviews with willing participants as a means of data collection. This method was chosen because it allows participants to share their views and where applicable, their lived experiences on the topic that is being researched. This means that the data being collected will be primary or first hand and reliable with no possibility of it having been manipulated in any form.

The research instrument used consists of interview questions which served as an interview guide during the data collection exercise when interacting with the participants.

The interview questions were drafted such that they are deliberate in helping with answering the research questions and, as a result, leading to taking a decision. The attached appendix 4 contains a list of the interview questions that were asked to the participants and used to answer the research questions as outlined in chapter 1 above.

In some cases, the researcher discovered, during the interviews, that there was room for additional interview questions that could help to better answer the research questions that were put together by the researcher.

C2 General

3.7 Procedure for data collection

The researcher has some form of relationship, through business interactions and some on personal capacity, with the participants.

The researcher reached out to the participants, sensitized them of the imminent request for the interview sessions through the cover letter and asked for their voluntary willingness to take part in same.

On confirmation of preparedness by participants to take part in the research study, the researcher then sent out the consent form documents to the participants for their perusal, completion, and signature. The cover letter and the consent form are attached in this research report document as appendices 1 and 2 respectively.

These were then followed up with the actual interview sessions meeting invites to the participant's calendars booking out time slots with them. On acceptance of the interview sessions meeting invites, the researcher then conducted the interviews using Microsoft Teams as one of the modern online collaboration application tools that was preferred by the interview participants. Other publicly available online collaboration tools that were at our disposal are, for example, Google meet, Zoom, and WhatsApp.

These other forms of collaboration applications were suggested to the participants but were not preferred. The participants opted for Microsoft Teams as their collaboration tool of choice.

None of the participants opted for a physical face to face meeting, the researcher was willing to accommodate those face-to-face interactions should it have happened that some participants wanted to have physical meetings. Face-to-face interviews would have given a real live interaction scenario where the researcher would also have seen and judged the facial expressions of the participants when answering questions.

C2 General

3.8 Data analysis strategies and interpretation

Finlay, (2021) described thematic analysis as a qualitative research technique which seeks to find, analyse, and report patterns within collected data. Analysing data using this technique can take different forms i.e., scientific, intuitive, systematic, and creatively artful. Qualitative data can be easily and flexibly analysed using thematic analysis. Unlike other methods of analysis, this method does not prescribe predefined themes based on collected data but rather allows researchers to discover their own patterns.

There are two types of coding methods that are commonly used in qualitative research i.e., inductive and deductive. The coding of the data in this study was done using an inductive coding approach since theory was generated based on the collected data. The deductive approach mostly focuses on the testing of existing theory (Williams & Moser, 2019).

The researcher followed the below coding process when going through coding preparations for the collected data (Finlay, 2021):

- Immersion and becoming familiar with the data through reading the interview transcripts and recordings.
- Systematically organising the data by collating extracts and creating the codes for each data set.
- Searching for similarities and identification of patterns in the data to create themes.
- Revising the themes and ensuring that they classified accordingly to answer or address the research questions.
- Definition and assigning labels to the themes.
- Writing up the themes to create a story line and inclusion of the themes in the wider report.

C2 General

The researcher went through the transcripts line-by-line in ensuring detailed immersion and understanding of the data to be analysed. This helped the researcher to assess if there are any new emerging themes from the data being engaged. The collected data has been clustered into themes that align to the research questions and next the propositions that were put forward in the earlier chapters for ease of analysis (Vaismoradi et al., 2016).

3.9 Possible limitations and challenges of the study

This study focuses on the challenges posed by loadshedding to small and medium-sized enterprises and how these could have accelerated the adoption of ICT solutions but does not consider other determinants or factors that could be reasons leading to organisations adopting alternative hosting platforms.

The study also does not cover in detail the benefits that could be realised by organisations who use cloud computing native applications and the potential efficiencies the benefits might bring to these organisations.

3.10 Trustworthiness

Jessica et al., (2020) mentioned that data collected and analysed as part of qualitative research helps answer the research questions and further adds that there's sometimes an element of researcher bias when the qualitative research methodology is used. This can be avoided through rigor and research quality.

Other researchers including Finlay (2021) have mostly cited Lincoln et al. (1985) who recommends that qualitative studies need to be evaluated for elements of trustworthiness and this can be achieved by taking them through the below criteria or test factors to ensure that they can be trusted and be used in another place.

C2 General

3.10.1 *Transferability*

In qualitative research methodology, researchers do not aim to reproduce the circumstances of the research findings, but it is mainly understood that the outcomes from earlier studies can be used or applied to similar backgrounds elsewhere (Stahl & King, 2020).

The same sentiment in defining the meaning of transferability is shared by Rose and Johnson (2020) that transferability in trustworthiness means that findings can be transferred to other contexts.

It is, therefore, the researcher's belief that the outcomes deduced from the study (based on the data that was collected from participants in Gauteng, South Africa) will be able to be applied to other similar contexts in other geographies outside the borders of the country. This is because loadshedding has been found to have been a phenomenon that is experienced by other countries outside the Republic of South Africa for example in Zambia (Umar et al.,2019). This study will be published and will be made accessible for other researchers doing literature review when they search for specific keywords as defined earlier in the abstract part of the document.

3.10.2 *Credibility*

The analysis drawn from qualitative research are believed to be credible in that the readers of these articles can believe what the researchers have come up with as part of their findings in their individual research studies (Rose et al., 2020).

It is believed that this study will have credibility because the participants who were interviewed were carefully chosen based on their professional positions and seniority levels, they hold in organisations they work for and/or own. It is also factual that the inputs and answers to the research questions were purely based on the participants' solid experience in the industries that they specialised in.

C2 General

This is for the duration of their careers, and this extends back to several years depending on how long the participant has been in a particular industry.

3.10.3 *Dependability*

The dependability criteria as defined by Stahl and King (2020), explores the trust element of trustworthiness. This means that this study can be trusted and be replicable or can be practically put into implementation. After the interview findings are documented, the report was shared with the supervisor or mentor for review which can be regarded as peer review or scrutiny.

3.11 Ethical considerations

This research study is compliant with the ethical standards as required by the university. The following were observed and followed as part of the ethics:

3.11.1 Consent form

The participants were requested to sign the formal consent forms as proof of them voluntarily agreeing to taking part in the interview sessions. All the conditions were explained to the participants including the fact that there would be no financial reward or benefit for them agreeing to take part in the study. Participants also consented to the fact that their contributions in the study may be used in the formal report that will be submitted to the university.

3.11.2 Protecting participant's identities

The identities of the interview participants were protected and were not disclosed to other participants or anyone else. The participant's identities were kept anonymous and are not identifiable in the research report.

C2 General

In addition, aliases with tag names were created and used for the identification of each of the participants.

3.11.3 Data collection

Data was collected through having semi-structured interviews with the participants. These are the participants who have agreed and have given consent to taking part in the research interviews.

3.11.4 Data protection

The interview data stored in the form of interview meeting audio recordings and transcribed data are stored online in a password protected laptop in a digital file format. The file names or any type of identifiable features have been removed to ensure concealment. This data is also backed up onto OneDrive and access to the online storage is limited to only the researcher. On completion of the research study, the collected interview data will be removed and disposed after one year.

C2 General

CHAPTER 4. PRESENTATION OF FINDINGS

4.1 Introduction

In this chapter, the aim is to outline and unpack the actual findings based on the participants' responses to the research and interview questions. These were evaluated and checked as to whether they address the problem statement as detailed in the earlier chapters. The study also assesses if there were any similarities in the responses from the participants. Analysis of the data resulting from the participants' responses was performed and subsequently themes were generated from the same collected data.

4.2 Participants profiles

Data was collected from participants who hold different senior positions in their respective organisations around the Gauteng province, South Africa. A total of 10 participants were interviewed to ask for their contributions on the topic at hand based on their lived experiences in the industry.

According to Etikan and Bala (2020), participants can be selected based on their demographics. Below is a table that shows all the identified participants that were interviewed and the positions they hold within the ICT industry. The participants' other demographical data relating to their gender, income level, religion and age were disregarded and not included in their profiles as it wouldn't have added value in terms of contributing to the study.

C2 General

Table 2: Interview participants' profile

Description	Alias	Position
Participant 1	P001	IT Manager
Participant 2	P002	General Manager
Participant 3	P003	Senior Manager
Participant 4	P004	Executive Head of Department
Participant 5	P005	IT Manager
Participant 6	P006	Chief Executive Officer
Participant 7	P007	Enterprise Architect
Participant 8	P008	Business Development Executive Director
Participant 9	P009	Business Architect Team Lead
Participant 10	P010	Technology Services Manager

These participants are mapped to aliases to ensure that their identity or any other personal information that might identify them is kept anonymous and protected. Alias names have been used when quoting the participants' responses in the report.

C2 General

For any researched data to be appropriately evaluated, there needs to be clearly identified data collection and analysis methods that are used (Peersman, 2014).

Table 3: Themes relating to the study

Main Themes	Data Groups - Codes		Research Questions
On-premises	Investment on hardware		1. Where are you currently hosting your IT servers infrastructure?
	Maintenance		2. What kind of infrastructure do you currently have and do you own the infrastructure?
	Support		3. What are the challenges or benefits have you experienced by owning same?
Backup power	Generators	Cost	4. How has loadshedding affected your business from an IT services perspective?
	UPS	Solar	5. How do you make sure that you have the systems powered up and always on even during loadshedding?
	Diesel	Downtime	6. What are the cost implications of providing backup or alternate power supply
Data centre	Colocation		7. Have you considered moving and hosting your IT infrastructure in a third-party facility as an option? If no, what are the reasons?
	Hybrid		8. If yes, what are the benefit of doing same?
	Awareness		9. Did you perhaps consider the hybrid method of hosting IT infrastructure? If no, what were the reasons?
	Applications		10. If yes, what informed the decision?
Cloud computing	Capex	Opex	11. Do you perhaps know about cloud computing as an alternative platform for running IT services?
	Insights	Value	12. Have you considered running your IT services using cloud computing? If no, what are the reasons?
	Innovations		13. If yes, what were the benefits of doing same?

4.3 Presentation of research findings

Thematic analysis – A qualitative analysis approach

In this qualitative research study, the data that is being presented was collected through interviews that were conducted with different identified participants.

C2 General

The collected data forms the basis on which the main themes and grouping of codes came about. This classification of data into the different themes helps create some structure to be used for the presentation of the findings for ease of comprehension to the reader.

4.3.1 Findings based on proposition 1

It was discovered during the semi structured interviews that there are organisations who still have some IT infrastructure running from on-premises, but some organisations do not have pieces of IT hardware still being hosted on-premises. So, there is a combination of different scenarios as these organisations are at various stages of their digital maturity journey. IT equipment on premises poses a risk of downtime and unavailability of services during loadshedding.

The researcher also noticed that there were different views and sentiments displayed from the data that was collected depending on who was being interviewed and their respective positions in organisations they work for.

Some of the responses to certain interview questions were quite similar while a few others were in contrary. Another factor of contribution to the different views was the actual nature of the business in which the interview participants are.

On-premises hosting - Investment on hardware, maintenance, and support

Participant 2 - *"So, what has happened is we have moved back to our headquarters who have their own physical on-prem IT team. We moved our own IT infrastructure to the headquarters who have a diesel generator on-prem plus solar. I would say the challenge with that is that it slows down your internal processes and creates massive frustrations with your clients, especially if you are dealing with or trying to resolve an issue for a client."*

C2 General

Participant 7 **-** *“We are still using the on-prem infrastructure that we have recently acquired and because they hold the core of the banking systems, it's something that we cannot just decide to move”.*
The challenge we are facing is that there is a certain number of transactions that we can process in a minute, and those are the challenges that we are sitting with, and we are aware of. In addition, we had an incident and because everything is running on one system, when that one part died it affected the whole flow.”

Participant 6 – “*The limitation that comes with on-site IT systems is the fact that you may not evolve as quickly as other technologies do.”*

Participant 7 - *“Having infrastructure on-premises also gives an advantage in terms of quick accessibility to the equipment as they are dealing with financial transactions so they cannot afford to be down for longer periods of time. We know that the technicians that are running those machines are skilled up and can support it while it is on-premises, right? So, it is easy for the technicians to just go downstairs and fix what needs to be fixed.”*

The comment from P007 above somewhat aligns with statements P002 and P006 mentioned earlier in terms of local support staff having quicker access to the IT infrastructure when it is on-premises leading to a faster resolution of IT issues.

4.3.2 Findings based on proposition 2

Backup power – Generators, UPS, solar, and diesel

Loadshedding has become so much of a challenge for the small and medium-sized organisations in South Africa. This eventually resulted in businesses looking for alternative means of power supply for their facilities.

An organisation needs to have a significant amount of CAPEX to cater for buying backup generators and other forms of alternative power.

C2 General

When conducting interviews, a discovery of information that suggests that there are organisations who are now renting offices from property owners who supply backup power as part of the rental agreement was made. This is new added information that emerged from the study and discovered at this point as it was not part of any of the propositions made earlier in chapter 2.

Participant 1 – *"If an organisation does not have backup power to keep their IT systems on, they will be dead in the water. We have put down generators in many of our stores. We also have UPS systems, which last for 30 minutes, in some of the stores. The stores with generators do not get affected during loadshedding but the ones with UPS systems can only run for 30 minutes so they do get affected".*

Participant 5 – *"There was no need for us to provide or make means to provide backup power because power was provided by the proprietor as part of the property lease agreement we have in place, we haven't had any issues with the server environment going down during loadshedding. The only time we have a service disruption is when our fibre link is down".*

Participant 6 **–** *"I think generators and the operating costs have also risen over time, obviously influenced by the cost of the generator itself, but also the cost of fuel. On the solar part, you find that it feels like an investment, but the limitation is that if you don't have the capital to invest in solar, you find that limitation".*

Participant 6 raised a crucial point around an entrepreneurial opportunity that Loadshedding might have opened. *P006 said "So we are seeing that maybe the future calls for companies to outsource power. When you outsource your IT, you could also outsource your power. Some entrepreneurs are promising to provide a dependable solution on ICT and with added energy support for a particular rate per month".*

C2 General

Participant 10 – **"***We are renting premises from a facilities provider and backup power is part of the lease agreement which the facilities owner caters for, so we did not have to derive any means for backup power and as such there was no cost incurred by them to supply backup power.*

Participant 3 – *"We had a generator system in place, but it was not big enough to power the server farm they had onsite but was just enough to run the lights.*

They needed to put down a heavy-duty generator which is quite costly, and they couldn't afford from a CAPEX *perspective. In addition, there's other cost factors like diesel they needed to consider. During higher stages of loadshedding, generators easily burn 1000 litres of fuel per week which affects their bottom line, support staff morale due to fatigue".*

Participant 4 – *"Loadshedding affects organisations in diverse ways because it boils down to…. What is the cost of downtime from an operations perspective? There is also a reputation damage involved because if you are running a plumbing business and I'm trying to find a plumber, but I don't find your website available or your phones are down or you can't give me a quote, the likelihood of me moving to a competitor who's available because probably they've adopted modern ways of working is high. The challenge that we phased was loss of operations during loadshedding especially because we were using an unreliable generator as a form of backup power. One of our biggest file servers had an ungraceful shutdown which led to 64TB of data being corrupted and it took us over a month to recover some of the critical data from backups".*

4.3.3 Findings based on proposition 3

Based on the information gathered from the participants through interviews, it was found that other businesses have opted to move their IT infrastructure from on-premises into third-party data centre providers.

C2 General

These companies are renting cabinet space from the data centre providers to mount and house their physical IT equipment.

There are companies that have fully migrated their workloads and are using the hosted environments existing in third-party data centres. Other organisations have fully adopted cloud computing where they use hyperscale cloud providers for the purposes of hosting their IT environments. The next part of the findings covers cloud computing in detail.

Data center – Colocation, hybrid and virtual hosting

Participant 10 – *"Due to loadshedding and our landlord's backup generator frequent failures, we had to move our infrastructure into a service provider data centre. We did this to avoid service downtime on our premises. We have different clients that were doing continuity planning especially in the banking sector and they were asking us what our mitigation measures are if the whole power grid were to fail or if there was to be downtime for 24/48 hours? It was getting to a point where we could not answer those questions because of our landlord's frequent generator failures."*

These two participants below are in the data centre provider business, and they have shared inputs as per their experience in the market:

Participant 4 - *"We take our customers through a cloud evolution roadmap that considers the current have and what infrastructure can customers keep or dispose. We also need to shine the light onto customers to inform them more about the available options and solutions for the physical equipment they have on-premises. Customers, especially in the banking sector keep business critical applications and other mainframes on-premises still."*

Participant 9 – "*Creating awareness about the different methods of hosting that customers can adopt is something that still needs to be done in the SME market.*

C2 General

Customers do come to us looking for solutions where they can rackmount their physical servers. We provide customers with an opportunity to collocate in our data centres and move their equipment to us. we will take away the pain of worrying about backup power as we supply these to mitigate against loadshedding."

Participant 6 – *"I feel that the data centre providers may not have been sufficiently aggressive in convincing the market that outsourcing infrastructure hosting to a third-party data centre also comes with the energy benefits". That information is lacking and not effectively communicated to businesses. This includes the fact that data centre providers have capability to supply very robust energy systems for alternative energy backup. Currently people do not look at datacentres as a strategy for energy security.*

The comment by Participant 6 above links back to the point raised by Participants 4 and 9 around the need for ICT providers to create awareness on the value of outsourcing IT systems to data centre providers.

Participant 7 – *"Our company has adopted a hybrid approach where we are running our core banking infrastructure on-premises and other applications are running in cloud computing. Our strategy is having applications that do not have dependencies on each other deployed in a hybrid mode."*

Participant 5 – *"We have a combination of physical hardware equipment that's on-premises and a cloud-based service. So, when I started at the company, I found the on-premises stuff already in existence but when I joined, I decided that every new system that I brought to the company is cloud based. Because some of us, since during the Covid-19 times, we were working from home. We got rid of manual systems and adopted paperless solutions and even our contact centre agents are working from home."*

C2 General

4.3.4 Findings based on proposition 4

Cloud computing – CAPEX, OPEX, data insights, value and innovation

Different organisations are at various stages when it comes to their digital maturity position. There are organisations who still run their IT infrastructure on-premises and those that have adopted a hybrid model where they have both on-premises and off premises hosting. Some organisations have fully adopted and are running their IT systems in cloud computing with distinct reasons informing those decisions.

Moving from a CAPEX to OPEX, where organisations pay for what they consume, way of sourcing IT Infrastructure is one of the reasons why companies are opting for cloud computing solutions.

Participant 1 – **"***The organisation took a decision to rollout new age solutions and ensuring better performance by adopting cloud-based solution. Cloud computing solutions offer added levels of security, reduces their cost from an IT expenditure perspective as they won't need to spend millions of rands for buying physical servers. By using cloud computing solutions, we can focus on our daily business operations and enhancements as we no more need to worry about maintenance of the IT environments".*

Participant 2 – *"I would say, the benefits of moving IT Infrastructure into the cloud would be the peace of mind on security of data, customer information and company information. This does not mean that the cloud is fully secure, but this is where the world is going from a technology advancement perspective. Capacity in the cloud is scalable and processing is much quicker which gives a good customer experience from a system performance perspective".*

Participant 4 **–** *"There are normal functional benefits like always-on, CAPEX to OPEX model of operation, use and pay for what you need infrastructure benefits.*

C2 General

"More to that is the value that can be derived from the data that exists in the cloud, what new revenues can be pursued, how do you stay top of mind.

Participant 5 – *"Our strategy to adopt cloud computing was particularly driven by Covid-19 and not so much by loadshedding. I joined the company literally three weeks before the pandemic and we could not do paper-based applications anymore because it means that people would have had to come to the offices to hand in their applications and this was not allowed during Covid-19 shutdown".*

Participant 6 – "*When organisations adopt and use cloud computing solutions, it helps them free up a lot of time and the automation of solutions makes them become more competitive.*

P006 highlighted limitations and said **–** *"The country needs to invest more in connectivity infrastructure and expand so that we can switch on the entire country and thereafter unlock more digital solutions. Investment on connectivity trajectory in South Africa needs to be given more attention so that commercial decision making is informed by the rewards that will follow because of the investments".*

Participant 3 – *"Data hosted in the cloud can be useful to organisations in that there are tools in the cloud that can enable the SMEs to make sense of the data, draw enhancement and innovation opportunities. This data can be used to develop and enhance existing products so that they can add more value to their customers and keep them competitive in the market".*

4.4 Chapter summary:

The table below gives a summary of the research findings based on the 4 research questions that were asked and meant to be answered as part of this study.

C2 General

Table 4: Summary of findings against research questions and propositions

Research Questions	Propositions	Findings
RQ1: How does loadshedding affect small and medium-sized businesses who are hosting their IT infrastructure on-premises in South Africa?	**Prop1:** Physical IT hardware infrastructure hosted on-premises without backup power supplies will not be operational during loadshedding. This will result in productivity of the organisations being negatively affected since their operations will be dysfunctional when there's no utility power supply. Continuous power supply ensuring that there is maximum system availability, is necessary for IT infrastructure that is hosted on-premises.	The rolling blackouts are a pain point for most businesses especially those that are still running their IT infrastructure on site. Their operations are severely disrupted and affected during loadshedding. Some lost critical information and others got their data corrupted due to systems failing because of power surges.
RQ2: What means could organisations employ to keep their businesses running and operational during loadshedding?	**Prop2:** The small and medium-sized enterprises who have IT hardware equipment running from on-premises can consider obtaining standby or backup generators and UPS systems to keep their systems powered up.	Some businesses have installed generators and other forms of backup power i.e., solar, UPS, etc. Most cannot afford backup power due to lack of finances. One interesting realisation was companies opting to rent out offices from property owners who can supply backup power.

C2 General

RQ3: Which ICT solutions, if any, did organisations consider as an alternative to hosting their IT infrastructure on premises?	**Prop3:** Businesses can consider hosting their IT hardware infrastructure with third-party data centre service providers and use the redundant design of these data centres affording them the maximum uptime of their IT services even during times when there's no electrical power supply.	Due to loadshedding, some businesses resorted to moving their IT infrastructure into third party data centres where they collocated. Some of the organisations who have multiple office branches where each had their branch IT infrastructure had to move and aggregate into their head offices where they can make use of backup power supplies from a central location.
RQ4: How did cloud computing, if used as a workaround or an alternative solution help to keep IT systems running and accessible from anywhere at any time?	**Prop4:** The adoption of cloud computing solutions helps position the small and medium-sized enterprises in a good competitive space within the markets they run business operations in. These organisations will realise, amongst others, several benefits like cost savings, being agile and flexibility.	The adoption of cloud computing is proving to be on an upward trajectory though it is slow. Lack of reliable connectivity, high internet cost, poor levels of support from cloud providers, and variable billing due to Rand/Dollar exchange fluctuations are some of the inhibiting reasons. Cloud computing providers are seeing a gap that needs to be closed in terms of creating awareness about cloud computing and its benefits. Those businesses who have adopted cloud computing are realising the value.

C2 General

CHAPTER 5. DISCUSSION OF FINDINGS

5.1 Introduction

In this chapter, the study will delve deeper and discuss the findings as detailed in chapter 4 above. The discussion is based on the responses received from the individual participants. The responses in chapter 4 have been classified under the respective propositions guided by the research questions they are meant to address. In this study, artfully interpretive analysis method has been used as it focuses on analysing the collected data based on is relativity (Finlay, 2021). The findings from this data have been compared with the propositions that were outlined earlier in chapter 2.

5.2 Discussion pertaining to proposition 1

Referring to Proposition 1 which reads: *IT hardware infrastructure hosted on-premises without backup power supplies will not be operational during loadshedding. This will result in productivity of the organisations being negatively affected since their operations will be dysfunctional when there's no utility power supply. Continuous power supply ensuring that there is maximum system availability, is necessary for IT Infrastructure that is hosted on-premises*.

There is a slow adoption of ICT solutions by small and medium-sized organisations in South Africa due to several reasons like security, prohibitive cost of reliable internet connectivity, etc. Most of the enterprises believe that their IT infrastructure is safer when hosted on-premises compared to when hosted with third-party hosting providers or in cloud computing (Morefield, 2022).

Some of the issues cited above are also confirmed in another literature where there is mention of the fact that even though there are benefits in the adoption of ICT services, similarly, there are disadvantages that come with using same.

C2 General

This is because these platforms are accessible remotely through using network connectivity. Nwogbada et al. (2016) argued that even the best designed hosting platforms which can be accessed from any location at any given point in time, are also prone to issues of malfunctioning. Another issue that needs to be taken into consideration when adopting ICT solutions is data security. Company data that is hosted in ICT solutions off premises including cloud computing is also not exempted from the determinants leading to the reluctance in organisational adoption of newer technological systems.

Some of the participants advised that there are software applications that have been outsourced away to off-premises, but these are mostly those that are non-business critical. The business-critical applications that run day to day business functions and need to be accessed often, are kept on-premises for ease of access and support.

One of the participants mentioned that some businesses are hosting their IT infrastructure on-premises because the applications they run are designed to run on traditional physical servers and cannot be virtualised. This kind of deployment has its own challenges in that it’s not easy to scale-up these types of environments as there is a long procurement process attached to obtaining more new IT hardware infrastructure.

Even when there is an issue, either unavailability of electricity or network challenges, the business-critical applications will still be accessible on-premises and there will be business continuity. The only issue is that the business needs to make sure that there is redundant or backup power supply.

C2 General

5.3 Discussion pertaining to proposition 2

5.3.1 Backup generators and UPS systems cost

Proposition 2 reads: *The small and medium-sized enterprises who have IT Hardware equipment running from on-premises can consider obtaining standby or backup generators and UPS systems to keep their system powered up when there is loadshedding.*

When further engaging literature as detailed earlier in chapter 2, the following was discovered:

Loadshedding seems to be a continuing challenge that affects organisations around South Africa. It negatively affects businesses by interrupting their productivity and, as a result, this affects the sustainability of such businesses going forward. To ensure that there is always business continuity even during loadshedding, organisations are putting in place contingency plans to keep their IT infrastructure powered up. The standby power systems come at an exorbitant cost and are not affordable especially for the small and medium-sized organisations (Umar et al., 2019).

Some enterprises have resorted to getting backup power sources like generators, batteries, and UPS systems. Dewa et al., (2020) highlighted that startup companies and other smaller organisations cannot afford to lay down capital to secure these alternative power supply systems.

From the interviews that were conducted with the participants, the above facts were confirmed to be legitimate and correct as other companies could not afford to source their own alternative power systems but resorted to other means that could see them managing cost.

C2 General

Instead of getting their own backup generators and other alternative means of power sources, two of the participants mentioned that they rented facilities on which their property owners provided alternative power supply as part of the lease agreements. This has seen them saving on CAPEX needed to buy generators and saving on the ongoing maintenance of the generators as this is now the responsibility of the property owner.

5.3.2 Escalating diesel costs

Over and above the high CAPEX needed to buy standby generators, it was clear that there is cost of diesel that comes into play for organisations who are using generators. South Africa has been seeing escalating costs of fuel and with higher stages of loadshedding, more diesel is burnt to ensure that standby power is supported. The conflict between Russia and Ukraine also has a negative effect resulting in increased costs on the prices of supplies that originate from that region (Mybroadband, 2022).

5.4 Discussion pertaining to proposition 3

5.4.1 Third-party data centre hosting – Colocation

Proposition 3 reads*: Businesses can consider hosting their IT hardware infrastructure with third-party data centre service providers and use the redundant design of these data centres affording them the maximum uptime of their IT services even during times when there's no electrical power supply.*

Physical data centre facilities are designed to cater for organisations who are not able to build their own hosting facilities and not want to fully outsource their IT services into public cloud providers. It is very costly for entities to build their own data centres and it might not be economically practical for small and medium sized enterprises to build their own of these facilities (Ren et al., 2014).

C2 General

These data centre facilities are usually constructed to have redundant power supplies, cooling, security and so forth. Multiple businesses or tenants can collocate with the data centre providers and host their IT hardware infrastructure at these facilities.

Literature has suggested that organisations who do not have enough capital to construct their own data centre facilities can consider collocating and using third-party data centre facilities as they have generators, batteries, and UPS system that can help to be operational for longer periods when there's loadshedding (McKane, 2018).

When engaging and collecting data from the participants, it was confirmed that some organisations have adopted the option of hosting their physical equipment with third-party data centre providers as this option takes away the pain of having to worry about providing standby power supply systems to keep their IT services operational during loadshedding.

There are however some companies that have moved some of their physical server environments, especially those that run critical applications, into third-party data centres and left those that aren't on-premises. This is done mainly to ensure that all critical applications are accessible and still operational even during loadshedding so that daily transactions are not affected by the loss of electrical power. Participant 4 regarded colocation as an important first leg in preparation for moving traditional IT infrastructure and services into cloud computing.

5.4.2 Hybrid hosting methods

There are organisations who have opted to move their physical hardware into the third-party data centre facilities providers and at the same time outsourced some of their IT applications into cloud computing. This is a hybrid model that some organisations have considered and implemented.

C2 General

This helps them realise more ROI on the assets they have invested capital on while at the same time transitioning into cloud computing by deploying cloud native applications in cloud computing from the beginning (NIST, 2011). There is somewhat some alignment between the literature review and the data collected from participants.

5.5 Discussion pertaining to proposition 4

Proposition 4 reads: *The adoption of cloud computing solutions helps position the small and medium-sized enterprises in a good competitive space within the markets they run business operations in. These organisations will realise, amongst others, several benefits like cost savings, being agile and flexibility*.

As companies continue to adopt ICT solutions, it is imperative that they also consider cloud computing as another form of ICT hosting.

One of the benefits of cloud computing, amongst others, is that there is no requirement for organisations to put down enormous amounts of capital to either buy their own IT hardware or build their own hosting facilities and supply backup power for when there is loadshedding.

Basically, when using cloud computing, the IT infrastructure is outsourced to the cloud services provider meaning that all the ongoing maintenance needed to upkeep the cloud computing environment is the responsibility of the cloud service provider (Rashid, 2019).

Cloud computing also allows for a pay-per-use model where consumers are expected to only pay for the resources they have used (Low et al., 2011). This kind of arrangement is in a form of an OPEX model where organisations are not needed to pay high once-off capital costs but will pay for the services on monthly basis.

C2 General

When utilising cloud computing, businesses who have subscribed to these services will have a capability of scaling up (when their organisations require more compute resources to run their workload transactions with improved performance) and scaling down (when there is a requirement for the organisation to reduce some resources either because they are now running less applications or they no more require high compute performance resources) as their business positions might dictate. Most of the participants have made similar comments around the benefits that are realised by organisations who have adopted the cloud computing platforms. Ease of scaling up and down, flexibility and quicker time to market are some of the added benefits (Skafi et al., 2020).

One of the participants however mentioned that there are still some organisations who would like to have full control of their IT estate and not outsource it to any third-party providers. The main challenge that was raised is the fact that after-sales support normally becomes a challenge as support calls for issues are logged but there is lack of prompt response from the cloud service provider support teams in addressing the support challenges.

This is one of the reasons why some of the small and medium-sized enterprises prefer to keep their own IT infrastructure on premises so that they can be able to support their IT environments better.

In addition, good and reliable internet connectivity is one other determining factor that was mentioned which is also critical for the adoption of cloud computing services.

The participant added that; lack of reliable internet connectivity to the cloud computing environment poses a challenge for anytime access to the IT infrastructure that will be hosted in the cloud computing platform. Loadshedding unfortunately also plays a contributing role on the unavailability of reliable and usable internet connectivity.

C2 General

In most cases, the network becomes congested when there is loadshedding, and this normally result in slow internet speeds affecting connectivity to the IT environments hosted off premises.

Chapter summary:

Loadshedding poses a serious challenge to SME organisations that are hosting physical IT hardware on-premises without backup power. Challenges ranging from data being corrupted and worst case, servers getting damaged by power surges were experienced.

Many smaller organisations do not have means of backup power started renting facilities that already have backup power sources to avoid the cost burden that comes with sourcing and maintaining own infrastructure. There are companies who have resorted to hosting their equipment in third-party data centers to avoid all the loadshedding challenges. Some organisations warmed up to the idea of moving completely to cloud computing and stared reaping the benefits of such migrations.

C2 General

CHAPTER 6. CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This study focused on investigating the main challenges caused by loadshedding and perhaps how, if at all, these have led to the adoption of alternative ICT solutions. We are looking to outline the conclusions deduced and the necessary recommendations based on the findings from the collected data.

The loadshedding challenge affected and continues to affect businesses in many ways. The ultimate result is that some business operations are set back by the continuing rolling blackouts in South Africa and anywhere else where it is being implemented.

It has become clear that there are some of the small and medium-sized businesses who still own traditional physical IT hardware infrastructure that is hosted on-premises and suffering the pain of not having backup power supply systems which leads to loss of revenue or income during loadshedding. Some of the businesses have since made contingency plans to circumvent the electricity issue to keep the businesses running.

During data collection, there were gaps that were found and not covered in the main propositions put forward in chapter 2. There is new data that was discovered emerging from the participants' responses and can be added to the propositions with an intention to further address the research questions.

C2 General

6.2 Conclusions regarding research question 1

The purpose of asking this research question was to understand the fundamental issues that the SMEs faced or continue to experience when it comes to loadshedding. The different entities could have experienced different challenges depending on how their current IT infrastructure has been deployed.

There are several fundamental challenges which any business that doesn't have some form of backup power on-premises experience. During loadshedding, these businesses, amongst others, suffer the loss of production and then the loss of revenue. Below are the added challenges faced by these organisations:

- The entities need to schedule the working hours of their resources and distribute them to align with the loadshedding schedule.
- IT infrastructure hosted on-premises will not be accessible as there will be no electricity resulting in the infrastructure not being remotely accessible.
- The generators now need to be maintained and serviced often because they are now being used more often due to loadshedding.
- IT servers go into forced and ungraceful shutdowns which negatively affect the applications running on them. Data sometimes gets corrupted in cases like this.
- For entities with backup power, their IT costs have increased because businesses need to supply backup power and the diesel cost to run the generators especially in the higher stages of loadshedding.
- Most of the businesses who do not have backup power systems ceased to work during loadshedding and eventually closed shop.

Based on the literature engaged, Doe (2014), and the collected data, loadshedding has a devastating impact on businesses who are reliant on the utility electrical power supply with no alternative means of supplying backup power.

C2 General

Provisioning of backup power has also been proven to be a challenge especially for the small to medium-sized enterprises. These entities usually work on thin profitability margins which makes it quite tough for them to incur added cost brought to them by the unavailability of electrical power.

The current economic status in South Africa makes it even more difficult for the SMEs to increase their prices so to can cover the added cost. The SME market is very price sensitive, so every cent counts for both the service providers and the end customers receiving services from the SMEs. There is a lot of reputational damage that comes with businesses being offline and not being able to supply services to customers. Basically, the cost of downtime and unavailability of services from SMEs results significant revenue loss.

6.3 Conclusions regarding research question 2

6.3.1 Standby generators

With loadshedding being implemented in South Africa, alternative power supply systems are a necessity. Standby power generators seem to be the most used sources of power than can ensure continued electrical power supply for businesses. Hosting facilities with a big server farm environment require heavy duty standby generators to be able to power up the facilities where IT infrastructure is hosted.

In addition, when servers are racked together in a room setup, it is required that there be good air conditioning or cooling to keep the servers at recommended temperatures (Ricardo et al., 2003). Cooling facilities are also high on power consumption so heavy-duty generators are needed to power these up.

The issue with the bigger type or industrial generators is that they come at an excessive cost and more often not affordable for SMEs.

C2 General

These are the type of generators suitable to power up server farms because the servers consume a lot of power.

Another cost to be considered when obtaining generators is the ongoing maintenance, fuel, and oil costs (McKane, 2018). Smaller generators can also be used to supply backup power, but these are mainly suitable to power up lights and some domestic appliances that do not have high power consumption.

6.3.2 Uninterruptible power systems

Some organisations have considered UPS systems as forms of backup power. The UPS systems however do not supply power for longer periods of time. UPS systems are used by business to ensure that they protect the infrastructure from electrical spikes that usually happen when electrical power is restored either from a faulty electrical supply system or when electricity returns after loadshedding.

One of the participants mentioned that they use UPS systems when they want to keep the Point-of-Sale (POS) devices on and upload information from these devices to the main servers for it to be backed-up. UPS supply shorter up-time, generators are more suitable for longer up-time requirements compared to UPS.

It is recommended that the businesses who opt to keep their IT infrastructure hosted on-premises should consider supplying backup power systems like generators to ensure that there is business continuity even during loadshedding. Organisations running from rented office spaces can consider renting facilities where property owners supply backup power systems as part of their lease agreements.

This will help alleviate the need for high capital needed to buy generators or any other form of backup power source. The businesses can pay for the backup power as part of their monthly rental agreement which is OPEX model based in nature.

C2 General

Alternatively, a solar system is another source of power that can be considered by businesses. These are even better from an environmental aspect as they supply clean energy harvested naturally from the sun. This form of power source is free from carbon emissions and air pollution which are not good for the environment.

6.4 Conclusions regarding research question 3

6.4.1 Colocation

Data centre facilities are built by hosting service providers to aid businesses who would like to move away from the traditional on-premises way of hosting IT hardware infrastructure. There are huge investments that go into the construction of these complex design facilities. These buildings are constructed such that they supply physical and network security for the IT infrastructure that is hosted in them. Redundant backup power systems, cooling and compliance to international standards are some of the benefits that come with hosting servers in these kinds of facilities (McKane, 2018).

The data centre service providers' core business is to offer rack spaces in these facilities. Colocation is a form of service that is provided to businesses who move their hardware infrastructure and host them in these data centres. Businesses hosting their servers in data centres still have full ownership of the hardware and carry the responsibility of making sure that the operating systems running on their hardware is updated with the latest patches (Guo et al., 2017).

Businesses hosting their IT hardware infrastructure in third-party data centres use the data centre providers' investment as saving for what they would have invested. They pay a monthly service fee to use these facilities.

C2 General

6.4.2 Hybrid hosting

Another hosting possibility that some businesses consider is hybrid hosting. This method is adopted when organisations choose to move their physical IT hardware equipment from on-premises into third-party data centres and keep some IT workloads or business applications on-premises. Most companies still opt to keep critical business applications on-premises and the non-critical business applications in cloud computing or off premises.

Some organisations believe that business-critical applications should still be hosted on-premises because they are accessed more often so if the applications cannot be remotely accessed because of loadshedding or any other network related issue, they should still be locally accessible on-premises. In this way, businesses will be able to continue running their IT services locally and continue being productive.

From the data collected during interviews with participants, it has appeared that several organisations have adopted this kind of hosting method because some of them either:

- Having IT hardware equipment from which they run their core business applications, and they are keeping them locally on-premises for business continuity and security reasons.
- Being in possession of applications that cannot be run on virtualised machines but running on infrastructure hosted on premises.
- Wanting to accommodate and balance between non-cloud ready applications running from on-premises and new applications that can run from off premises in a virtualised environment.
- Normally businesses who adopt this method are those that already have a cloud computing strategy and already embarking on the early steps of executing on the strategy.

C2 General

6.5 Conclusions regarding research question 4

6.5.1 Benefits

The last research question was focused more on cloud computing solutions as the last alternative for hosting that businesses can consider for keeping their operations running even during loadshedding. Research has shown that some organisations still have their reservations when it comes to the adoption of cloud computing services. From the literature that was engaged, there are several benefits that were discovered, and these are not far off from some of the data collected during the interviews.

Cloud computing is one of the latest technologies when it comes to supplying technologies in the hosting space. Cloud computing supplies the ultramodern infrastructure from a virtual hosting perspective.

Nwogbaga and Ogbaga (2016) stated that using this kind of hosting technology comes with benefits. Some of the benefits that come with adoption of cloud computing services are the following:

- **Security** – Forms part of the core underlying components on which cloud computing is reliant for protection against all sorts of threats. Security can be provided as a standalone service or integrated as a module into the cloud computing platforms to protect these environments.
- **Reliability** – Cloud computing systems are very reliable as the data centre facilities in which these systems are hosted are built with high availability components ensuring always on services for applications and other workloads hosted in. Standby generators, backup batteries, UPS and solar systems are installed to get around the loadshedding challenges or any form of utility electrical power supply loss.

C2 General

- **Scalability** – For traditional physical servers, one needs to manually upgrade memory, CPU or storage on a server, which might take long because of the ordering of such components. Cloud computing offers the opposite because it is much easier and effortless to scale up or down resources depending on the business requirements. At any time, one can spin up resources to cater for a high-capacity requirement and similarly, the environment can be easily scaled down when needed.
- **Quick time to market** – With cloud computing, businesses can activate services in a short space of time as there is no need to for ordering and waiting for delivery of physical IT equipment. Pooled resources are always available to be configured as might be needed. This enables businesses to deploy services quicker and without delays. Since cloud computing is deployed in architectures that allows for global points of presence in international regions, businesses can scale out globally in minutes and reach international markets without laying down huge CAPEX investments.
- **Central data repository** – Cloud computing supports the central storage and management of data. Data from different organisational branches and multiple projects can be aggregated and stored in one central storage area. As mentioned by some of the participants, some of the benefits of cloud computing over and above the infrastructure, software, and platform services,

  Central data storage is particularly useful when it comes to deploying business intelligence reporting and data analytics which also gives a benefit of gaining insights into the customer or the service provider's environment. The insights derived from the analytics can be used to better the environment, innovate and enhance existing products and eventually create new revenue streams for the companies.

C2 General

There are many other benefits that come with cloud computing but have not been mentioned in this research report. On the contrary to benefits, cloud computing also has its own disadvantages. Some of these drawbacks were also highlighted during the participant's interviews.

Nwogbaga et al., (2016), also mentioned that one of the cloud computing disadvantages that was highlighted is around technical issues that can arise either affecting specific customer workloads or the entire platform (even though it's unlikely the entire cloud computing platform can fail; a possibility always exist that something might go wrong). Some of the participants highlighted concerns around the support of services hosted off premises or in the cloud. The participants complained about the non-responsiveness of the cloud computing providers which lead to delayed resolution to technical system issues reported to the cloud providers.

The participants also highlighted the fact that cloud computing becomes expensive due to the South African currency volatility to the US dollar.

Businesses are therefore not able to forecast their spending due to the variable billing associated with cloud computing especially the hyperscale cloud providers like AWS, Microsoft Azure, Huawei and so forth.

6.6 Research report recommendations

Having conducted this research through literature review and interviews with the participants, it became clear that loadshedding has a negative impact on businesses in South Africa and this is also seen by businesses in other countries. There is a need for businesses especially SMEs to make sure that they sustain their business operations against all odds.

C2 General

South Africa is reported to have a high failure rate of start-up companies in the world. About 70-80% of start-up companies fail in the first 5 years loadshedding and increasing cost of fuel were listed as some of the contributing factors (Business Report, 2020).

It is therefore imperative that start-up companies and SMEs in general find ways and means of securing their businesses into the future. Based on what this study has uncovered, it is recommended that SMEs consider the following means of combating or working around the challenge of loadshedding:

6.6.1 Backup power for SMEs

Procuring generators, fuel and ensuring they are supported proved to be costly for smaller companies who have physical IT hardware infrastructure on-premises, they can consider renting office spaces in facilities where property owners are able to supply standby power. Payment for the backup power solution will be included in their monthly rental fees. This option will help these businesses to ensure that their systems are always powered up resulting in continued business operations and productivity.

These businesses will be rest assured that they have continuous income which will contribute towards their future sustainability.

6.6.2 Alternative ICT solutions for SMEs:

Colocation: Another possibility for smaller organisations who still want to continue getting their ROI on hardware infrastructure they have recently obtained; they can move this equipment into third-party data centres on a colocation basis. In this way, they will have peace of mind during loadshedding knowing that the data centres are equipped with dependable and robust backup power solutions to sustain the SMEs' business operations during loadshedding.

C2 General

Cloud Computing*:* Technological advancements have made it easy for businesses to set-up business footprints without having to invest massive amounts of capital constructing hosting facilities and ensuring that there are backup power systems in place. Businesses also don't need to enter into long-term contract agreements with service providers and be locked in for years.

Cloud computing is a solution that can be considered and be adopted by businesses of any size. Some of the benefits of cloud computing have been outlined in the earlier chapters above and these can be used by the start-up SME businesses. What is even of more benefit for SMEs is that they can increase and/or reduce their hosting environments with the cloud service providers in line with the growth performance of their businesses.

Should the SMEs require to terminate the cloud computing services, they can cancel their services with the cloud providers at any time without having to forego any upfront cost that they would have invested should they have bought their own IT infrastructure.

6.6.3 Recommendations for ICT service providers

Technological limitations were cited as one of the challenges that prohibits the growth of SME businesses. The technological limitations, amongst others, include the unavailability of reliable internet connectivity in the country (Entrepreneurs, 2019).

One of the respondents in the research study highlighted the lack of reliable connectivity as one of the reasons why cloud computing platforms are not considered and adopted by businesses. It is therefore important that the service providers ensure that there is reliable access connectivity coverage in most parts of the country and not just in urban areas.

C2 General

Quick response times to customers are also crucial for the continued business operations. The cost-of-service degradation or complete downtime has far more reaching consequences for SMEs especially if they are trying to set up themselves and grow their businesses. There is a lot of reputational damage that gets attached to these organisations when they cannot provide always-on services.

6.7 Conclusion

Following the rolling blackouts that are being implemented in the country, the researcher saw a need to conduct this research study and explore the challenges brought by loadshedding to SMEs in South Africa and get some insight on the impact that this had on these businesses. Literature review extending to other markets outside South Africa was also engaged. This was done to try to find an understanding of how the SMEs in other regions were affected by loadshedding and what work around solutions, if at all, did they explore.

The study went on to find out the alternative means of power supplies the businesses put in place to power up their systems during loadshedding.

The researcher believes that:

- This report will contribute and add to the existing limited body of knowledge especially in the South African SME market. There seems to be a lot of evangelism and knowledge sharing that needs to be done to educate start-ups about different ICT solutions they could adopt and how these solutions could be of benefit to them.
- ICT service providers can create more awareness around the full bouquet of services they offer in the market so that SMEs may have options to choose from. This exercise will create business opportunities for service providers and close awareness gap that exists in the SME market around ICT solutions.

C2 General

- There must be a big emphasis on the benefits cloud computing brings and what SMEs can do to optimise costs.

Since this study was conducted on small and medium-sized organisations in the Gauteng province, this leaves an opportunity for other future research studies that can be done in other provinces across the country. A comparison on the findings from all the other provinces can be made and conclusions or overall learnings can be deduced.

Perhaps some positive learnings from other provinces can be implemented or utilized in other provinces where there might be gaps that need to be addressed.

Another area of research that can be explored is investigating larger corporates as a sample. This will be a good sample to investigate and check the findings against the small and medium-sized organisations.

C2 General

REFERENCES

Abdalla, P. A., & Varol, A. (2019). Advantages to disadvantages of cloud computing for small-sized business. 2019 7th International Symposium on Digital Forensics and Security (ISDFS),

Abubakar, A., Bass, J. M., & Allison, I. (2014). Cloud computing: Adoption issues for sub-Saharan African SMEs. The Electronic Journal of Information Systems in Developing Countries, 62(1), 1-17.

Adane, M. (2018). Cloud computing adoption: Strategies for Sub-Saharan Africa SMEs for enhancing competitiveness. African Journal of Science, Technology, Innovation and Development, 10(2), 197-207.

Ateba, B. B., Prinsloo, J. J., & Gawlik, R. (2019). The significance of electricity supply sustainability to industrial growth in South Africa. Energy Reports, 5, 1324-1338.

Awa, H. O., Ukoha, O., & Emecheta, B. C. (2016). Using TOE theoretical framework to study the adoption of ERP solution. Cogent Business & Management, 3(1), 1196571.

Baker, L. (2017). Post-apartheid electricity policy and the emergence of South Africa's renewable energy sector. The Political Economy of Clean Energy Transitions, Oxford University Press, Oxford, 371-390.

Banderker, S. I. (2023). The perceived psychosocial and economic impact of Loadshedding on employees in selected small micro medium enterprises.

Bello, S. A., Oyedele, L. O., Akinade, O. O., Bilal, M., Delgado, J. M. D., Akanbi, L. A., Ajayi, A. O., & Owolabi, H. A. (2021). Cloud computing in construction industry: Use cases, benefits, and challenges. Automation in Construction, 122, 103441.

C2 General

Braun, V., & Clarke, V. (2021). To saturate or not to saturate? Questioning data saturation as a useful concept for thematic analysis and sample-size rationales. Qualitative research in sport, exercise, and health, 13(2), 201-216.

Busetto, L., Wick, W., & Gumbinger, C. (2020). How to use and assess qualitative research methods. Neurological Research and practice, 2, 1-10.

Communications, M. (2022). On-premises vs cloud. Retrieved March 28 from https://morefield.com/blog/on-premises-vs cloud/#: ~:text=On%2Dpremises%20servers%20will%20provide, such%20a%20high%2Dspeed%20connection.

Creswell, J. W., & Poth, C. N. (2016). Qualitative inquiry and research design: Choosing among five approaches. Sage publications.

Delahunt, M. M. B. (2017). Doing a thematic analysis: A practical, step-by-step guide for learning and teaching scholars., 8(3). https://ojs.aishe.org/index.php/aishe-j/article/download/335/553.%20Accessed%2025%20February%202021

Dewa, M. T., Van Der Merwe, A. F., & Matope, S. (2020). Production scheduling heuristics for frequent loadshedding scenarios: a knowledge engineering approach. South African Journal of Industrial Engineering, 31(3), 110-121.

Dhiman, A. (2011). Analysis of on-premises to cloud computing migration strategies for enterprises Massachusetts Institute of Technology].

Doe, F., & Emmanuel, S. E. (2014). The effect of electric power fluctuations on the profitability and competitiveness of SMEs: A study of SMEs within the Accra Business District of Ghana. Journal of competitiveness, 6(3).

Donepudi, P. K. (2016). Influence of cloud computing in business are they robust. Asian journal of applied science and engineering, 5(3), 193-196.

C2 General

Dr. Brian Armstrong, D. G. J. L. (2021). Digital Business (2nd ed.). Silk Route Press.

Entrepreneurs. (2019). South Africa's SMEs landscape report. https://smesouthafrica.co.za/south-africas-smes-landscape-report/#:~:text=The%20majority%20of%20South%20African,Next%20Steps%27%202018%2F2019.

Etikan, I., & Bala, K. (2017). Sampling and sampling methods. Biometrics & biostatistics international journal, 5(6), 00149.

Finlay, L. (2021). Thematic analysis: The 'Good', the 'Bad' and the 'Ugly'. European journal qualitative research in physiotherapy, 11. http://ejqrp.org/index.php/ejqrp/article/view/136

Guo, Y., Li, H., & Pan, M. (2017). Colocation data center demand response using Nash bargaining theory. IEEE Transactions on smart grid, 9(5), 4017-4026.

Hagaman, A. K., & Wutich, A. (2017). How many interviews are enough to identify metathemes in multisited and cross-cultural research? Another perspective on Guest, Bunce, and Johnson's (2006) landmark study. Field methods, 29(1), 23-41.

Hernandez, E., Hughes, B., & de Jesús Durón-Mendoza, J. (2020). Case study: Adaptive loadshedding in critical industrial facilities. 15th International conference on Developments in Power System Protection (DPSP 2020),

Hiran, K. K., & Henten, A. (2020). An integrated TOE–DoI framework for cloud computing adoption in the higher education sector: case study of Sub-Saharan Africa, Ethiopia. International journal of system assurance engineering and management, 11, 441-449.

C2 General

Ilker Etikan, K. B. (2017). Sampling and sampling methods. 5(6). Retrieved 17 January 2024, from https://d1wqtxts1xzle7.cloudfront.net/76605654/bbij-05-00149-libre.pdf?1639717444=&response-content-disposition=inline%3b+filename%3dsampling_and_sampling_methods.pdf&expires=1705519484&signature=qc8ksselylcoyvtbzhhr2dvxgvnb--agyezhxpspqeb5zusszyr1k66p18lwdxnlepxecuytpx8p2qd9-xo1o9agis4ym9l8dfoy0k1hydc4zxtmmrxtg7hxq-w4mcfbx0twi7fx~ylsnd-pybdlcvmcgcz6oirtrwysq6aduidxoe7vxlxvglezm3sc-x7wo8pedrx5-xizzpfl7yzhjzhtcm2vem9v5gvj4ionji4vj7hf2gc2ww2ngcy2sghxgqtrxpnlgo8ta13xvqj5edw9851ik3luspipv8qxkkb3hufgvdc4gnmm8qbnoxy221vjfsr2q9yj5mjo9ovg4g__&key-pair-id=apkajlohf5ggslrbv4za

King, N. A. S. a. J. R. (2020). Understanding and using trustworthiness in qualitative research. Expanding approaches for research, 44(1).

Lesley Eleanor Tomaszewski, J. Z., Elsa Gonzalez. (2020). Planning qualitative research: Design and decision making for new researchers. https://doi.org/10.1177/1609406920967174

Li, S., Li, S., Zhao, H., & An, Y. (2019). Design and implementation of state-of-charge estimation based on back-propagation neural network for smart uninterruptible power system. International Journal of Distributed Sensor Networks, 15(12), 1550147719894526.

Low, C., Chen, Y., & Wu, M. (2011). Understanding the determinants of cloud computing adoption. Industrial management & data systems.

Maphosa, V., & Maphosa, M. (2022). Factors influencing the adoption of ICT for remote work among Zimbabwean SMEs: A case study of Bulawayo metropolitan province. International Journal of Advanced and Applied Sciences, 9(3), 150-158.

C2 General

Mbomvu, L., Hlongwane, I. T., Nxazonke, N. P., Qayi, Z., & Bruwer, J.-P. (2021). loadshedding and its influence on South African small, medium and micro enterprise profitability, liquidity, efficiency, and solvency. Business Re-Solution Working paper BRS/2021/001.

McKane, J. (2018). How loadshedding cripples South African data centres. Mybroadband. Retrieved 20 March from https://mybroadband.co.za/news/energy/288586-how-loadshedding-cripples-South-African-data-centres.html.

Mohlameane, M. J., & Ruxwana, N. L. (2013). The potential of cloud computing as an alternative technology for SMEs in South Africa. Journal of economics, business and management, 1(4), 396-400.

Mojtaba Vaismoradi, J. J., Hannele Turunen, Sherrill Snelgrove. (2016). Theme development in qualitative content analysis and thematic analysis. Journal of Nursing Education and Practice, 6(5). https://doi.org/10.5430/jnep.v6n5p100

Moser, A., & Korstjens, I. (2018). Series: Practical guidance to qualitative research. Part 3: Sampling, data collection and analysis. European journal of general practice, 24(1), 9-18.

Mtebe, J. S., & Raisamo, R. (2014). eLearning cost analysis of on-premises versus cloud-hosted implementation in Sub-Saharan countries. The African Journal of Information Systems, 6(2), 2.

Muzari, T., Shava, G. N., & Shonhiwa, S. (2022). Qualitative research paradigm, a key research design for educational researchers, processes, and procedures: A theoretical overview. Indiana Journal of Humanities and Social Sciences, 3(1), 14-20.

Nwogbaga, N. E., & Ogbaga, I. (2016). Overview of cloud computing, Benefits and drawbacks. EPRA Int. J. Multidiscip. Res, 2.

C2 General

Olajuyin, O. F., & Mago, S. Effects of loadshedding on the performance of small, medium and micro enterprises in Gqeberha, South Africa.

Pahl, C., Xiong, H., & Walshe, R. (2013). A comparison of on-premises to cloud migration approaches. Service-oriented and cloud computing: Second European Conference, ESOCC 2013, Málaga, Spain, September 11-13, 2013. Proceedings 2,

Partner, M., NWU. (2022). Increased fuel costs are not merely increased fuel costs. https://mybroadband.co.za/news/industrynews/463069-increased-fuel-costs-are-not-merely-increased-fuel-costs.html

Peersman, G. (2014). Overview: Data collection and analysis methods in impact evaluation. UNICEF Office of Research, Florence. https://www.unicef-irc.org/publications/pdf/brief_10_data_collection_analysis_eng.pdf

Permwonguswa, S., & Anuvareepong, S. (2019). Choosing between on-premises and on-cloud deployment model: a new challenge in ERP. AU ICBE 2019, 171-182.

Rashid, A., & Chaturvedi, A. (2019). Cloud computing characteristics and services: a brief review. International Journal of Computer Sciences and Engineering, 7(2), 421-426.

Ren, S., & Islam, M. A. (2014). Colocation demand response: Why do I turn off my servers? 11th International Conference on Autonomic Computing ({ICAC} 14),

Report, B. (2022). 70-80% of small businesses fail – Tips on how to stay afloat. IOL. https://www.iol.co.za/business-report/entrepreneurs/70-80-of-small-businesses-fail-tips-on-how-to-stay-afloat-4d1793c7-1b5d-4ed6-a209-bb8e09833ab0

C2 General

Reporter. (2020). How to protect your business assets in times of loadshedding. IOL. Retrieved 06 May from https://www.iol.co.za/business-report/companies/how-to-protect-your-business-assets-in-times-of-Loadshedding-a950dab8-6245-43e7-937d-5a069cf8fb04.

Rodrigo Augusto Modesto, S. A. O. d. S., Azauri Albano de Oliveira Júnior. (2015). Power quality improvement using a dual unified power quality conditioner/uninterruptible power supply in three-phase four-wire systems [Research Article]. The Institution of Engineering and Technology, 8(9), 1595–1605. https://ietresearch.onlinelibrary.wiley.com/doi/abs/10.1049/iet-pel.2014.0734 (IET Power Electronics)

Senyo, P. K., Addae, E., & Boateng, R. (2018). Cloud computing research: A review of research themes, frameworks, methods, and future research directions. International Journal of Information Management, 38(1), 128-139.

Skafi, M., Yunis, M. M., & Zekri, A. (2020). Factors influencing SMEs' adoption of cloud computing services in Lebanon: An empirical analysis using TOE and contextual theory. IEEE Access, 8, 79169-79181.

Smith, D. C. (2020). COVID-19 and the energy and natural resources sectors: little room for error. In (Vol. 38, pp. 125-129): Taylor & Francis.

Turale, S. (2020). A brief Introduction to qualitative description: A Research design worth using. Pacific Rim International Journal of Nursing Research, 4(23).https://he02.tci-thaijo.org/index.php/PRIJNR/article/download/243180/165336

Umar, B. B., & Kunda-Wamuwi, C. F. (2019). Socio-economic effects of loadshedding on poor urban households and small business enterprises in Lusaka, Zambia. Energy and environment research, 9(2), 20-29.

C2 General

Zhang, L. R., S; Wu, C; Li, Z. (2015). A truthful incentive mechanism for emergency demand response in colocation data centres. Conference on computer communications workshops, Hong Kong.

C2 General

APPENDICES

Appendix 1 : Participant Information Sheet (PIS)



Dear Sir / Madam

My name is **Senzi Michael Masilela**. I am a Master of Management in Digital Business student at the University of the Witwatersrand, Johannesburg. My supervisor is Dr Jabulile Msimango-Galawe. I am conducting a research study about Loadshedding and Cloud Computing. The study title is **Loadshedding challenges and adoption of ICT solutions by SMEs in the South African context.**

I am inviting you to take part in an interview and if you decide to take part, your participation in this research study will last about 30 minutes (maximum). The interview will take place online or face-to-face at the time convenient to you during office or after office hours.

With your permission, I would like to audio record the interview. This data will be stored in the cloud for 1 year and removed after that (1 year). Only the researcher will have access to the data.

The interview will be confidential and anonymous. When I share the results of the research study, I will not include your name or anything else that could identify you. With your permission, other researchers may use the data collected from this research study, but your name and any personal information will not be used or passed on.

C2 General

If you decide to take part in the research study, it should be because you want to volunteer. You do not have to take part. You can stop being in the study at any time. You do not have to answer any questions if you do not want to. You will not get any direct benefits if you choose to join the research study. You will not lose any services, benefits, or rights you would normally have if you decided not to join. Taking part in the research study will not cost you anything. You will not be paid for being in this research study.

The risks for this research study are no more than what happens in everyday life / some of the questions asked may make you feel sad or upset. If this happens, I will stop the interview and continue another time.

This research study will be written up as a research report. The report will be available on the university library website. If you would like to receive a summary of this report, I will be happy to send it to you.

If you have any questions during or afterwards about this research study, feel free to contact me or my supervisor on the details listed below. If you have any concerns or complaints about the ethical procedures of this research study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za.

Yours sincerely,

Researcher:
Senzi Michael Masilela
2026529@students.wits.ac.za
+27 82 389 8668

C2 General

Supervisor:

Dr Jabulile Msimango-Galawe

jabulile.msimango-galawe@wits.ac.za

Appendix 2 : Consent form

Consent Form

Title of project:
Loadshedding challenges and adoption of ICT solutions by SMEs in South Africa.

Name of researcher:
Senzi Michael Masilela

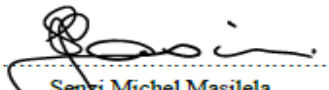
I, ……., agree to participate in this research project.

I agree to the following:

(Please circle the relevant options below)

The research study was explained to me. I understand what this study is about.	YES	NO
I understand that I can volunteer to take part in the study	YES	NO
I agree that the interview may be audio recorded.	YES	NO
I agree that direct quotations from my interview/focus group/other activity may be used by the researcher in their research report/ manuscript/book chapter.	YES	NO
I agree that my participation will remain anonymous (my name or other identifying data will not be used by the researcher in their research report	YES	NO
I agree that other researchers may use the information I provide in my interview, but my name and any personal information will not be used or passed on	YES	NO

…… (signature)
…… (name of participant)
…… (date)



…… (signature)
……Senzi Michel Masilela…… (name of researcher/person seeking consent)
……2022-09-13 …… (date)

C2 General

Appendix 3: Ethics clearance

Graduate School of Business Administration
University of the Witwatersrand, Johannesburg

Wits Business School Ethics Committee
Constituted under the University Human Research Ethics Committee (Non-Medical)

Ethics Clearance Certificate

Ethics protocol number: WBS/DB2026529/433

This certificate is only valid with a legitimate ethics protocol number and signed by the Researcher (below).

Project title	Loadshedding challenges and adoption of ICT solutions by SMEs in South Africa
Investigator / Researcher	Mr Senzi Masilela
Nature of Project	MM (Digital Business)
Decision of the Committee	Approved, provided stakeholders and participants are guaranteed confidentialty.
Issue Date of Certificate	8/28/2023
Expiry date	Date of submission of the project / research report
Chairperson	Dr Pius Oba ☎ +27 11 717 3976 +27 82 733 6587 pius.oba@wits.ac.za

Declaration by Researcher

One copy must be signed by the Researcher and returned to the Chairperson of the Wits Business School Eti Committee.

I fully understand the conditions under which I am authorized to carry out the abovementioned research a guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I undertake to resubmit the protocol to the Committee.

Signature

2023 - 09 - 01
Date:

C2 General

C2 General

Appendix 4: Interview guide

Interview Guide		
	Research Questions	**Interview Questions**
RQ.1	What challenges does loadshedding bring to small and medium-sized businesses who are running their IT services on-premises in South Africa?	• Where are you currently hosting your IT server's infrastructure? • What kind of infrastructure do you currently have, and do you own the infrastructure? • What are the challenges or benefits have you experienced by owning same?"
RQ.2	What means could organisations employ to keep their businesses running during loadshedding?	• How has loadshedding affected your business from an IT services perspective? • How do you make sure that you have the systems powered up and always on even during loadshedding? • What are the cost implications of providing backup or alternate power supply.
RQ.3	Which hosting methods or options, if any, could organisations consider as an alternative to hosting on-premises?	• Have you considered moving and hosting your IT infrastructure in a third-party facility as an option? If no, what are the reasons? • If yes, what were the benefits of doing same? • Did you perhaps consider the hybrid way of hosting IT infrastructure where some will be on premises and some off-premises? • If yes, what informed the decision?
RQ.4	How would cloud computing, if used as a workaround or an alternative solution help maintain IT systems availability and accessibility from anywhere?	• Do you perhaps know about cloud computing as an alternative platform for running IT services? • Have you considered running your IT services using cloud computing? If no, what are the reasons? • If yes, what were the benefits of doing same?

C2 General