The Factors Influencing the Adoption of Big Data in the Financial Services Sector in South Africa

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ABSTRACT

This investigation examines factors influencing the adoption of big data in the South African banking sector. The dearth of studies on big data in the sector inspired the research. The investigation interrogates factors that influence the adoption of big data using the TOE model. The study used a total of 173 respondents across 53 South African banks. The primary data analysis model used was linear regression. The study's findings are as follows:

[1] Government regulations, competitor's actions, and customer demands significantly influence adoption of big data. **[2]** Technology has a significant influence on the adoption of big data. **[3]** Organizational factors have a significant influence on the adoption of big data. Regression analysis showed that the dependent variable, big data adoption, is either positively or negatively affected by the study's variables. The study conducted a hypothesis test, which showed enough evidence to accept all alternative hypotheses suggesting a relationship between the variables and big data adoption. The study concludes that factors in the TOE model influence the rate of big data adoption in the banking sector. The study recommends that the government reduce regulations hindering big data adoption. The industry is encouraged to invest in big data for sustainable competitive advantage.

Keywords: Big data; Technology; Environment; Organisation; Banking Sector.

DECLARATION

I, Upenyu Toma, 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: Upenyu Toma   Signature: U.Toma

Signed at Parktown, Johannesburg (South Africa)

On Friday, 30 June 2023

DEDICATION

To the almighty God.

To my Father and Mother, and my Sisters.

ACKNOWLEDGEMENTS

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ABSA: Amalgamated Banks of South Africa

ATM: Automated Teller Machine

ICT: Information Communication Technology

IP: Internet protocol

PLS-SEM: Partial Least Squares-Structural Equation Modelling

SME: Small to Medium Enterprises

SD: Standard Deviation

SDG: Sustainable Development Goals

TOE: Technology-Organisation-Environment

UN: United Nations

CHAPTER ONE: INTRODUCTION

1.1　Statement of purpose

The emergence of new technology and the Covid-19 pandemic has resulted in the growth of internet banking, a significant big data source (National Treasury Annual Report, 2021). South African banks such as Standard Bank, Absa, Nedbank, and First Rand are experiencing an increase in internet banking. The use of electronic money has increased due to the rapid growth of online shopping by companies such as Takealot and Amazon. This rise of e-business and internet banking in South Africa brought about internet penetration and the adoption of online transactions, resulting in a constant and fast flow of big data (Shambare et al., 2012).

According to People's Banks of China an Fintech Consultancy Group (2020), most banks collect vast amounts of data daily from their clients. The adoption rate has been different across the spectrum, raising the perception that various factors may affect specific organizations' adoption of big data. For instance, government laws are the foundation for the adoption of big data in the European finance sector (Al-Khasawneh et al., 2022). In South Africa, the Bank Act of 1990 is the principal legal framework the government uses to regulate the banking industry. Yoon and George (2013) suggest that the Bank Act of 1990 may influence the adoption of big data because it allows the central bank to oversee and manage the collection and management of information.

The Bank Act influenced the creation of the Consumer Protection Act of 2008, which prohibits banks from using certain marketing acts. These acts include personalized marketing efforts relying on the client's financial information. Banks are only allowed to collect information supplied by the customer and use it for the relevant purpose. Financial institutions should not collect data without express consent from the client (Promotion of Access to Information Act, 2000). In addition, the sending of unsolicited electronic communications by banks is prohibited. Banks are also prohibited from gathering personal information without the targeted person's knowledge (Protection of Personal Information Act, 2013).

All these regulations limit how banks and other banking institutions collect and use client information.

Using big data has improved decision-making in the business world. Big data helps organizations to have access to accurate information. It has been helpful in other industries, such as healthcare, financial, retail, and agriculture, where forecasting and customer targeting have significantly improved (Lutfi et al., 2022). In all its success, it is worth noting that big data has also brought about other challenges, such as privacy issues and high business costs due to the increased computing power needed (Wang et al., 2018). The requirement for high energy consumption may hinder big data adoption since businesses must cover the energy costs associated with data storage and processing. Big data technology has this as a built-in difficulty, and businesses must consider this when implementing it.

This research performed a quantitative analysis of the factors that influence the adoption of big data. It investigated the applicability of the technology-organization-environment model (TOE) elements in the South African banking sector. The study adopted the TOE as its conceptual framework. The TOE model is a framework to explain the technological innovation and adoption process in organizations (Tornatzky & Fleischer, 1990). The model has three significant areas: the organization factors, the environmental factors, and the aspects of technology innovation.
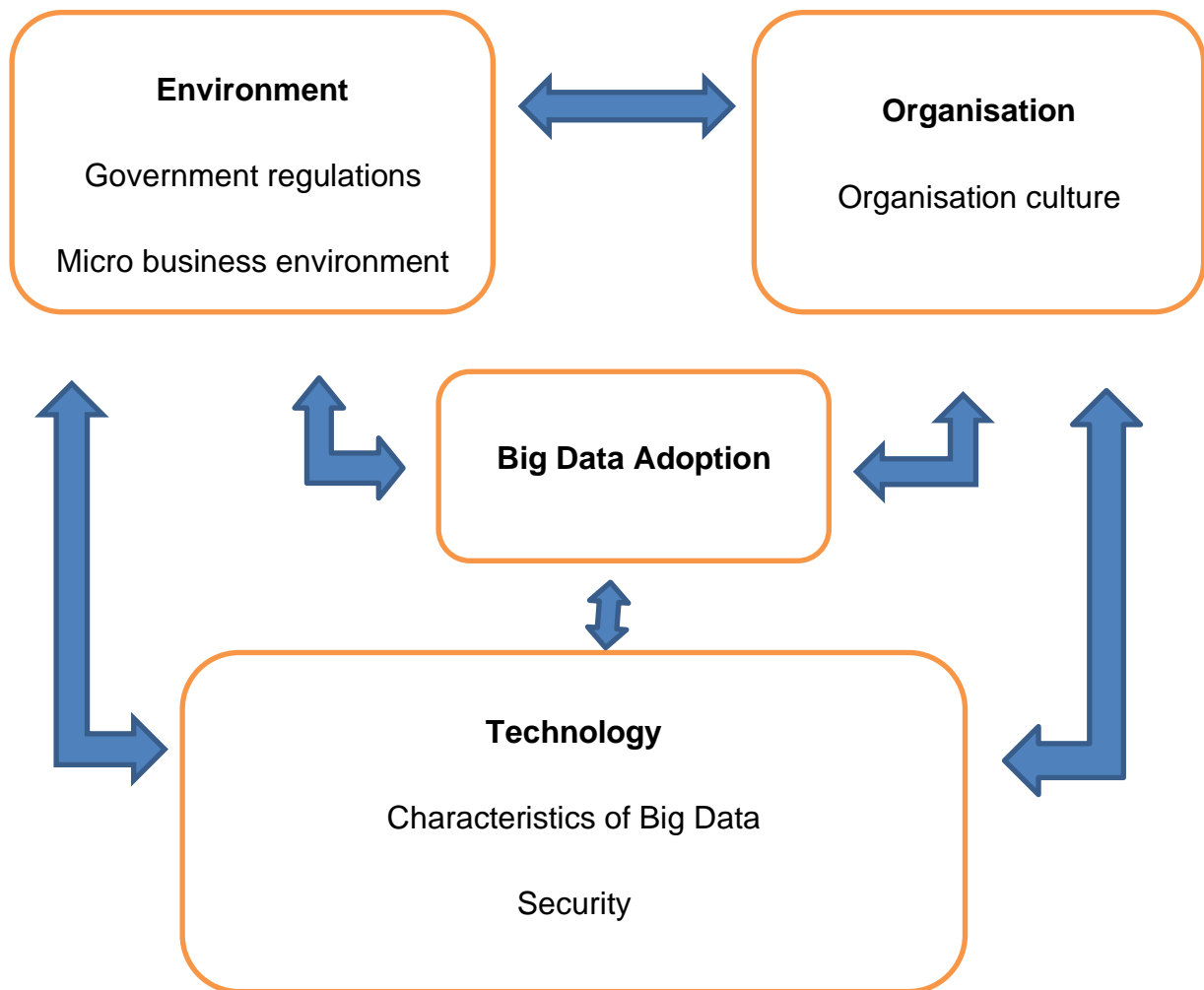
Figure 1: The extended TOE framework for big data adoption

Source: Adapted from Salleh and Janczewski (2016)

Security risks have been central to digital developments and big data adoption. Security and privacy are critical to adopting big data (Salleh & Janczewski, 2016). Various authors have studied the influence of security and privacy using the TOE model. Their findings reveal that security is an integral part of big data adoption (see Kim & Kim, 2021; Lutfi et al., 2022; Nasrollahi et al*., 2020)*. Given this context, this study sought to highlight the significance of security as an essential technology factor affecting big data adoption.

According to the TOE model, cultural norms, organizational size, and business climate influence the adoption of big data (Galdon-Sanchez & Gil, 2022; Lutfi et al., 2022; Wang et al., 2018). It was necessary to thoroughly analyze big data adoption in the South African banking sector because this varies from context to context (Lutfi et al., 2022). This analysis aligns with the notion that big data was a novel phenomenon whose influence and perception depended on the sector and people (Walker & Brown, 2019). This study aimed to investigate how contextual factors affect the adoption of big data in the South African banking sector.

1.2   Background of the study

Big data refers to a large amount of data generated from operations that ordinary data management strategies or techniques cannot process (O'Reilly Media, 2005). O'Reilly Media (2005) posits that the complexities of data require a new way of managing it and better ways of keeping such data, which need immense computing power.

Big data began with the advent of e-business and web 2.0. E-business and web 2.0 resulted in online business transactions (Walker & Brown, 2019). This advent also led to the generation of more data. With the introduction of new technologies and inventions that support e-business, the level of usage and sophistication of big data collection and generation has since changed (Galdon-Sanchez & Gil, 2022; Salleh & Janczewski, 2016). Companies such as Amazon and Alibaba process transactions worth hundreds of billions of dollars annually, making it one of the century's largest sectors generating big data (Keen & Mackintosh, 2019).

Online business activities are growing exponentially (National Treasury Annual Report, 2021). Influenced by online business growth, big data sources are also increasing exponentially. Studies in Malaysia on adopting big data in the education sector show that using big data has increased efficiency in education systems (Casanova & Miroux, 2019). However, Casanova and Miroux (2019) note that despite all these benefits, several factors affect the adoption of big data.

Akande and Van Belle (2014) found that modern technology has little impact in areas with low education levels. However, the influence was more substantial in areas with above-average educational levels (Akande & Van Belle, 2014; Taylor, 2019). This statistic raises the question of whether education level affects the adoption of big data, in this case, in the banking sector in South Africa.

A study by Galdon-Sanchez and Gil (2022) in Malaysia shows that big data has increased organizational performance. However, laws governing data harvesting limit big data implementation (Taylor, 2019; Galdon-Sanchez & Gil, 2022; Lutfi et al., 2022). Despite these benefits of big data adoption, their study also found that organizational culture influences big data adoption. Galdon-Sanchez and Gil (2022) claim that while some firms are flexible, others dislike change despite its potential advantages.

The COVID-19 pandemic served as a reminder of the value of big data adoption in sustaining business continuity. Big data is essential for online banking and artificial intelligence for tasks related to self-service banking, including cash withdrawals from automated teller machines (ATMs). Financial institutions collect this data from the market for these automated operations, which need vast amounts of data to understand how to handle requests or queries. Therefore, it is essential to understand the factors influencing the adoption of big data in banks (Walker & Brown, 2019). Understanding what affects the adoption of big data in the banking sector will assist governments when crafting regulations and organizations to achieve a sustained competitive advantage.

The finance sector contributed US $41.4 billion in 2019 to the country's GDP, and the industry is paramount in managing the economy as it facilitates the flow of money across industries (National Treasury Annual Report, 2021). This research was needed to shed more light on the banking sector, given that the sector is vital to the nation's overall economic performance.

1.3   Research problem

Studies on the adoption of big data have employed different frameworks. New dimensions to adopting big data in banking are coming in. The significant

influence on big data adoption comes from organizational factors, which are internal and external (Saade et al., 2006). Some studies on adopting big data in insurance companies in the Middle East show that external factors significantly influence big data (Salleh & Janczewski, 2016). Amiri and van Engelen (2022) state that factors influencing the adoption of big data were situational and depended heavily on the country, respondents, and the industry.

Government regulations, business environment, and organizational culture are common factors arising in one research. Still, their influence varies depending on the situation (Amiri & van Engelen, 2022). This background highlights the need to develop a systematic and specific approach to research factors influencing big data adoption, focusing on different countries and industries. This study sought to determine which of the TOE model's factors influence big data adoption in South Africa's banking sector.

The Centre for Strategic and International Studies report (2014) reports that data breaches cost the world over 500 billion United States dollars annually, and projections show that the figure will continue rising. Big data in banking deals with highly sensitive information. The most common challenges in banks are data security, managerial security awareness, and employees' security skills (Salleh & Janczewski, 2016). There is a growing concern about security risks associated with big data adoption, which has resulted in adoption challenges and the enactment of cyber laws (Kshetri, 2014; Lutfi et al., 2022). Considering this revelation, this study sought to comprehend the impact of security challenges on big data adoption in South Africa.

According to the United Nations Report (2022), only 10% of the world's countries have 70% of their population with digital skills, which slows digitization. The report also notes that digitization is critical to attaining sustainable development goals. In addition, insurance contributes trillions in rand to the country in asset value. As such, it is critical to digitizing the sector (National Treasury Annual Report, 2021).

Like any digital framework, the adoption of big data requires skills development, storage cost, and power (Lutfi et al., 2022). Financial challenges constrain small to medium business enterprises (SMEs), whereas other organizations

experience difficulty restructuring to accommodate big data, affecting adoption (Olufemi, 2018; Nasrollahi et al., 2020). The challenges caused by the attributes of big data may lead to firms re-evaluating their decision and position on big data. As a result, the study sought to comprehend the impact of big data's characteristics and attributes on its adoption in the banking sector.

Several studies exist on adopting big data, and the outcomes focus on the influence of the TOE factors in developed countries. Studies show that the impact of the TOE factors differs from region to region, and the model's bearing is not universal (Akande & Van Belle, 2014; Galdon-Sanchez & Gil, 2022; Walker & Brown, 2019). The study aimed to investigate the TOE model's relevance in the banking sector and contribute to the body of knowledge on factors influencing big data adoption in the South African banking sector.

1.4   Research objectives

1. To examine the influence of the external task environmental factors on adopting big data in the banking sector in South Africa.
2. To investigate the influence of technology on adopting big data in the banking sector in South Africa.
3. To analyze the influence of organizational factors on the adoption of big data by banks in South Africa.

The objectives align with the recommendations which support the need for more government initiatives that incentivise the adoption of big data by banks. Government adoption would lead to more adoption of big data, a core part of objective 2. The research's third objective aligns with the final recommendation calling for further research on big data adoption factors in South Africa.

1.5   Rationale

There are numerous studies on the effects of the TOE model on the innovation and adoption of big data (see Akande & Van Belle, 2014; Galdon-Sanchez & Gil, 2022; Walker & Brown, 2019). The factors are situational, as different organizations have different approaches to business. In addition, different technologies have varying characteristics, and the environments in which

businesses operate are different (Lutfi et al., 2022). All these factors motivate the need for a study focusing on big data adoption in the South African banking sector.

Empirical studies on the TOE model found that the model has different context-based factors and different characteristics from different technologies affecting innovation adoption (Salleh & Barczewski, 2016). Studies show that environmental factors such as competition and regulations influence innovation adoption. Findings suggest that internal factors have less influence on big data adoption (Casanova & Miroux, 2019; Walker & Brown, 2019). These nuances make it necessary to establish the factors that influence the adoption of big data in the research context.

Big data has a set of unique characteristics that require organizational adjustments during adoption (Lutfi et al., 2022). Luffi et al. (2022) note that challenges such as digital skills development needs and the energy costs for servers and technicians can be prohibitive to big data adoption. Luffi et al. (2022) agree with several other studies on big data which highlight that most banks could not adopt the required adjustments (Nasrollahi et al., 2020; Olufemi, 2018; Rassam et al.,2021). Considering these challenges, this research aimed to clarify the influence of the above-listed characteristics on the South African financial sector. The study's findings may aid in policy formulation and strategic planning for the financial sector.

The TOE model highlights several factors, and the most outstanding among them are various environmental situations, country regulations, and industry regulations, which are all context-based (Salleh & Janczewski, 2016). In contrast, internal factors such as organizational culture, strategy, finances, and human resources heavily influence the adoption of big data (Oncioiu et al., 2019). These findings raised the need for context-based research based on the model factors.

A systematic literature review found two significant gaps in research concerning the adoption of big data. The first one is that the available studies on the factors influencing big data adoption are limited. Their general conceptual nature called for more empirical studies to contribute to the body of knowledge (Oncioiu et al.,

2019). The second gap is that most studies on this problem were in the developed world in North America and Asia, and very little exists in Africa and the Middle East (Oncioiu et al., 2019).

Limited literature on big data adoption exists, particularly in developing countries (Casanova & Miroux, 2019). This study attempts to add a more systematic view to adopting big data in the banking sector, focusing on South Africa using the factors of the TOE model. According to the United Nations Trade Conference Report (2020), big data management is critical to businesses in the modern world. The processing of more and more transactions worth trillions online generates web data, which creates transaction data and customer files. Due to improvements in technology and its ability to meet the internal needs of organizations, companies now have the means to track their customers online using their internet protocol (IP) addresses, cookies, and global positioning system.

The data must be processed, turned into meaningful information, stored accordingly, and used when required. This has led to more targeted advertisements, informed decisions, outperforming competitors, and the discovery of new revenue streams (Shambare, 2012). Understanding the factors affecting big data will aid in creating conducive environments for businesses to achieve the abovementioned benefits.

According to the Banking Association of South Africa (2020), the finance industry has contributed over 41.1 billion dollars annually, making it a crucial part of the economy. Over 65% of the population uses the banking sector in their individual and business capacity (Banking Association of South Africa, 2020). Understanding and studying this sector for South Africa's benefit is thus essential.

The importance of this study lies in its quest to test the application of the TOE model in banking in South Africa. The study determined the extent to which each factor influences big data adoption. The model allows for adjustments on context-based factors to suit the technology under review. The approach aided in examining the influence of factors such as security and privacy on big data adoption, and it will add elements to the model. The study established that

external factors such as government regulations, competitors, and customers influence the adoption rate of big data. Furthermore, the study also showed that internal factors such as big data training needs, organizational culture, and costs associated with big data also influence the adoption of big data.

1.6 Delimitations of the study

This study focused on factors that influence big data adoption and its use in the banking sector in South Africa. It included companies in the banking sector, specifically banks. Below are the delimitations.

a. Research sites: The research focused on adoption of big data among banks based and operating in South Africa.
b. Research objectives: The study focused on current dynamics, and the present factors influencing big data adoption in selected banks.
c. Theoretical delimitations: This adopted the TOE as a theoretical framework to explain big data adoption.

1.7 Definition of terms

Big Data: The information organizations gather from their clients before, during, and after a business interaction. It involves information obtained through web crawlers, listening devices, and official customer submissions and from other sources such as transactions and processing (Magoulis, 2005).

Technology-organization-environment: A high-level theory explaining how three aspects of a firm's context impact adoption decisions. These three elements are the technological context, the organizational context, and the environmental context. All three impact on technological innovation (Tornatzky & Fleischer, 1990).

a. Technological context: An organization considers a set of technology-related characteristics before adopting an innovation. It includes the

required environment, functions, and benefits (Tornatzky & Fleischer, 1990).

b. Organizational context: How organizational culture and strategies influence the decision to adopt an innovation. It includes the human resources capacity regarding skill (Tornatzky & Fleischer, 1990).

c. Environmental Context: The external factors influencing an organization's choice to adopt an innovation. These include competition, government regulations and economic factors (Tornatzky & Fleischer, 1990).

1.8 Assumptions

In conducting this study, the researcher made the following assumptions:

a. The elements stated as the factors of big data adoption in the theoretical framework apply to the banking sector in South Africa, and their contribution to the adoption is statistically significant.

b. Validation of the data and the data's reliability is possible. Reliability of data is critical in ensuring that the research has a small margin of error and proving the appropriateness of the instruments used for data collection. Hence, the researcher selected the most pertinent instruments to validate the data.

c. The benefits of big data to the banking sector are apparent, and internal and external factors determine their acceptance by organizations.

d. No participant felt coerced, and they willingly provided the information.

e. All respondents provided actual facts to their knowledge because clear boundaries were established for all respondents regarding what should be provided and the use of the information. Respondents were given assurance that the information was strictly for academic purposes only.

1.9 Chapter Outline

The study's structure is as follows:

Chapter One: This chapter introduced the study by examining the background and research gaps that informed the research problem.

Chapter Two: This chapter examined the available literature on big data adoption. It conducted a theoretical and empirical review of previous research and reaffirmed the study's hypothesis.

Chapter Three: This chapter examined the study's research methodology and design. It clarified the data collection procedure and the instruments used.

Chapter Four: This chapter covered data presentation and analysis per the research methodology recommendations.

Chapter Five: This chapter discussed the research findings and how they contributed to the objectives.

Chapter Six The chapter summarized key findings and their implications on recommendations and policy formulation.

CHAPTER 2: LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1   Introduction

This chapter looks at the development of big data since its inception and adoption by different companies in different industries. The first section traces the development and growth of the South African banking sector since the liberalization of 1990. The second section delves into the theoretical framework and empirical evidence informing this study. The third and last section investigates the research objectives by analyzing the available literature for a comprehensive study.

2.2   Background Discussion

South Africa has 62 banks and over 172 insurance companies as of 2021 (National Treasury Annual Report, 2021). This figure represents above a 100% increase since the liberalization of the sector in 1990. The rise in the number of depositors and population increases have enhanced growth. Due to programs such as Black Economic Empowerment (BEE), the number of people opening banks has increased (Momoniat et al., 2019). The Banks Act of 1990 regulates the South African banking sector well by specifying standard operating conditions and minimum capital requirements.

The advancements and developments in the interconnection of society through social networks and the internet have increased the volume of data generated and collected by banks and insurance companies. In recent years, banks like FirstRand and ABSA have implemented artificial intelligence (AI) to enhance service delivery. AI operation necessitates collecting, processing, and filing of data for use in AI and machine learning (Clark et al., 2022).

Companies such as the ABSA Group use software like brand mentions to track people's online activities and what they seek. This feature allows businesses to receive notifications whenever someone says something related to their services. Millions of social media users in South Africa are a source of big data for financial service organizations. According to Huimin and Jianyue (2018), there has been a consistent increase in the adoption of big data technologies, possibly due to technological advancements.

According to The Data Portal Report (2022), the internet penetration rate in South Africa stood at 68.2 percent of the total population at the start of 2022. This figure represents a population with access to online services which feed information to organizations daily. In South Africa, the number of people participating in or adopting e-commerce and/or e-business increased by 66% in 2016, representing a considerable increase compared to the increase seen in the preceding years (Shambare, 2012).

The population of people who use the internet represents a pool of people willing to share information with businesses online. This information must be managed and processed. The factors that have led to the widespread adoption of the internet, such as advancements in technology, affordable services, and the government's drive towards digitization, also impact how businesses perceive technology and how they approach the process of adopting it.

Many studies explored the adoption of big data in the banking sector. One such research by Olufemi (2018) analyzes the adoption of big data criteria based on cloud computing. Olufemi's (2018) studies focused on three innovation diffusion models: the unified technology acceptance and use theory and the technology organization environment framework. These studies concluded that one could break down the factors influencing the adoption of big data into two categories: internal and external factors. Internal factors are those that are under the control of the company or organization, while external factors are an imposition upon the company.

Organizational culture and size are internal variables influencing big data adoption (Salleh & Janczewski, 2016). According to the study, external factors

that influence the adoption of big data are government regulations and the micro business environment. However, Salleh and Janczewski (2016) do not specify the extent to which each factor influences the adoption of big data. Given that external forces are beyond the control of any organization, this research seeks to determine if they are more powerful in influencing big data adoption than internal factors.

In the Middle East, Skafi et al. (2020) found that external factors are more influential than internal factors in adopting big data in the banking sector. Their research notes that even though internal factors influence big data adoption, their impact is not comparable to the influence of external factors because they are beyond the organization's control. This contradicts the findings by Nasrollahi et al., (2020), who show that internal factors have more influence on the adoption of big data. The context of their research was different, so it is possible that since these factors are situational, their impact and significance would differ based on location, region, and sector.

In Korea, a study by Park (2017) shows that innovation adoption is not universal in its procedure. Park (2017) observed that the factors considered important in the manufacturing industry differ from those considered necessary in the services industry. Yunis et al (2018), whose research unearthed a different model from the TOE model, confirm these findings. However, their conclusion matches that of Park (2017). Yunis et al., (2018) found that adopting technology innovation is more of a context affair than a generalization.

Yunis et al., (2018) conclude that understanding the environment is first required before exploring internal and external factors. This is a prerequisite to understanding big data progression in each industry. The concept of context-based research assumes that the environment plays a pivotal role in shaping the adoption pattern. This assumption neglects the characteristics of the technology under study, which are universal (Wu et al., 2022). For example, big data characteristics such as velocity and variety do not change with context; as such, the impact of such variables should be universal.

This study establishes the influence of government regulations, organizational culture, security, big data characteristics and micro-business environment on adopting big data. These factors are consistently linked to innovation adoption based on the technology-organization-environment framework. The study proposes that these factors have a statistically significant impact on big data adoption.

2.3 External environment and adoption of big data

TOE model includes government regulations, business competition, customers' requirements, and many more. The environment is dynamic, and its impact and elements vary depending on the industry and geographical location (Salleh & Janczewski, 2016). The government highly regulates South Africa's banking sector through the central bank. The government released the Financial Services Act 9 of 2017 through the gazette. The Act aims to enforce financial conduct standards, provide powers to the central bank to enforce financial laws, and establish data protection laws. In addition, the Act seeks to make comprehensive provisions for financial institutions to gather information and conduct investigations on a supervisory basis as per the central bank's discretion (Government Gazette, 2017).

According to Shambare (2012), the financial services sector must be well regulated because it operates in a critical industry. The sector is crucial as the survival of the whole economy depends on it. Shambare (2012) states that the financial services sector needs laws and rules on data collection strategies. All data collected by banks should be voluntary, with no use of cookies or cache memory, and using social listening tools is prohibited (Protection of Personal Information Act, 2013). Banks and insurance companies are encouraged and required to process all the data collected from customers through deep web means. The deep web refers to data processing through official online accounts that are password protected, allowing the consumer to give their express consent (Government Gazette, 2017).

Businesses operate in a society that has primarily three distinct categories. The first environment is internal and is within the control of the business. The second category, the micro business environment, is external but limited to a specific industry. The last category is a macro business environment focusing on macro factors such as economic and government actions (Porter, 1995). Studies show that the financial services sector business environment comprises existing companies, customers, and potential new entrants. New entrants range from banks, insurance companies, and micro-finance companies.

In South Africa, the central bank sets high capital requirements for new financial service entrants. These requirements are a barrier to reducing the influence of new entrances. Most of the influence on big data adoption comes from existing rivalries. Existing competition is the primary source of most of the influence. The FirstRand bank and the rest of the banks monitor the activities of ABSA. According to Walker and Brown (2019), when mobile banks were first adopted, other banks quickly followed as this was deemed the new industry standard. The need to lead and enjoy the same benefits as the other existing players creates an unofficial oligopoly market with unofficial cartels. The financial services sector operates in unison not by choice but as a means to stay with the pack regarding service delivery (OEC-ilibrary, 2022). The OEC-ilibrary (2022) reports that the business environment could influence the adoption of innovation if the market leader were to adopt it. Figure 2.1 illustrates components in the micro-environment that influence big data adoption.
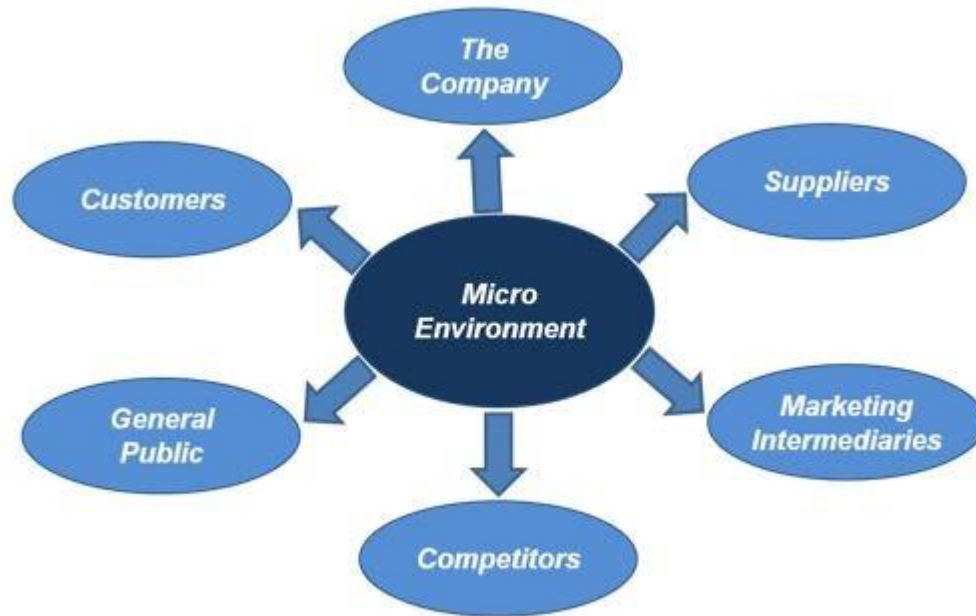
Figure 2.1: Micro-business environment

Source: Adopted from Sinha (2020)

Figure 2.1 shows six components of the micro-environment: competitors, suppliers, customers, the public, the company, and marketing intermediaries. These components make up the South African financial services sector's micro-business environment. They are all linked, and their influence on the firm varies according to the phenomenon. This research seeks to uncover and measure their impact on adopting big data in the banking sector.

Competitors: These are existing finance firms offering the same service or substitute service in a particular industry. There are market leaders and followers in different spheres and aspects. Some firms are leaders in adopting technology, some in prices, and some in service excellence (Porter, 1995).

Customers: These are the clients the firms serve, including potential clients. Clients' needs, requirements, and power exert pressure on firms and often lead them to action and adoption of the perceived object or strategy best known to give the best outcome for customers (Porter, 1995).

Suppliers: Suppliers are critical in providing for the needs of firms. In the financial services sector, suppliers have limited capacity in real terms (Porter, 1995).

2.3. Influence of external environment on the adoption of big data

Companies will not adopt an innovation due to a lack of facilitating conditions and too much effort required to comply with government regulations (Clark et al., 2022). However, Marissa (2019) criticizes this, stating that multiple pieces of legislation regarding technology adoption have always constrained organizations, but organizations have found a way to conquer this.

A business environment is the equivalent of social influence and culture for businesses. Uzoamaka and Kingsley (2015) have an interesting view of the business environment. They state that the most powerful tool in adopting big data is the influence of external forces in the micro business environment. They borrow from Porter's five forces, in which he explains that the threat of new entrance, existing rivalry, and the requirement of customers influences a business.

In pursuit of the same motion, Aduloju et al. (2019) state that data increases the efficiency of how an organization deals with its customers as and when they demand more. More companies require data to inform their decision-making regarding how to serve their customers better. Aduloju et al. (2019) note that even when companies operate as separate entities, they follow each other on cutting-edge technology or strategy adoption.

Yoon and George (2013) researched the adoption of big data in Europe, and they concluded that most economies lean towards a capitalistic approach that empowers companies to compete and create wealth based on merit, efficiency, and manipulation of market forces. Because of these, companies copy each other and are highly influenced by what others do to sustain or gain a competitive advantage (Lappeman et al., 2021).

In China, a capitalistic approach has little effect compared to government regulation (Qolomany et al., 2019). Their findings signify possible influence but are not statistically significant. In South Africa, businesses operate profitably and will do anything that aligns with their strategic objective to gain an edge over the rest (Walker & Brown, 2019). Walker and Brown (2019) note that the spirit of innovation is still lagging in other spheres. Some companies preferred a more traditional approach which meant putting aside the dictates of capitalistic ideas.

There are debates on the extent of the influence of external factors on big data. This study borrows from the arguments put forward by Saade et al., (2006) that the factors are situational, and systematic research is needed to determine the existence of the influence of the factors in the adoption of big data in a given sector and parameters.

2.3.1 *Hypothesis 1*

H1: Big data adoption in South Africa is statistically significantly influenced by government regulations.

2.3.2 *Hypotheses 2*

H2: Banks in South Africa are significantly influenced by their competitors' actions when it comes to adopting big data.

2.3.3 *Hypothesis 3*

H3: South Africa's banking sector adopts big data statistically significantly due to customer demands.

The TOE framework reveals that the environment plays a vital role in determining data adoption among organizations This informs hypothesis 1, suggesting that the government is part of the environmental factors. The framework also reveals that competitive pressure is one of the environmental factors influencing big data adoption, a factor acknowledged in hypothesis 2. Customer demands under hypothesis 3 also fall under the environment.

2.4 The influence of technology on the adoption of big data

Different technologies have different characteristics, and these play a role in acceptance by people and businesses (Baig et al., 2021; Lutfi et al., 2022; Walker & Brown, 2019). Big data uses content management systems designed to collect and process vast amounts of data for decision-making and automation of

functions (Amiri & van Engelen, 2022). Big data has several characteristics, and the major ones are as follows:

Volume: The amount of data collected has been increasing over the years, which has led to the need for even more computing power to manage such amounts of data (Amiri & van Engelen, 2022). Large volumes of big data are collected, requiring storage and efficient data compressing software to be stored easily. Large volumes of data have led to most companies seeking the cloud to limit the number of physical servers they have to invest in (Wu et al., 2022)

Velocity: Technology progression has led to an increase in big data sources. Data is collected through websites, especially Web 3.0, social media, and online tracking systems (Amiri & van Engelen, 2022). Data production is now fast and coming in quickly to organizations.

Variety: Due to the various data collection points and sources, the amount of data collected can be structured, semi-structured, or unstructured. All these require processing and turning analysis into information usable to firms. (Baig et al., 2021).

Value: Upon processing and application, big data has value to businesses. The value of the data depends on the type and source of information. In addition, the nature and needs of the business determine its value (Salleh & Janczewski, 2016).

Veracity: The accuracy of the information is subjective and depends on the source of the information. The level of confidence in the information depends on its verification and its source (Baig et al., 2021)

The characteristics of big data include the need for high energy-consuming computers to process and analyze, memory needs, costs associated with servers and cooling systems, data breach risks, and privacy issues (Wu et al., 2022). It also requires configurations of organizations in terms of capital expenditure, procedures, and skills development.

Big data technologies are available in South Africa. Companies can use cloud computing for storage and data processing offered by organizations like Amazon web services. The number of systems attacks has increased due to increased technology adoption by companies and technological advances (MIT Technology Review, 2015).

System breaches present a new challenge critical to organizations. Companies must ensure security and privacy to enjoy the benefits of big data. Billions of dollars are lost yearly due to data breaches in companies' systems, leading to the high cost of maintaining security (Keshetri, 2014). Considering this challenge, companies have resorted to using cloud computing through companies like Amazon Web Services, a specialist company dealing with data hosting and protection. This service comes at a cost that some industry players may not afford.

Big data characteristics determine the number of aspects of an organization. Big data dictates financial requirements, the number of customers, and its impacts on the market (Sekli & De La Vega, 2021). Big data adoption depends on facilitating conditions, and one of those conditions is financial capacity.

A study on adopting big data in the telecoms industry revealed that companies analyze the fit between the technology and their strategy to decide whether to adopt innovations. In support, Baig et al. (2021) note that the major constraint in adopting big data for artificial intelligence use in applications and finance use was the risks associated with data management. They mention the need for expensive hardware, cloud computing services, security services, data processing systems, and human capital training for efficient adoption. Baig et al. (2021) argue that firms have stringent budgets, and their use of finance is highly regulated and aimed at growing the revenue sources instead of perfecting already working systems.

In contrast, Walker and Brown (2019) argue that financial service organizations would stop at nothing to adopt business-enhancing technologies such as big data. They also claim that organizations are more willing and open to adopting big data to compete with established companies. The argument seems to suggest that these banks can afford to meet the minimum required conditions (Salleh &

Janczewski, 2016). This argument also means that micro-finance houses, insurance companies, and money transfer companies can invest their profits into adopting big data to compete with more established companies.

The number of firms facing data breaches is on the rise. In 2020, over US 300 billion dollars was lost due to data breaches worldwide. Companies such as Amazon, HBO, and Facebook have had their accounts or products hacked or been involved in data privacy scandals (Carbon Security, 2020). These issues and data protection expenses can potentially slow down big data adoption.

Big data is a branch of technology, and it comes with several attributes of the technology. The most common are the threats coming from the revolution going on in the technology industry. According to Marchany and Tront (2002), all technologies that include internet use are at risk of privacy inversion. As much as there are many benefits associated with big data, there are several serious challenges organizations must be aware of when it comes to big data. The most common one is the issue of security (Salleh & Janczewski, 2016). Studies show that when organizations embark on big data in all industries, they aim to provide a system with maximum security and privacy (Salleh & Janczewski, 2016).

Various studies have been conducted to determine how much security issues influence big data adoption. The outcomes consistently show a negative relationship between these factors (Wu et al., 2022). According to Baig et al. (2021), there are limited empirical findings on the influence of privacy and security on the adoption of big data. Hence, further research in various sectors was needed to add more empirical findings.

This study believes that the risks associated with security are a factor in adopting big data. The arguments put forward by previous researchers suggest that the characteristics of big data have specific challenges they bring about in its adoption. The storage costs associated with power usage and the need for skilling and training employees affect organizations. These attributes may lead to firms re-evaluating their decision and position on big data. The study, therefore, aims to understand the influence the characteristics and features of big data have on its adoption in the banking sector.

2.4.1 *Hypothesis 4*

H4: *Big data training needs significantly influence the adoption of big data in the banking sector in South Africa.*

2.4.2 *Hypothesis 5*

H5: *Costs associated with big data significantly influence the adoption of big data in South Africa's banking sector.*

2.4.3 *Hypothesis 6*

H6: *Security and privacy risks negatively influence the adoption of big data in South Africa's banking sector.*

Training is part of organizational top management support. Hypothesis 4 speaks to how top management is willing to offer training support to staff under TOE organization factor. Costs and the ability to afford big data form part of the organization's TOE factor encapsulated in hypothesis 5. Hypothesis 6 falls under the security TOE factor influencing adoption.

2.5 Influence of organizations on the adoption of big data

Organizations are corporate legal personas with a set of values and cultures. There are different organizational structures and forms, including formal and informal organizations. This also includes aspects of communication channels and leadership styles implemented in the approach (Salleh & Janczewski, 2016). Many organizational elements affect ICT adoption; the most popular are culture and communication channels (Akande & Van Belle, 2014; Kawalek et al., 2009).

Culture is a set of values and ethics followed by a group of people or a society, the society defines these values, and their value is derived from commonly understood principles (Eva, 2018). Organizational culture encapsulates the values an organization believes in and is part of its ethics (Porter, 1995). The

management style and ethical beliefs influence the culture followed by an organization.

Swanson and Taylor (2018) believe that the most crucial factor in building and shaping an organization's culture is management style. Their argument bases on the fact that management decides the company's future and its drivers. If the organization has a conservative leader, the pace of big adoption will be meager, and it can be considered a laggard. Some organizations are proactive when it comes to the adoption of big data based on their beliefs.

Organizational culture goes beyond management styles. It includes policies on employee training and development and strategies being pursued (Away et al., 2011). Culture is challenging to change since it emanates from the organization's core (Alatawi et al., 2012). Every organization has a culture built from its beliefs and the needs of investors, making them different across organizations.

The culture of an organization plays a critical role in its functions. ABSA group has one of its core values as "we innovate, are decisive, and act quickly" (ABSA Report, 2022, p. online). This statement implies that they are always looking for recent trends and better ways of doing business, which may consist of using big data. Another example of a bank's culture in South Africa is that of the Standard Bank. It aims to transform client experience, execute with excellence, and drive sustainable growth and value. It fosters innovation and superior service, and these values suggest it seeks to keep up with technology to offer exceptional service to clients (Standard Bank, 2022). These same values exist across the big four banks, including FNB and Nedbank, and they influence strategic and operational decisions these banks make since they are their core values and pledges made to the market.

Studies in Europe show organizational culture is the second most crucial factor influencing innovation adoption (Alatawi et al., 2012). Culture informs the strategic view of any organization, and the decisions made rely on the culture. In organizations deemed to be conservative, the adoption of big data is slow. In contrast, experimental organizations are leaders in adoption and have a favorable view of taking risks (Gerber, 2010).

Organizations with progressive employee training and development policies easily adopt bug data to equip their digitally skilled employees. The same goes for companies driving toward technology-based businesses. They quickly embrace any innovation that pushes toward their objectives (Gerber, 2010). Big data is crucial for some organizations, and some view it as unnecessary. This view means that the adoption of these two views is different, and a systematic study is required to ascertain the extent to which organizational culture influences big data adoption (Ramdani et al.2009).

In other studies, the adoption of ICT is affected by the lack of digital skills in organizations. According to Clark et al. (2022), there are shortages of digital skills in organizations that are slowing down the rate at which companies adopt big data. According to Wu et al. (2022), firms find incorporating big data in an environment with limited digital skills challenging. The level of education required to adopt big data could play a role in its adoption.

2.5.1 *Hypothesis 7*

H7: *Organisational learning curve influences the adoption of big data in the banking sector in South Africa.*

2.5.2 *Hypothesis 8*

H8: *Organisational culture affects the adoption of big data in the banking sector in South Africa.*

2.6 ANALYTICAL FRAMEWORK

The study uses the technology-organization-environment framework to explain the adoption of big data in banking organizations. The study uses the theoretical framework as a base for the conceptual framework.

2.6.1 *Theoretical Framework*

This study uses the technology-organization-environment framework to explain the adoption of big data. TOE is a high-level theory describing how three different aspects of a firm's context influence technology adoption. The technological, organizational and environmental contexts are the three elements that make up the TOE model. All three impact big data adoption significantly (Tornatzky & Fleischer, 1990).

The TOE model has been used to explain innovation adoption since its inception(Casanova & Miroux, 2019). The underpinning reason for accepting the TOE model is that the model allows modifications and additions of factors (Casanova & Miroux, 2019). The adoption process is influenced by various social, economic, and governmental factors, whose sources and degrees of influence differ depending on society (Walker & Brown, 2019). The TOE model is not exhaustive and needs more studies to be done as per the area of focus since some of its factors are not applicable in certain areas (Salleh & Janczewski, 2016).

Technological Security Context (T)
Perceived Complexity (-)
Perceived Compatibility (+)

Organizational Security Context (O)
Top Management Support (+)
Information Security Culture (+)
Organizational Learning Culture (+)

Environmental Security Context (E)
Security/privacy Regulatory Concerns (-)
Risks in Outsourcing (-)

Organizational intention to adopt Big Data Solutions
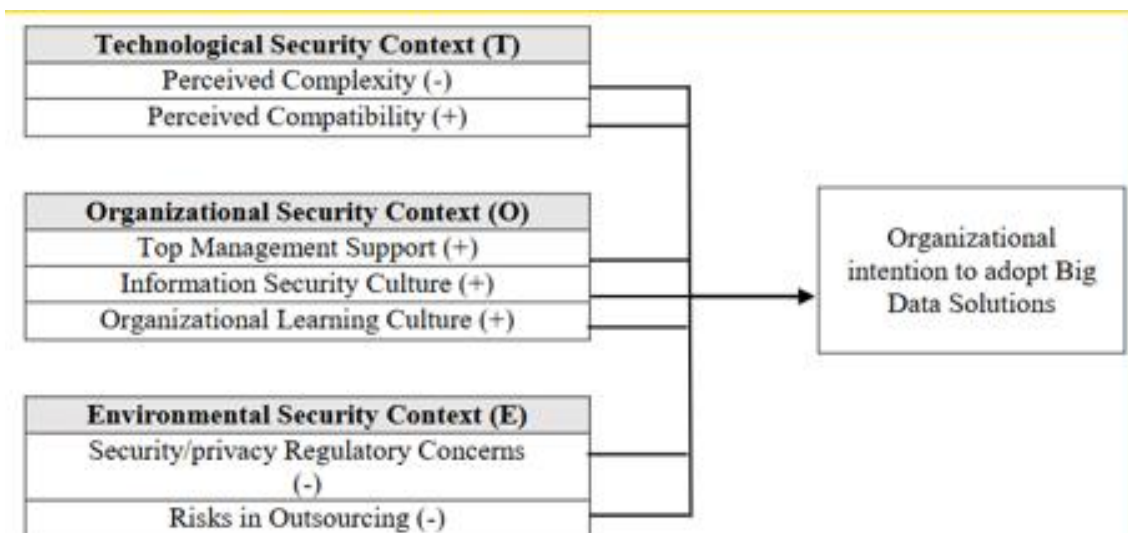
Figure 2.2: The technology-organization-environment model

Source : Adapted from Salleh and Janczewski (2016)

This study builds on prior research on big data adoption and the TOE model factors for technology adoption. The factors put forward based on the model are as follows.

a. **Technological:** A set of characteristics of the innovation which an organization considers before adopting an innovation. It includes the required environment, functions and benefits (Tornatzky & Fleischer, 1990). The insurance sector in the Middle East's adoption of technology depends on technology's features (Lutfi et al., 2022).

b. **Organizational context:** The culture and strategies of the organization influence its decision to adopt an innovation. It includes the human resources capacity regarding skill (Tornatzky & Fleischer, 1990).

   Fundamental organizational modifications, such as restructuring, culture, and skilling employees and strategy, hinder technology adoption (Akande & Van Belle, 2014). This is not the case in the information technology industry. Even when radical, the attempt to accommodate innovation is viewed positively to encourage innovation (Kang, 2018). The study seeks to deduce how organizational culture affects financial service data adoption.

c. **Environmental Context:** The external factors compel an organization to adopt or not adopt an innovation. These factors include competition, government regulations, and economic factors (Baig et al., 2021). Every society has values and ethics to maintain balance. These values stand as standards for monitoring the actions of a society's citizens (Bennett & Raab, 2020).

The values can influence innovation adoption positively or negatively depending on how the innovation relates to the values. Walker and Brown (2019) note that society is all about moving to the next stage and being the first to introduce advanced innovation in the technology industry. This means that each new program is adopted quickly, encouraging others to do so. Some environmental factors are regressive, while other factors can be viewed as progressive in

different spheres (Salleh & Janczewski, 2016). When it comes to big data adoption, external factors that have an influence are government intervention, competition, and standards (Salleh & Janczewski, 2016). Their influence is open to interpretation depending on the context and parameters set in the study.

2.6.2 *Conceptual Framework*

The study relies on the technology-organization-environment framework, and it takes a deductive approach to deduce the influence of four variables stated in the model. The impact of the sub-variable indicated in the conceptual framework is based on the industry and characteristics of the technology under study (Salleh & Janczewski, 2016). The model has extended to add security, a context-based factor critical to big data. Big data use networks that are usually targets of phishing and hacking. To guard against this, companies must invest in data and system protection technologies that may influence their big data decisions. In addition, the rise in data breaches has led to specialized systems and protection technology to maintain privacy (Marchany & Tront, 2002).

Technology: It includes high energy consumption, data security and privacy risks, and the cost associated with equipment set-up. All these challenges influence the adoption of big data (Marchany & Tront, 2002).
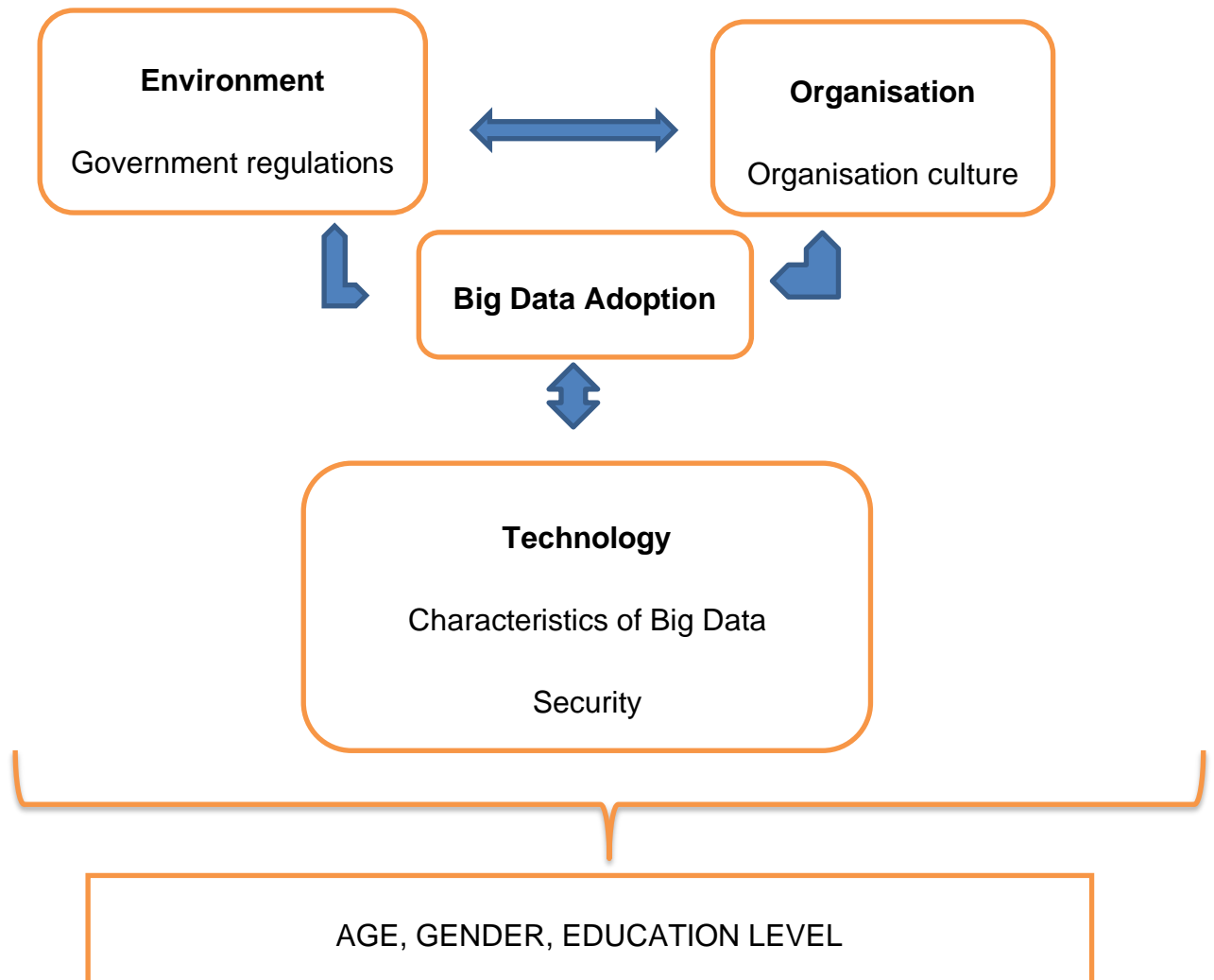
Figure 2.3: The extended TOE framework for Big Data adoption.

Source: Adopted from Salleh and Janczewski (2016)

The study included security as a standalone variable because of its importance, as highlighted by previous researchers (Salleh & Janczewski, 2016; Vladimir, 2017). Classifying security risks as a stand-alone category will allow them to be thoroughly analyzed and get the attention it deserves, as it has proved to be a critical element.

External task environment: This includes laws and rules the government sets in acts and statutory instruments to govern and monitor certain activities (Lutfi et al. 2022, Abdo & Saad, 2022). The South African government monitors and

controls the actions in the banking sector through the Banks Act and several statutory instruments as per the directive of the central bank and the Ministry of Finance. Regulations such as controls on how data is gathered, stored, and manipulated have, in the past, impacted big data adoption (Salleh & Janczewski, 2016). This study notes that government intervention influences the adoption of big data in the banking sector.

Industry standards, competitors, suppliers, and customer requirements fall under the micro-business environment (Porter, 1995). The business environment must be taken seriously, especially in the capitalistic world, where the main objective is to be the best and make the most in revenues and profit (Casanova & Miroux, 2019). In Europe, the business environment is the most powerful force in business decision-making, and its influence on big data adoption is impactful (Sekli & De La Vega, 2021). This study seeks to ascertain the influence of the micro-business environment on big data adoption in the banking sector.

Organization: This includes the way of life or the organization's conduct. Some organizations are risk-takers and encourage the development of employees' digital skills. Some are less inclined to try new things (Wu et al., 2022). An organization's strategy depends on its culture and affects its technology adoption drive (Porter, 1995). In this study, the aim is to find out the influence of the culture of organizations in the banking business on their drive for big data.

Security: Network breaches and privacy invasions are serious issues in the current business environment. The number of security measures required to secure data is costly. Firms must hire data security specialists, build custom firewalls, and adopt several security measures (Marchany & Tront, 2002; Salleh & Janczewski, 2016). These measures act as hindrances for other firms, possibly in the context of South Africa. These requirements could affect the adoption rate as companies must ensure complete data security to maintain customer privacy.

2.7   Conclusion of Literature Review

One must approach big data adoption the same way one would any technological innovation. Several factors influence big data adoption, particularly in the banking

sector. The most influential variables are government intervention and the micro-business environment, especially in the capitalistic and communist business approach countries. There are conflicts in the literature on which factors have the most impact and under which circumstances. The most logical step is to test as many contexts as possible to determine the actual impact or influence of the specific variables. Based on the literature findings, this study uses the following hypotheses to guide the research:

2.7.1 Hypothesis 1

H1: There is a statistically significant influence of government regulation on big data adoption in the banking sector in South Africa.

2.7.2 Hypotheses 2

H2: The adoption of big data in South Africa is statistically significantly influenced by competitors' actions.

2.7.3 Hypothesis 3

H3: Banks in South Africa are adopting big data in response to customer demands in a statistically significant way.

2.7.1 Hypothesis 4

H4: Big data training needs significantly influence the adoption of big data in the banking sector in South Africa.

2.7.2 Hypothesis 5

H5: Costs associated with big data significantly influence the adoption of big data in South Africa's banking sector.

2.7.3   *Hypothesis 6*

H6: Organisational learning curve influences the adoption of big data in the banking sector in South Africa.

2.7.4   *Hypothesis 7*

H7: Organisational culture affects the adoption of big data in the banking sector in South Africa.

2.7.1   *Hypothesis 8*

H8: *Security and privacy risks negatively influence the adoption of big data in South Africa's banking sector.*

CHAPTER 3. RESEARCH METHODOLOGY

The chapter first discusses a high-level justification of the research design and approach that the study employs. A description and justification of the research data collection procedure and analysis models follow. The chapter then ends by describing the necessary measures and tests to ensure that the results and specifications of the study can be relied upon in answering the research questions and can be trusted to formulate recommendations, policies, and strategies.

3.1 Research approach

This study used a quantitative approach, utilizing primary data to investigate the influence of technology-organization-environment factors on adopting big data. Goundar (2017) recommends the quantitative research approach; Ali (2021), Destiny (2017), and Eyisi (2016) adopted it. The study preferred a quantitative research approach because it allows for a detailed analysis of the influence of the independent variables on big data adoption. A quantitative approach is more helpful in identifying causal relationships. This usefulness makes it suitable for this study, given that this investigation sought to understand the causal relationship between variables in the TOE model and the adoption of big data.

Ali (2021) highlights that quantitative research is ideal for large samples and when establishing causality relationships between an independent and dependent variable. The large sample size in this study made it more appropriate. The study was able to show the relationship using PLS-SEM analysis on the quantitative data collected from South Africa's banking sector.

3.2 Research design

This study used a survey research design that made use of questionnaires. Questionnaires are recommended for data collection from large samples (Goundar, 2017). McDonald et al. (2008), supported by Young et al. (2016), note that using questionnaires in investigations based on a quantitative research

approach enables the researcher to reach a wider audience and allows the collection of enough data to be analyzed using different statistical models. Unlike previous studies that focused on interviews, this inquiry took the recommendations of McDonald et al. (2008), which Young et al. (2016) support on using questionnaires in investigations based on a quantitative research approach.

The study comprised 173 respondents selected from 53 banks, which were set using the Yamane sample size selection method from a sample size of 62 banks. A quantitative study needs to be objective and precise regarding data collection. In the event of an extensive sample structure, questionnaires provide a stable and uniform approach to data collection (Young, 2015). In addition, complex statistical analyses can be done using a questionnaire approach if it is adequately modelled to collect the required data (Munn et al., 1995). Bird (2009) expresses the same view that questionnaires allow studies in areas the researcher might not be able to reach quickly. Considering these arguments, this study benefited from a survey design due to the size of the target sample of 200 respondents. The data collected was suitable for statistical analysis and increased research objectivity.

3.3 Data collection methods

Questionnaires were explicitly used as a quantitative data collection tool to collect data from the banking sector. Gell et al. (2008) recommend using a structured questionnaire approach in line with quantitative data. O'Keeffe et al. (2016) support the structured questionnaire. As such, the study preferred a structured questionnaire. Using questionnaires in quantitative studies allows the researcher to collect objective information from a large sample (Frels & Onwuegbuzie, 2013). Qualtrics survey software is suitable for complex surveys, or extensive sample size surveys were used for the study (*see* www.qualtrics.com).

The questionnaire's primary objective was to establish the influence of factors such as security risks, government influence, and technology on adopting big

data. The researcher collected quantitative information that can be subjected to PLS-SEM analysis. Goundar (2012) recommends questionnaires for a large sample. The author argued that a structured questionnaire easily classifies information. Goundar (2012) posits that a structured questionnaire increases the researcher's control over the data shared (Frels & Onwuegbuzie, 2013; O'Keeffe et al., 2016). Considering this revelation, the study used a structured questionnaire to investigate the influence of the independent variables on big data adoption.

O'Keeffe et al. (2016) recommend using a Likert scale questionnaire when collecting quantitative data for statistical analysis. This aligns with the views of Joshi et al. (2015) and Apuke (2017). Against this background, this study used a structured 6-point Likert scale questionnaire to collect data. The data gathered using the Likert scale approach allowed the study to calculate the means, standard deviation, and deviations and, most importantly, carry out a PLS-SEM analysis to measure the influence of internal and external factors on big data adoption in the banking sector in South Africa.

3.4 Population and sample

Population is the aggregate number of items found in the area where the problem is emanating. A population should share common characteristics and exhibit the right qualities for the intended research (Apuke, 2017). In pursuit of this definition by Apuke (2017), this study focused on banks in South Africa as the target population.

3.4.1 *Population*

This study is based on banks operating or with offices in South Africa as the total population. There are 62 banks registered in South Africa (*see* www.resbank.co.za). Thus, the total population of the study is 62. This population represents all the banks categorized as Branches of Foreign Banks, Foreign Bank Representatives, Foreign Controlled Banks, Locally Controlled Banks and

Mutual Banks by the Reserve Bank of South Africa. Of the 62 banks, only 53 were used.

The study excludes any other entity operating as a bank or offering banking like a bank but not registered by the Reserve Bank of South Africa. Using only registered banks gave credibility to the data collected and increased the internal and external validity of the result.

3.4.2 *Sample*

Olonite (2021) recommends using the Yamane sample size selection model in quantitative research. Adriansyah et al. (2020) also support this approach. The study had 53 banks, and the full sample size was calculated using the Taro Yamane method at a 5% significance level. The total population is 62, as per the Reserve Bank of South Africa (2022). The formula used is as follows:

n = N / [1 + N (e) 2]

Where:

n = the sample size

N = the finite population

e = the level of significance

1 = unit or a constant

The Yamane method is widely used because it uses proportions and margins of error on population size to create a sufficient sample size (Uakarn et al., 2021). The study targeted 200 employees from the 53 banks chosen for the survey. Memon et al.'s (2020) recommendation informed the sample size selection. The model was supported as standard sample selection criteria when the population size was unknown (Macdonald et al., 2008).

3.4.3 *Sampling method*

Sandelowski (2000) and Hamed (2016) note that snowball sampling is best for large sample sizes and when the researcher can determine the selection of suitable sample subjects following referrals from respondents. In pursuit of this recommendation, this study used the snowball sampling method. The Taro Yamane model was used to determine the target employees from the 53 banks. The study used the snowball sampling technique to collect data from relevant employees. Naderifar et al. (2017) note that when the sample size is large and the researcher needs to collect relevant data from the right people, one recommends snowball sampling. Snowball sampling is appropriate for choosing the most suitable candidates based on referrals made by other respondents (Sedgwick, 2013). This study benefited from the referrals made by employees of the banks under investigation.

Sedgwick (2013) notes that the researcher can be referred to the right candidate from whom data can be collected using snowball sampling. The researcher was referred to other organizational employees with enough knowledge of the subject matter. Snowball sampling uncovers hidden subjects, which the study might not have been able to establish under any different sampling technique. It uses referrals from people familiar with the system or company (Sedgwick, 2013). This study benefitted by accessing some employees with specialized knowledge that other methods might not have found.

3.5   The research instrument.

Guyonnet et al. (2008) note that structured questionnaires are a reliable data collection tool for quantitative data. In pursuit of this recommendation, this study collected data using structured questionnaires designed to cover all the objectives of this study. The structured questionnaire was divided into sections, with each section covering a specific purpose and objective.

The study's objectives were detailed in Sections A through C of the questionnaire, with one section devoted to each of the three objectives. The objective was stated in the first sentence of the section so that respondents would know what to expect

from the questions that would follow. Section D consisted of demographic data questions such as gender, age, work experience, and position. Demographics were placed at the end because they are potentially sensitive and intrusive.

The questionnaire used a Six-Point Likert scale approach, which encouraged respondents to thoroughly evaluate the questions and choose either positive or negative, resulting in a higher Cronbach alpha rating, making it more reliable.

The constructs of the study are derived from the extended TOE framework. These include technology, organization and environment. The study argued that these constructs have a profound effect on big data adoption.

3.6   Procedure for data collection

Data from the banks constituting the sample was collected from employees from the selected banks. The researcher used random sampling. The researcher opened the survey online and shared it with their LinkedIn Community, which was encouraged to share the link with any interested parties in its network. The questionnaire thoroughly explained the study's ethics and goal, allowing respondents to provide information freely.

3.7   Data analysis strategies and interpretation

Data collected using a Likert scale structured questionnaire should be analyzed first using measures of central tendency (Frels & Onwuegbuzie, 2013; Goundar, 2012; Joshi et al., 2015). Considering this recommendation, this study analyzed data collected using descriptive statistics to get a general overview of the influence of independent variables on big data adoption. Frequency tables were used to present the data groups per objective, and the data was processed to find the mean and standard deviation.

There are many methods and models used in quantitative data analysis. Hair et al. (2019) recommend using PLS-SEM data analysis for studies trying to investigate a causality relationship. This view is supported and adopted by Samani (2016) and Sarstedt et al. (2020). This study uses PLS-SEM analysis to

test the relationship between the independent and dependent variables big data adoption. According to Fernández-Val and Lee (2013), testing a relationship between multiple independent variables and a single dependent variable requires using a method that allows for a multivariate analysis approach. PLS-SEM analysis allows for multivariable testing, making it easy for the study to analyze the factors affecting big data adoption in banking simultaneously.

3.8   Quality Assurance

External validity, internal validity and reliability supported by literature and previous studies were used to assess the study's quality.

3.8.1   *External validity*

The study was subjected to the Cronbach alpha test. The model states that for a study to be valid, the alpha value must be at least 0.70 (Bonett & Wright, 2015). The model is widely used due to test reliability, as Bonett and Wright (2015) recommended. As such, it produced a reliable and valid test for the study. In addition to the Cronbach alpha test, the study conducted a Chi-square test to assess discriminant validity. The method analyzes whether the study's independent variables are related (Bertea, 2011).

The sample was drawn from a pool of organizations operating in the same environment and is subjected to the same factors. Big data is the technology under study, and its characteristics are similar across all firms in banking. The research is reliable, and the data is generalizable to the entire industry because of the research approach. The data was collected from a representative sample to ensure external validity (Calder & Tybout, 1982). The study used the Yamane Statistical Formula to select the sample size from the total population, a method recommended by different authors (Uakarn et al., 2021). The research is, therefore, externally valid.

3.8.2 *Internal validity*

The PLS-SEM model was used to test the reliability of the data collected on independent variables: the external environment, the organization, and technology in evaluating the factors influencing big data adoption. The model has been used to determine internal validity and has proved effective (Lutfi, et al., 2022).

The data was subjected to confirmatory factor analysis. This model is used to test the internal validity of the hypotheses. It is significant because it helps measure the relationship between the dependent and independent variables (Hoyle, 2000; Prudon, 2015).

3.8.3 *Reliability*

The study used the same questionnaire across all respondents to collect data. A reliability test should use the same data collection tool in the same context. This study used the same data collection tool with the results collected via an online survey from each respondent chosen (Lutfi et al., 2022). The data were subjected to a further test using Cronbach's α, with an expected minimum of $\alpha = 0.70$.

3.9   Ethical considerations

The research upheld several ethical considerations to ensure that the study's outcome does not infringe on the rights of respondents, affect the banking sector negatively, or tarnish the image of any institution. The research followed the following ethics:

a) The respondents were expressly asked for consent to be part of the study. The researcher shared the relevant documents with the respondents indicating the academic purpose of the research.
b) Targeted respondents could leave the study anytime they wanted without being pressured otherwise.
c) The researcher ensured that data was collected without bribing respondents to be part of the study, twisting facts or otherwise.

d) Respondents were not coerced or forced to reveal the names of their employers.

e) Academic ethics were upheld, and sources of literature were credited accordingly.

f) Data collected through this study was solely for academic purposes and was not used for commercial purposes or to assist a specific organization with confidential information from the study.

g) The study was conducted using adult respondents and no minors were included.

3.10 Chapter Summary

The chapter looked at the research methodology and philosophy in detail. A detailed encounter of the population and sample, as well as the sampling technique used, was given. The chapter looked at data analysis and data collection tools used per the recommendations of various authors. Lastly, the chapter looked at the ethics observed in the study. The next chapter looked at data presentation.

CHAPTER 4: PRESENTATION OF RESULTS

4.1. Introduction

This chapter presents the research results from the sample. It presents results as descriptive statistics, correlational statistics, and regressions. The latter part of the chapter focuses on hypothesis testing using estimated multiple regression models. It uses the results of the hypotheses testing to determine whether the null hypotheses should be accepted.

The investigation used a six-point Likert scale. The study analyzed the results using descriptive statistics for Likert scale analysis. The scale of the study was represented by numerical values (Strongly Agree=1, Agree=2, Somewhat Agree=3, Somewhat Disagree=4, Disagree=5, and Strongly Disagree=6).

A mean within the range of 1 to 3 shows agreement with the assertion, and a mean above 3 shows disagreement with the statement. The closer the mean to 1, the stronger the agreement. A high standard deviation shows the variability and dispersion of participants' submissions. A low standard deviation means that responses from participants were similar, whereas a high standard deviation indicates that responses were not aligned.

The target population for this investigation was 200. Only 173 respondents completed the online survey. This number might result from some respondents having hectic schedules and others finding it uncomfortable to access the survey link because of security concerns. However, Suanders et al. (2014) posit that any sample above 150 is adequate and can be generalizable to the larger population. Therefore, the 173 sampled in this study are sufficient for understanding the variables influencing big data adoption in the South African banking industry.

4.2. Demographic profile of respondents

Gender
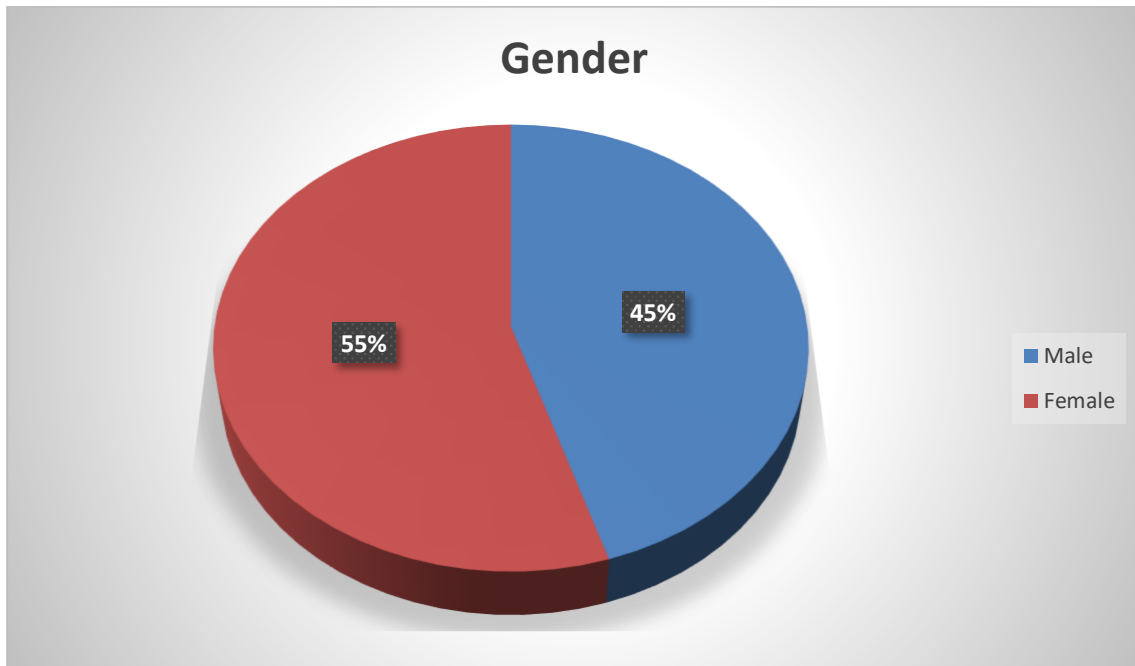
Most respondents were female, possibly reflecting the ratio of men and women in the banking sector.

Age
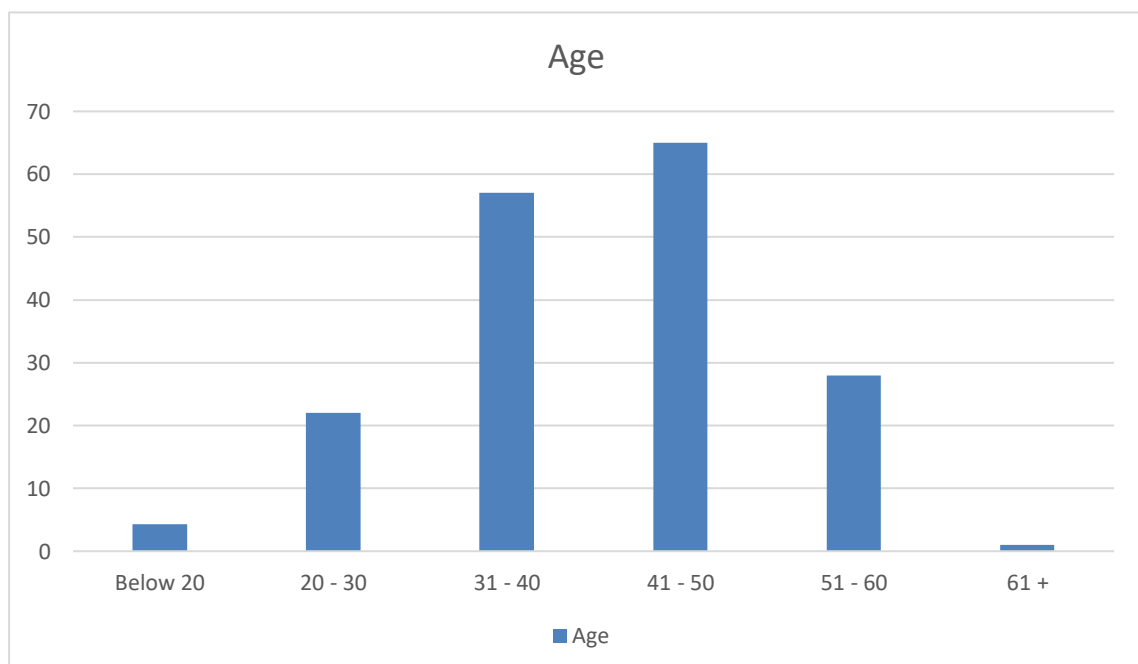
Figure 4.1: Age of Respondents

Source: *Author Calculations*

The study shows that most respondents were between the ages 31 and 50. There were a few with over 50 and comparatively few people less than 30 years of age. These demographics could reflect the age group in the banking sector in South Africa.

Work Experience
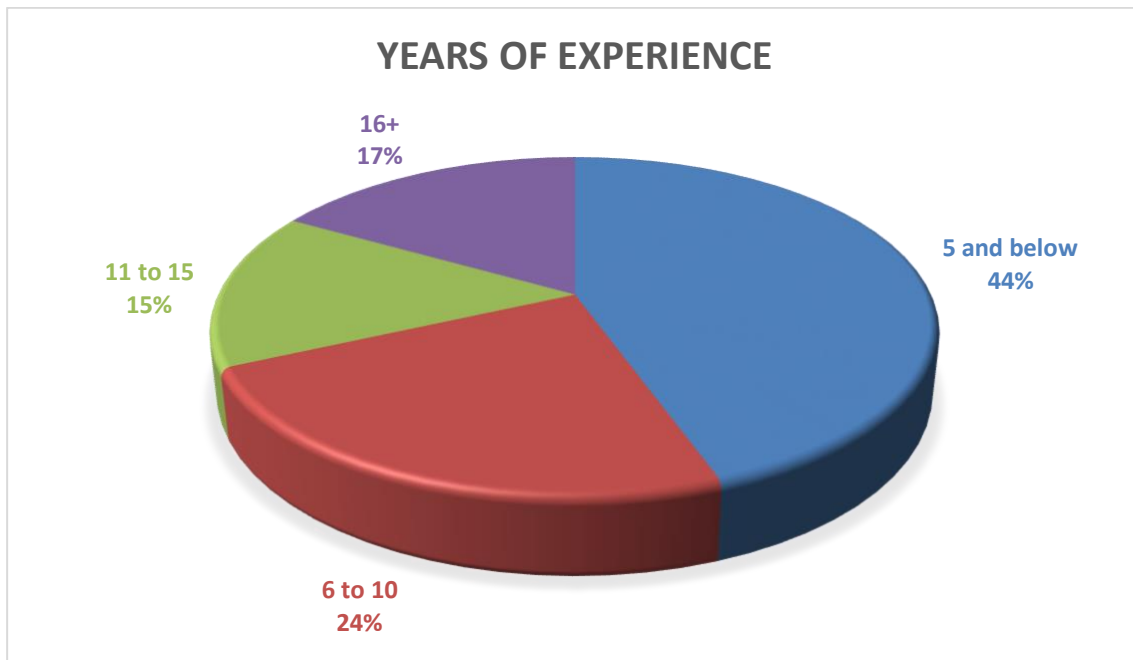
Figure 4.2: Work Experience of Respondents

Source: *Author Calculations*

Most respondents had work experience of five years and below. This finding shows that big data is still a new area in the banking sector. However, 17% of the respondents had 16-plus years of experience. As such, the study comprised a well-experienced sample with credible information on big data adoption.

Institution worked for

Institution categories respondents fall under

5%

26%

69%
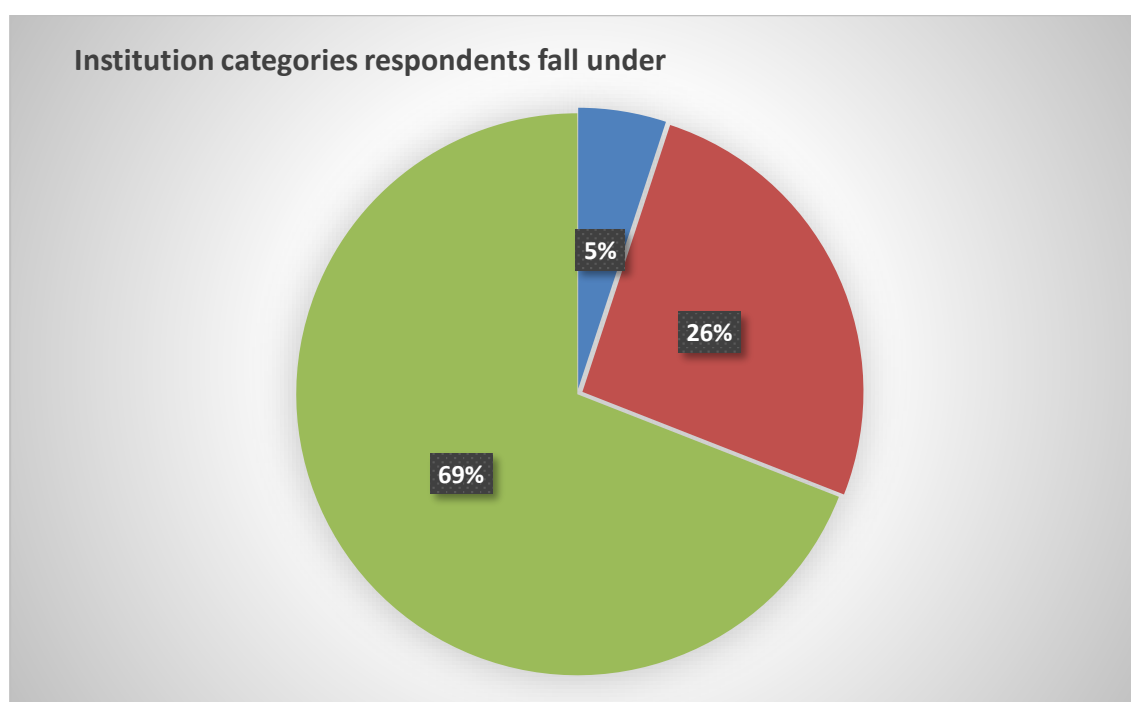
■ I work for one of these financial institutions: Standard Bank, FNB, Nedbank, Capitec, or Discovery Bank.

■ I prefer not to mention it.

■ I work for a financial institution not listed above.

Figure 4.3: Organizations of Respondents

Source: *Author Calculations*

Most respondents preferred not to mention the category of the organization they work for. This discretion is because they wanted to safeguard their employers' and private information. However, all respondents were from the banking sector. Their responses are valid and reflect what is happening in the banking sector.

4.3 Descriptive Statistics

Below is a table that summarises all the descriptive statistics.

	N	Maximum	Mean	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Maintaining data privacy influences big data adoption in the financial services sector	173	5	2.35	-1.486	.192	5.571	.383
Organisational technology readiness in the financial services sector affects the adoption of Big Data.	173	5	2.20	-1.495	.198	3.387	.394
Big Data volumes influences its adoption in the financial services sector .	173	5	2.14	-1.255	.195	1.372	.389
The benefits of Big Data in the financial services sector affect its adoption .	173	5	2.14	-1.412	.202	2.381	.401
Big Data Velocity (how quickly data is generated and how it moves) influences adoption.	173	5	2.28	-1.020	.206	3.375	.410
Big Data Variability (the number of inconsistencies in the data) influences adoption.	173	5	2.06	-1.255	.195	1.288	.387
Big Data computing power requirements influence adoption.	173	5	2.12	-1.416	.198	2.606	.394

Big Data energy consumption requirements influence its adoption.	173	5	3.81	-.859	.183	.387	.364
Big Data processing and manipulation influences its adoption.	173	5	3.96	-.712	.183	.535	.364
Security Concerns in big data influence adoption.	173	5	2.22	-1.667	.198	3.099	.394
Big Data value influences its adoption in the financial services sector.	173	5	2.15	-1.297	.197	2.478	.392
Organisational specific factors that influence the adoption of Big Data in the financial Services Sector in South Africa. Organisational culture influences the adoption of Big Data in the financial services sector.	173	5	2.11	-1.427	.193	2.843	.384
Training and development interventions in my organisation influence the adoption of Big Data.	173	5	2.16	-1.275	.196	1.318	.390
Organisational Technology readiness affect the adoption of Big Data.	173	5	2.23	-1.505	.195	3.031	.389

	N		Mean	Skewness		Kurtosis	
Financial resources / budgets influence the adoption of Big Data adoption in the financial services sector.	173	5	2.28	-1.330	.195	2.865	.389
The size of the organisation influences the rate of big data adoption.	173	5	2.07	-1.302	.199	1.081	.396
Organisational Strategy influences big data adoption.	173	5	2.20	-1.642	.195	4.072	.389
Big Data adoption is influenced by the caliber of employees.	173	5	3.82	-.883	.201	-.282	.400
Top management support affects big data adoption.	173	5	2.18	-1.304	.199	1.616	.395
Employee buy-in affects big adoption.	173	5	3.97	-1.109	.203	.557	.404
Organisation's objectives influence big data adoption in the financial services sector.	173	5	2.18	-1.472	.203	2.915	.403
The organisation's vision affects big data adoption.	173	5	2.07	-1.244	.199	1.112	.395
The influence of external environmental factors on the adoption of big Data in the financial services sector in South Africa.	173	5	2.13	-1.347	.197	1.760	.391

Actions of other financial institutions influence your decision to adopt Big Data.	173	5	2.14	-1.453	.209	2.864	.414
Customers willingness to share their personal information with financial institutions influences Big Data adoption.	173	5	2.11	-1.268	.199	1.062	.395
Suppliers willingness to share information with the financial institutions influence Big Data adoption	173	5	2.08	-1.196	.201	1.120	.399
High competition levels influence Big Data adoption by financial institutions to gain competitive advantage	173	5	2.28	-1.372	.199	2.610	.395
The rapid increases in E-Business practices influences the adoption of Big Data in financial services sector .	173	5	2.33	-1.426	.199	2.813	.395
Access to external data storage facilities influences the adoption of Big Data in the financial services sector.	173	5	2.08	-1.671	.201	3.862	.399
An increase in internet usage influence the adoption of Big Data by financial institutions.	173	5	2.27	-1.551	.196	2.978	.390

Global business trends influence the adoption of Big Data by financial institutions in South Africa.	173	5	2.27	-1.531	.194	4.482	.385
Government willingness to share data influences the adoption of Big Data in the financial services sector in South Africa .	173	5	2.97	-1.300	.197	1.251	.392
Government polices influence the adoption of Big Data in the financial services sector in South Africa.	173	5	2.13	-1.494	.197	2.660	.392
Government regulations on data collection affect big data adoption in the financial services sector in South Africa .	173	5	2.23	-1.508	.197	2.989	.391
Valid N (listwise)	173						

Source: Author

The most prevalent mean ranges from 2-3 meaning that respondents agreed to the given statements. Most of the data is skewed to the left. The kurtois represents the numeric peak of the data specific to each statement. For every statement, at least one person disagreed.

4.3.1 Big Data Adoption

The study also sought to understand the extent of big data adoption in the South African services sector. Table 4.1 below shows that 51.6 percent of respondents wrote yes, confirming big data adoption and 48.4 percent reported no. These

responses mean that most organizations in the banking sector in South Africa have adopted big data.

Table 4.1 Descriptive Statistics of big data adoption

Big Data Adoption

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	89	51.5	51.5	51.5
	No	84	48.5	48.5	100.0
	Total	173	100.0	100.0	

Source: Author

4.3.2 **Government and Big Data**

Table 4.2 Descriptive statistics of government regulations

Field	Mean	Standard Deviation	Total Respondents
Government regulations on data collection affect big data adoption in the banking sector in South Africa	1.95	0.93	173
Government policies influence the adoption of Big Data in the banking sector in South Africa	2.06	1.00	173
The government's willingness to share data influences the adoption of big data in the banking sector in South Africa.	2.23	1.16	173
Global business trends influence the adoption of Big Data by financial institutions in South Africa.	1.80	0.77	173
Average	**2.01**	**0.96**	**173**

Source: Authors Calculations

Many respondents agree that government regulations influence the adoption of big data. A low standard deviation corroborates this, meaning there was an alignment of responses among study participants.

4.3.3 Competitor's actions and big data

There were four indicators of competitors' actions to quantify their impact on the adoption of big data descriptively. Table 4.3 shows descriptive statistics on competitors' actions.

Table 4.3: Descriptive statistics on Competitors' actions

Field	Mean	Standard Deviation	Total Respondents
Actions of other financial institutions influence your decision to adopt Big Data	2.16	0.96	173
High competition levels influence Big Data adoption by financial institutions to gain a competitive advantage	1.92	0.87	173
The rapid increases in E-Business practices influence the adoption of Big Data in the banking sector	1.90	0.92	173
Global business trends influence the adoption of Big Data by financial institutions in South Africa	1.80	0.77	173

Average	**1.94**	**0.88**	**173**

Most study respondents agree that competitors' actions influence the adoption of big data. A low standard deviation that signifies consensus amongst respondents' opinions also supports this.

4.3.4 Customer demands and big data

Customer demands were divided into two indicators to measure the impact of customer demands on big data. Table 4.4 shows descriptive statistics on customer demands.

Table 4.3: Descriptive statistics on customer demands

Field	**Mean**	**Standard Deviation**	**Total Respondents**
Customers' willingness to share their personal information with financial institutions influences Big Data adoption	2.10	1.08	173
An increase in internet usage influences the adoption of Big Data by financial institutions	1.92	0.97	173
Average	**2.01**	**1.02**	**173**

Most respondents agree that customer demands influence the adoption of big data. This finding is consistent with a low standard deviation showing corroboration of responses amongst study respondents.

4.3.5 Big data training needs and big data

To measure the influence of big data training needs on its adoption, the respondents stated how much they agreed with the indicator. Table 4.4 shows results on big data training needs.

Table 4.4: Big data training needs and adoption of big data

Field	Mean	Standard Deviation	Total Respondents
Training and development interventions in my organization influence the adoption of big data.	2.01	1.01	173

Source: Authors Calculations

Most respondents agree that big data training needs to influence the adoption of big data. A low standard deviation also corroborated this, meaning there was an alignment of responses amongst study participants.

4.3.6 Costs associated with big data.

To understand the influence of costs associated with big data on adopting big data, the independent variable was divided into five indicators. Table 4.5 shows descriptive statistics on big data training needs.

Table 4.5: Costs associated with big data.

Field	Mean	Standard Deviation	Total Respondents
The costs of implementing big data platforms affect their adoption in the banking sector	1.79	0.76	173
The size of the organization influences the rate of big data adoption	2.00	1.00	173
Financial resources/budgets influence the adoption of Big Data adoption in the banking sector	1.87	0.75	173
Big Data computing power requirements influence the adoption	2.00	0.99	173
Big Data energy consumption requirements influence its adoption.	2.12	1.07	173
Average	**1.98**	**0.91**	**173**

Source: Authors Calculations

The results show that respondents agreed that costs associated with big data influence big data adoption. This trend is consistent with low standard deviation showing convergence in responses of study responses.

4.3.7 Organisational culture and big data

Organizational culture was divided into seven indicators to understand the influence of organizational culture on big data adoption. Table 4.6 below shows descriptive statistics of organizational culture and the adoption of big data.

Table 4.6: Descriptive statistics on organizational culture affects the adoption of big data in the banking sector in South Africa.

Field	Mean	Standard Deviation	Total Respondents
Organizational technology readiness in the banking sector affects the adoption of big data.	2.01	0.93	173
The organization's vision affects big data adoption	2.11	1.10	173
Organization's objectives influence big data adoption in the banking sector	2.00	0.99	173
Employee buy-in affects big adoption	2.26	1.14	173
Top management support affects big data adoption	2.08	1.04	173
Big Data adoption is influenced by the calibre of employees	2.35	1.23	173

Organizational Strategy influences big data adoption	1.96	1.03	173
Average	**2.11**	**1.08**	**173**

Source: Authors Calculations

Based on the results presented above, respondents agree with the hypothesis, and organizational culture in the South African banking sector affects the adoption of big data. Results show that respondents did not strongly agree with the notion. However, they indicated that organizational culture does impact the adoption of big data. The study had a standard deviation from the mean of 1.08, showing that not all respondents shared the same view. This could be because of differences in organizational cultures.

4.3.8 Security and privacy risks

The study literature showed that security and privacy are critical issues, and this led to this variable being divided into three indicators of security issues highlighted, including storage of financial data, cost of implementing security measures and threats presented by big data adoption. The table below shows the results from the data collected.

Table 4.7 Descriptive Statistics on Security and Privacy Risks

Field	Mean	Standard Deviation	Total Respondents
Maintaining data privacy influences big data adoption in the banking sector	1.73	0.61	173

The costs of implementing big data platforms affect their adoption in the banking sector	1.60	0.75	173
Security Concerns in big data influence adoption	2.02	0.95	173
Average	**1.71**	**0.72**	**173**

Source: Authors Calculation 2023

The study shows that security and privacy are of great concern regarding big data adoption in the banking sector. The study shows that most respondents agreed there are reservations regarding big data adoption in the banking sector because of big data security concerns.

4.3.9 Big data characteristics and big data

Different technologies have different characteristics that affect organizations in different ways. Big data characteristics include its value, the variety of the data, velocity and processing requirements. The study divided big data characteristics into six indicators. The table below presents the results of the survey.

Table 4.8: Descriptive statistics on big data characteristics

Field	Mean	Standard Deviation	Variance	Total Respondents
Big Data volumes influence its adoption in the banking sector	1.82	0.71	0.51	173

The benefits of Big Data in the banking sector affect its adoption	1.92	0.80	0.63	173
Big Data Velocity (how quickly data is generated and how it moves) influences the adoption	2.10	0.85	0.75	173
Big Data's value influences its adoption in the banking sector.	2.02	0.84	0.70	173
Big Data Variability (the number of inconsistencies in the data) influences the adoption	2.00	0.92	0.81	173
Big Data processing and manipulation influence its adoption.	1.94	0.88	0.77	173
Average	**1.90**	**0.90**	**0.79**	**173**

Source: Authors Calculations

The results show that big data characteristics influence the banking sector's technology adoption. The study had a mean of 1.90, indicating that respondents agreed that data value, volume, and format affect big data adoption in the banking sector. This finding is consistent with a low standard deviation, signifying convergence of opinions amongst respondents.

4.4 Correlation Analysis

4.4.1 Pearson Correlation Analysis

The Pearson correlation test relationships. The big data adoption is the dependent variable and the factors influencing big data adoption are the independent variables.

Table 4.10 Correlation scale

Sign of correlation coefficient	Strong	Moderate	Weak	Very weak
+values Positive relationship	0.5-1.0	0.3-0.49	0.1-0.29	0-0.009
-values Negative relationship	-1.0 to -0.5	-0.49 to -0.3	-o.29 to -0.1	-0.009 to 0

Source: Authors Calculations

Table 4.10 Correlation Analysis

		Big Data Adoption	H1	H2	H3	H4	H5	H6	H7	H8
Big data adoption	Pearson Correlation	1	-0.756	0.536	0.95	0.614	-0.542	0.784	-0.541	-0.845
	Sig. (2-tailed)		0.000	0.00	0.280	0.000	0.000	0.354	0.124	0.200
	N	173	173	173	173	173	173	173	173	173

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

This investigation found that some factors negatively influence big data while others influence it positively. Findings show that big data characteristics and government regulations have a strong negative relationship with big data adoption. Costs, security and privacy risks have a moderately negative relationship with big data adoption. On the other hand, customer demands and organizational culture have a strong positive relationship with big data adoption. Big data training needs and competitors' actions have a moderate positive relationship with big data adoption.

4.4.2 Reliability Test

A reliability test was performed on the study using Cronbach's Alpha test to measure the internal consistency of the Likert scale in the research instrument.

An alpha coefficient of 0.7 and above attests that the instrument was reliable in measuring the constructs (Cronbach, 1951). The table below shows the Cronbach's alpha values:

Table 4.11 Cronbach Alpha test

Construct	Name of items	Cronbach Alpha
In the South African banking sector, regulations play a statistically significant role in driving the adoption of big data	10	0.76
South Africa's banking sector is statistically influenced by competitors' actions on big data adoption	10	0.84
South Africa's financial sector adopts big data based on customer demands statistically significantly	10	0.75
Big data training needs significantly influence the adoption of big data in the banking sector in South Africa	10	0.83

Costs associated with big data significantly influence the adoption of big data in South Africa's banking sector.	**10**	**0.86**
Organizational culture affects the adoption of big data in South Africa's banking sector.	**10**	**0.76**
Security and privacy risks negatively influence the adoption of big data in the banking sector in South Africa	**10**	**0.79**
Big data characteristics influence the adoption of big data in the banking sector in South Africa	**10**	**0.81**

All the variables had a result above 0.70, the threshold for exemplary performance in data and instrument reliability quantitative studies. The study's results are, therefore, reliable based on the Cronbach Alpha test conducted in the study.

4.4.3 Sample Adequacy

Table 4.12 Sample Adequacy

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.841
Bartlett's Test of Sphericity	Approx. Chi-Square	10278.67
	Df	325
	Sig.	.05

Source: Author

The KMO of the study is 0.841, which is above 0.8, indicating that the sample is adequate and that one can generalize the study's findings to the broader population on the factors influencing big data adoption. Huston et al. (2015) support that a KMO test between 0.8 and 1 is adequate for generalizing to the whole population.

4.5 Hypotheses Testing

Estimated Multiple Regression Model

The research adopted a hierarchical regression approach to analyzing the impact of the various variables highlighted in the study on big data adoption in the banking sector.

The model was of the functional form:

$y = a + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 \ldots\ldots + \beta_j x_j + é$

Table 4.13: Estimated Regression Model

Y	Big data adoption
A	Constant

É	Error
x1	Government regulations have a statistically significant influence on the adoption of big data in South Africa's banking sector.
x2	Competitors' actions have a statistically significant influence on the adoption of big data in South Africa's banking sector.
x3	Customer demands have a statistically significant influence on the adoption of big data in the banking sector in South Africa.
x4	Big data training needs significantly influence the adoption of big data in the banking sector in South Africa.
x5	Costs associated with big data significantly influence the adoption of big data in South Africa's banking sector.
x6	Organizational culture affects the adoption of big data in South Africa's banking sector.

| x7 | Security and privacy risks negatively influence the adoption of big data in South Africa's banking sector. |
| x8 | Big data characteristics influence the adoption of big data in South Africa's banking sector. |

Source: Author

The study conducted a regression analysis to determine the impact of the highlighted factors and whether they supported or refuted the study's hypothesis. When the p-value is higher than the standard 0.05, the hypothesis is rejected, and when it is lower, the hypothesis is accepted (Agresti, 2013).

4.5.1 In South Africa, government regulations significantly impact the adoption of big data in the banking industry.

Table 4.14 Hypothesis 1 Regression and Coefficient of Determination

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std Error	Beta (β)	T Statistic	P-value
(Constant)	0.63	0.27	2.33	0.0117	0.021
x1	0.53	0.255	0.28	2.23	0.004

Source: Author

The p-value is 0.004, and this is below the standard of 0.05. This means government regulations have a significant influence on big data adoption. When the calculated p-value is below 0.05, it shows that the independent and dependent variables are related. The relationship could be positive or negative based on this result.

4.5.2 Competitor's actions have a statistically significant influence on the adoption of big data in the banking sector in South Africa

Table 4.15: Hypothesis 2 Regression and Coefficient of Determination

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std Error	Beta (β)	T Statistic	P-value
(Constant)	0.63	0.27	2.33	0.0117	0.021
x2	0.65	0.25	0.33	4.75	0.001

Source: Author

In this analysis, the p-value of 0.001 shows that the competitors' actions statistically significantly influence the adoption of big data in the South African banking sector. When the p-value is below 0.05, it represents a relationship

between the independent and dependent variables. This association could be negative or positive.

4.5.3 Customer demands have a statistically significant influence on the adoption of big data in the banking sector in South Africa

Table 4.16 Hypothesis 3 Regression and Coefficient of Determination

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std Error	Beta (β)	T Statistic	P-value
(Constant)	0.63	0.27	2.33	0.0117	0.021
x3	0.56	0.13	0.04	2.20	0.004

Source: Author

The analysis shows that customer demands influence big data adoption in banking. This is displayed by a p-value of 0.004, which, according to regression analysis, is below the standard required to indicate an association of a p-value of 0.05. Customer demands may be influencing big data adoption positively or negatively.

4.5.4 Big data training needs significantly influence the adoption of big data in the banking sector in South Africa

Table 4.17: Hypothesis 4 Regression and Coefficient of Determination

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std Error	Beta (β)	T Statistic	P-value
(Constant)	0.63	0.27	2.33	0.0117	0.021
x4	0.66	0.14	0.19	4.78	0.000

Source: Author

The study had a p-value of 0.0000 in analyzing a relationship between big data adoption and training needs in the banking sector. These results signify that big data training needs significantly influence big data adoption.

4.5.5 Costs associated with big data significantly influence the adoption of big data in South Africa's banking sector.

Table 4.18 Hypothesis 5 Regression and Coefficient of Determination

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std Error	Beta (β)	T	P-value

				Statistic	
(Constant)	0.63	0.27	2.33	0.0117	0.021
x5	0.55	0.12	0.11	2.13	0.003

Source: Author

The study's p-value is 0.003, below 0.05; this shows that the cost associated with big data adoption in the banking sector significantly influences big data adoption.

4.5.6 Organizational culture affects the adoption of big data in South Africa's banking sector.

Table 4.19: Hypothesis 6 Regression and Coefficient of Determination

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std Error	Beta (β)	T Statistic	P-value
(Constant)	0.63	0.27	2.33	0.0117	0.021
x6	0.65	0.23	0.25	3.45	0.015

Source: Author

Inquiring on the 6th hypothesis, the research attained a p-value of 0.015, which is below the threshold of 0.05. This value shows that organizational culture significantly influences big data adoption.

4.5.7 Security and privacy risks negatively influence the adoption of big data in the banking sector in South Africa

Table 4.20 Hypothesis 7 Regression and Coefficient of Determination

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std Error	Beta (β)	T Statistic	P-value
(Constant)	0.63	0.27	2.33	0.0117	0.021
x7	0.54	0.16	0.21	2.54	0.006

Source: Author 2023

A calculated p-value of 0.006 signifies that security concerns in the banking sector in South Africa significantly influence big data adoption.

4.5.8 Big data characteristics influence the adoption of big data in the banking sector in South Africa

Table 4.21: Hypothesis 8 Regression and Coefficient of Determination

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std Error	Beta (β)	T Statistic	P-value
(Constant)	0.63	0.27	2.33	0.0117	0.021
x8	0.55	0.18	0.13	2.56	0.015

Source: Author

A p-value of 0.015 is below 0.05. Therefore, it shows that the two variables have a significant relationship. The result indicates that the characteristics of big data in the banking sector in South Africa significantly influence big data adoption.

4.6 Hypothesis Summary

Table 4.21 Hypothesis Testing Summary

Hypothesis	β	t-Statistic	Significance	Decision to Accept or Reject
Government regulations have a statistically significant influence on the adoption of big data in South Africa's banking sector.	2.33	0.0117	0.021	Accepted

Competitor's actions have a statistically significant influence on the adoption of big data in the banking sector in South Africa.	0.28	2.23	0.004	Accepted
Customer demands have a statistically significant influence on the adoption of big data in the banking sector in South Africa.	0.33	4.75	0.001	Accepted
Big data training needs significantly influence the adoption of big data in the banking sector in South Africa.	0.04	2.20	0.004	Accepted
Costs associated with big data significantly influence the adoption of big data in the banking sector in South Africa.	0.19	4.78	0.000	Accepted
Organizational culture affects the adoption of big data in the banking sector in South Africa.	0.11	2.13	0.003	Accepted
Security and privacy risks negatively influence the adoption of big data in the banking sector in South Africa.	0.25	3.45	0.015	Accepted
Big data characteristics influence the adoption of big data in the banking sector in South Africa.	0.21	2.54	0.006	Accepted

Source: Author

The study sought to test eight hypotheses involving independent variables emanating from the TOE model and the sole dependent variable, big data adoption. All the tests performed produced a p-value less than 0.05, meaning the

eight factors significantly influence that big data. Therefore, all hypotheses are accepted and retained.

4.7 Summary of the Results

The study computed demographic and descriptive statistics. The study conducted a reliable test using the Cronbach Alpha and sample adequacy tests, concluding that the data collected was reliable. The study conducted a correlation analysis to establish a relationship between the study's variables. Regression analysis showed that the dependent variable, big data adoption, is either positively or negatively affected by the study's variables. The study conducted a hypothesis test, which showed enough evidence to accept all alternative hypotheses suggesting a relationship between the variables and big data adoption.

CHAPTER 5: DISCUSSION OF RESULTS OR FINDINGS

5.1 Introduction

This chapter compares findings from the existing literature on factors influencing big data adoptions. The chapter also discusses findings based on the TOE model. It ends by giving a summary of these findings to the South African banking sector.

5.2 Government regulations and adoption of big data

The study found that government regulations are influential in the adoption of big data in the banking sector in South Africa. This pattern aligns with Salleh and Janczewski's (2016) findings that TOE model factors uniformly influence big data adoption. However, this finding diverges from Skatie et al.'s (2020) findings in the Middle East, revealing that government regulations are limited in adopting big data in the manufacturing industry. Two explanations may account for this difference. One is that the South African business environment is less democratic. Moss (2022) corroborates this explanation through studies showing that the South African business environment is not as democratic as in developed nations. The other explanation may be that the banking sector needs to pay attention to security, hence many regulations, unlike the manufacturing sector used by Skatie et al. (2020).

The results are a testament to the impact of government regulations on data collection and how this affects big data adoption in the South African banking sector. The study also shows that the limitations on the type of data that South African banks and other banking organizations can collect affect the application of big data; hence its adoption rate is also affected. Big data can violate people's privacy, and the government needs to protect its citizens. Shambare (2017) observes that the financial sector needs to be well regulated, especially in the data it collects, to ensure that customers are always protected.

The results also align with the Protection of Personal Information Act (2013), which spells out that all data collected in the banking sector must be provided

voluntarily by customers. According to this Act, banks have limited access to cookies used for online data collection. This Act and the Government Gazette (2017) significantly reduce the data collection rate, which also affects the adoption of big data. The government's sheer control of data collection in South Africa hinders the adoption of big data. This corroborates Clark et al.'s (2022) findings that the more government regulations there are, the lower the big data adoption rates. Clark et al.'s (2022) study showed that in countries where the business environment is democratized, big data has been widely adopted in their banking sectors. Examples include the USA and Japan.

Indeed, the government's willingness to share data influences the adoption of big data in South Africa's banking sector. The study notes that the government reserves the right to choose which data to share with banks, primarily through the Reserve Bank. This circumstance restricts the volume of data banks receive and their ability to apply that data. This finding is consistent with the arguments advanced by Yoon and George (2013), who state that in a capitalist economy with little intervention from the government, businesses quickly adopt innovations to stay ahead of the competition and perform better. In stark contrast to the European context in which Yoon and George (2013) conducted a study, South Africa has various government restrictions in the form of ACTS and Gazettes, which are slowing down the rate at which big data is adopted and used by organizations in the banking sector.

The study found that big data adoption in the South African banking is slow because of excessive government regulations. This finding contrasts with other countries' findings because they have a laissez-faire business environment. In addition, this finding converges with other studies because of the nature of the banking sector, where security issues are high, hence the need for government regulations.

5.3 Competitor's actions and adoption of big data

In terms of TOE factors, the influence of competitors had a p-value less than the standard, demonstrating that it is the major external business environment factor influencing big data adoption in the banking sector in South Africa. This

converges with the findings by Musaigwa and Mutula (2022), who found that high levels of competition influence big data adoption in financial institutions to gain a competitive advantage.

According to Hitt et al. (2017), competition drives big data adoption, and the more competition, the high the big data adoption. According to Musaigwa and Mutula (2022), big data increases organizational competitiveness, improving financial and non-financial performance. It means that big data is a strategy to achieve a sustained competitive advantage, and where there is high competition, they are high levels of big data. In South Africa, where there are many banks and the war for customers is fierce, it makes sense that big data is helpful to gain a sustained competitive advantage. However, Nasrollahi et al. (2020) did not establish competitors as a significant factor influencing big data adoption. Instead, Nasrollahi et al.'s (2020) study focused on central banks with a monopoly that do not have to fight for customers. The current study focused on all companies in the banking sector in South Africa which do not have any monopoly. It is important for them to adopt big data to avoid perishing.

Findings show that competitors strongly influence big data adoption in the South African banking sector. This is so because the sector is highly competitive, and big data is instrumental in achieving a sustained competitive advantage. This finding diverges mostly from studies focusing on monopolistic organizations in their industries.

5.4 Customer demands and adoption of big data

This study established that customers influence the adoption rate of big data in the South African banking sector. This finding aligns with Galdon-Sanchez and Gil (2022) and Kshetri's (2014) finding that customer demands result in big data adoption. The availability of data supplied by customers increases the rate at which big data adoption occurs in industries and sectors, and the high technology usage rate of 68% in South Africa (Olufemi, 2018) supports this. This means that banks have information on the internet that they can tap into. An increase in internet usage influences financial institutions' adoption of Big Data. With more

and more internet users, the amount of data at the disposal of organizations in the banking sector has been steadily increasing.

Customers increased demand for internet services increases the supply of big data, thus influencing its adoption. The study concludes that the increase in internet usage in South Africa positively impacts big data adoption. The results are similar to the arguments made by Akande and Van Belle (2014) and Musaigwa and Mutula (2022). They observe that the increase in internet adoption positively impacts technology adoption. This study also agrees with Qolomany et al. (2019) that today's customers are changing. This finding is consistent with the TOE model, which shows that customers are critical in the adoption of technology. There are generations, such as millennials and Generation Z, who are potential bank clients (Lappenman et al., 2021). These internet generations lay the foundation for big data adoption in South Africa.

The study concludes by accepting the alternative hypothesis, which states that customer demands statistically significantly influence the adoption of big data in the South African banking sector.

5.5 Big data training needs and adoption of big data

The study found that big data training needs to influence the adoption of big data. This finding is in line with Chivasa and Hurasha (2014), who state that the central concern of organizations when it comes to big data adoption is the need to train employees. Based on the analysis, the study accepted the alternative hypothesis, stating that, statistically, big data training needs to impact big data adoption significantly. Akande and Van Belle (2014) affirm this finding, observing that South Africa has limited big data analytics skills, which is a setback in the rate at which firms adopt big data. Furthermore, this finding converges with Wu et al.'s (2022) findings, detecting shortages in digital skills worldwide and resulting in low big data adoption rates. However, in countries such as Canada and the USA, people have acquired digital skills and big data has been adopted rapidly (Clark et al., 2022).

These results rely on organizations understanding the implications of training and development on their finances. When new technology is adopted, employees need training, and in most cases, it is expensive, leading to financial concerns (Akande & Van Belle, 2014; Galdon-Sanchez & Gil, 2022; Salleh & Janczewski, n.d.; Thaha et al., *2022)*. There is a need for employee training using experienced associates and experts. Still, costs may be too high in monetary terms, and companies may decide not to adopt the technology.

5.6 Costs and adoption of big data

The study found that in the banking sector in South Africa, the costs of implementing big data platforms impact the adoption of big data. This corroborates Wu et al.'s (2022) submission that the characteristics of big data come with the need for high energy-consuming computers to process and analyze, memory needs and costs associated with servers and cooling systems. As Alatawi et al. (2012) summarized, the larger the costs of adopting big data, the less adoption there is.

In contrast, these findings diverge from Walker and Brown (2019), who established that organizations in financial services, especially those in fintech, would stop at nothing to adopt business-enhancing technologies regardless of the costs. Their study submits that as part of strategic planning and a strong business case, organizations are more willing and open to adopting innovation to compete with established companies. They suggest that these banks can afford to meet the minimum required conditions for entry (Salleh & Janczewski, 2016). This argument in the banking sector means micro-finance houses, insurance companies, and money transfer can invest their profits into adopting big data to compete with more established companies.

Furthermore, Chivasa and Hurasha (2021) also support this study as they submit that many organizations have limited spending capacity, limiting their ability to adopt expensive technology. They note the need for expensive hardware, cloud computing services, security services, data processing systems, and human capital training for efficient adoption. This aligns with the TOE model, which shows that new technologies may be costly. They also submit that firms have

stringent budgets, and their use of finance is highly regulated and aimed at growing the revenue sources instead of perfecting already working systems, a submission in tandem with this study.

In summary, the study established that costs associated with big data adoption arising from its characteristics affect its adoption in banking. The study accepted the alternative hypothesis, which states that costs related to big data significantly influence the adoption of big data in the banking sector in South Africa. Various studies came to the same conclusion. However, other authors state that organizations take a cost-and-benefit analysis route and invest in technology that promises better returns regardless of the cost.

5.7 Organizational culture and adoption of big data

The study established that organizational culture influences the adoption of big data. Away et al. (2011) concur when claiming that technology adoption comes with the need to conform to the requirements of the adopted technology, and these changes require organizations to be ready in terms of their culture.

Big data adoption represents a significant change in the organization. Culture is difficult to change since it emanates from the organization's core (Alatawi et al., 2012). Every organization has a culture built from its beliefs and the needs of investors. This makes them different from organization to organization, and this culture influences their perception of technology and innovation and influences big data adoption. The present study reflects this sentiment. The adoption of big data in the banking sector in South Africa is affected by the organization's vision, objectives, management support, the calibre of employees and organizational strategy. This finding is also in tandem with the TOE framework, showing that organizational cultural systems may hinder or facilitate technology adoption.

Based on these findings, the study concludes that organizational culture certainly affects big data adoption and accepts the hypothesis posed in the study.

5.8 Security and privacy risks and adoption of big data.

The study found that security and privacy influence the adoption of big data. This finding is supported by Kim and Kim (2021), who state that there are several serious challenges organizations must be mindful of when it comes to big data. The most common one is the issue of security. A study by Kshetri (2014) also corroborates these findings by documenting that in all industries, when organizations decide to embark on big data, their main objective is to provide a system with maximum security and privacy. These findings support what this study concluded, and the impact of security needs and guarantees has a critical influence on the final decisions in banking organizations.

Further, Salleh and Janczewski (2016) concur with these findings as they detected that security issues negatively influence big data adoption, and the outcomes have all consistently demonstrated a negative relationship between these two factors. Therefore, security is a significant issue that makes it easier to adopt big data upon addressing it. This is not unique to South Africa, as studies in Europe, America, and Asia also show that security can slow or quicken the rate of big data adoption. However, this finding diverges from the TOE framework as it overlooks security and privacy issues.

The present study concludes that the banking sector has sensitive information. Because of that value, a characteristic of big data, they must be concerned about data security and privacy. The analysis carried out in this study accepts the alternative hypothesis and concludes that security and privacy concerns relating to big data indeed affect big data adoption.

5.9 Big data characteristics and adoption of big data

This study found that big data characteristics influence the adoption of big data. This finding is similar to observations by Wu et al. (2022) that big data volumes influence its adoption. The more data there is, the more extensive the data will be, the more expensive it will be to refine the data, and the adoption rate will be slow. Further, Kshetri's (2014) position that if there are valuable data organizations tend to adopt big data analytics because there is a perception that the data will lead to profitability affirms this finding. Amiri and van Engelen (2022) also found that the characteristics of big data come with the need for high energy-

consuming computers to process and analyze, memory needs, costs associated with servers and cooling systems, data breach risks, and privacy issues. It also requires configurations of organizations in terms of capital expenditure, procedures, and skills development. In support of these arguments, the study found that big data processing and manipulation influence adoption in the banking sector. This aligns with the TOE framework, showing that costly characteristics usually accompany technology. The features of big data affect adoption by inflating costs associated with big data, and the configuration needs may change how an organization operates.

In conclusion, the study showed that the characteristics of big data affect its adoption in the banking sector. The impact can be negative or positive depending on the factor. Factors such as the value of the data encourage big data adoption because they bring potential to the organization. Other factors, such as volume, require capital investment, which may limit organizations' ability to adopt big data. The study, therefore, accepts the alternative hypothesis, which states that big data characteristics influence the adoption of big data in the banking sector in South Africa.

5.10 Conclusion

The study examined factors that influence the adoption of big data in the banking sector in South Africa. The study concludes that external factors such as government regulations, competitors, and customers influence the adoption rate of big data. Furthermore, the study concludes that internal factors such as big data training needs, organizational culture and costs associated with big data also influence the adoption of big data. The findings were corroborated mainly by empirical studies with divergences. This is accounted for by the differences between the countries and industries, as the banking sector in South Africa is unique.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter discusses and merges the research objectives with the research hypotheses findings. The chapter compares the research objectives and the hypotheses and determines if the study met the objectives. It further gives recommendations to different groups based on the study's findings. Lastly, the study recommends further studies arising from the questions raised.

6.2 External Factors Influencing Big Data Adoption.

The study established various factors influencing big data adoption: government intervention, competitor and customer actions. These external factors arise from the multiple aspects identified in the business environment of organizations operating in the banking sector in South Africa.

6.2.1 Government regulations and adoption of big data

The study found that the government controls data gathering through various acts and regulations. This led to the study hypothesizing that government regulations have a statistically significant effect on adopting big data in the banking sector. The study established that too many restrictions by the government, especially on data collection and handling, reduce the rate of adoption of big data. Findings show that numerous government regulations hinder and negatively influence the adoption of big data in the banking sector in South Africa.

6.2.2 Competitors and Adoption of big data

Another revelation made by the study in literature is that competitors play crucial roles in adopting big in banking organizations. This led to the study hypothesizing that competitor in South Africa impact big data adoption in the banking sector. The study found that competitors influence the adoption of big data in the banking sector. The banking sector has many institutions, which has led to high competition. This high competition leads to the adopting big data to gain a

sustained competitive advantage. The study met the objective by establishing that the competitors influence the adoption of big data in South Africa.

6.2.3 Customers and adoption of big data

In addition, the study found that customers' willingness to supply data affects organizations' ability to operate using big data since they are the major contributors to the much-needed data. The impact of customers on big data adoption is mostly because the newer generations (millennials and generation Z), who make up a significant clientele for banks, are dynamic and technology savvy. This has necessitated using big data to understand the dynamic customer. The study, therefore, concludes that customers are critical in the adoption of big data.

6.3 The influence of technology on big data adoption

The study's second objective was to uncover the impact of technology on the adoption of big data in the banking sector, and it found that technology heavily influences the adoption of big data.

6.3.1 Big data training needs and adoption of big data

The investigation established that big data training needs significantly influence the adoption of big data in the banking sector in South Africa, and costs associated with big data significantly impact the adoption of big data in the banking sector in South Africa.

6.3.2 Big data characteristics and adoption of big data

The study discovered that the characteristics of big data work as negative and positive factors simultaneously. The characteristics such as value provided by big data act as a positive factor for adopting big data, whereas other factors, such as big data volume and format, affect organizations in terms of cost and resources, thus becoming a negative factor for the technology's adoption.

6.3.3 Security and adoption of big data

The study also established that security is a significant concern regarding big data adoption. The fact that the banking sector deals with sensitive information heightened the significance of this factor. This is an important concern and has profound implications for big data adoption in the banking sector.

6.4 The Influence of Organizational factors on the adoption of big data

This objective sought to establish factors relating to financial service organizations and how they influence big data adoption. The study discovered that organizational factors are critical for big data adoption.

Organisational culture and adoption of big data

The study sought to understand the influence of organizational culture on the adoption of big data in the banking sector in South Africa. The study found that rigid culture hinders the adoption of big data, while open cultural systems encourage the adoption of big data.

6.5 Recommendations

The study discovered the usefulness of big data and how it can help multiple sectors and groups. Various recommendations came up during the study, which are made for the following groups:

6.5.1 Government

Big data has proven to be a game changer in the business world, and it is, therefore, necessary for the government to review some of its restrictions, especially on how long data gathered from customers can be kept. The government should be at the forefront of advocating for big data adoption to increase technology adoption and the development of digital skills. These efforts will assist the government in meeting some of its sustainable development goals, specifically those related to the development of digital skills and the adoption of

technology, as published by the United Nations. The government needs to reduce its regulations to encourage big data adoption, as the study noted that too many regulations result in low adoption of big data.

6.5.2 Banking sector

The characteristics of big data include value. From the study, big data is vital to various organizations. Organizations are encouraged to consider adopting big data to make their operations more efficient and effective. The study recommends that banks take time to educate their clients on the benefits of big data, change their culture and experiment more with technology so that they can fully benefit from the positive impact of big data. Banks are advised to invest more in big data and ignore the costs, as big data is instrumental in company profitability and survival. With growing competition, businesses need departments and personnel specializing in big data. Furthermore, the study found issues to do with limited big data skills. Organizations are encouraged to train their employees in digital and big data skills.

6.5.3 Academics

The study found that many areas relating to big data adoption and use in Africa need researching. The study highlighted various gaps and challenges posed by importing models such as the TOE into the African context. There is a need for further analysis of the applicability of big data and the models in the African context. The importance of security in adopting modern technology, such as big data, is evident and a core factor in the TOE model.

6.6 Possible limitations and challenges of the study

The study had the following limitations:

- Structured questionnaires might have limited the information respondents shared. There are likely other aspects they may have wanted to share that were not included in the questionnaire.

- Data was analyzed using PLS-SEM analysis which does not provide a global fit statistic for models. This means it does not include variables outside the study resulting in an incomplete picture of independent variables affecting big data adoption, thus giving a preliminary view.

- The scope and length of the research limited full exploration of the TOE framework.

6.7 Suggestions for further research

The study aimed to understand factors influencing big data adoption. However, there arose areas that require further research. For example, there may be a need for a follow-up study based on qualitative studies to seek further clarity on this quantitative study. Furthermore, there is a need to study the status of big data skills in the banking sector. In addition, investigating the impact of big data adoption on firm performance is critical. Other areas of research may be on in-house and external big data consultancy.

Table 4. Consistency table: research questions, propositions, data collection and data analysis

RQ #		State Research Question or Objective	Prop/hyp #	State Proposition or Hypothesis	Data collection detail	Data analysis method
1		To examine the influence of the external task environmental factors on the adoption of big data in the banking sector in South Africa			Questionnaire Likert statement A1, A2, A3, A4	Regression Analysis
1.1		How does government regulations influence big data adoption in the banking sector in South Africa?	1	Government regulations have a statistically significant influence on the adoption of big data in the banking sector in South Africa	Questionnaire Likert statement A3	Regression Analysis

RQ #		State Research Question or Objective	Prop/hyp #	State Proposition or Hypothesis	Data collection detail	Data analysis method
1.2		How does competitor's actions influence big data adoption in the banking sector in South Africa?	2	Competitor's actions have a statistically significant influence on the adoption of big data in the sector in South Africa	Questionnaire Likert statement A2	Regression Analysis
1.3		How does customer demands influence big data adoption in the banking sector in South Africa?	3	Customer demands have a statistically significant influence on the adoption of big data in the banking sector in South Africa	Questionnaire Likert statement A4	Regression Analysis
2		To investigate the influence of			Questionnaire Likert statement	Regression analysis

RQ #		State Research Question or Objective	Prop/hyp #	State Proposition or Hypothesis	Data collection detail	Data analysis method
		technology on the adoption of big data in the banking sector in South Africa.			B1, B2, B3, B4	
2.1		How do costs associated with big data influence big data adoption in the banking sector in South Africa?	5	Costs associated with big data have a significant influence on the adoption of big data in the banking sector in South Africa	Questionnaire Likert statement B1	Regression analysis
2.2		How do security and privacy risks influence big data adoption in the banking? sector in South Africa	6	Security and privacy risks negatively influence the adoption of big data in the banking sector in South Africa	Questionnaire Likert statement B2, B3	Regression analysis

RQ #		State Research Question or Objective	Prop/hyp #	State Proposition or Hypothesis	Data collection detail	Data analysis method
3		To analyse the influence of organisational factors on the adoption of big data by organizations in the financial service sector in South Africa			Questionnaire Likert statement B1, C1, C2, C3, C4, C5	Regression analysis
3.1		How do big data training costs influence big data adoption in the banking sector in South Africa?	4	Big data training needs have a significant influence on the adoption of big data in the banking sector in South Africa	Questionnaire Likert statement B1	Regression analysis
3.2		How does organisational learning curve influence big data adoption in the	7	Organisational learning curve influences the adoption of big data in	Questionnaire Likert statement C2, C3, C4, C5	Regression analysis

RQ #		State Research Question or Objective	Prop/hyp #	State Proposition or Hypothesis	Data collection detail	Data analysis method
		banking sector in South Africa?		the banking sector in South Africa		
3.3		How does organisational culture influence big data adoption in the banking sector in South Africa?	8	Organisational culture affects the adoption of big data in the banking sector in South Africa	Questionnaire Likert statement C1	Regression analysis

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APPENDIX A: THE PARTICIPANT INFORMATION SHEET

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Participant Information Sheet (PIS)

Dear Sir / Madam

My name is Upenyu Toma I am a masters student in Digital Business at the University of the Witwatersrand, Johannesburg. My supervisor is Dr Ndlovu and I am conducting a research study about Big Data Adoption. The study title is: The factors influencing the adoption of Big Data in the financial Services Sector in South Africa.

I am inviting you to answer a questionnaire. If you decide to take part, your participation in this research study will last about 20 minutes and it is online .

During the research activity, I will need to ask for some personal information about you, including age , gender and education level .

The survey will be treated with confidentiality and anonymous. When I share the findings of the research study, I will not include your name or any other information that could be used to identify you. Other researchers may use the data collected from this research study with your permission, but your name and any personal information will not be used or passed on.

You should participate in the research study because you want to volunteer. You are not required to participate. You can leave the study at any time. You are not required to respond to any questions if you do not wish to. If you choose to participate in the research study, you will not receive any direct benefits. If you choose not to join, you will not lose any services, benefits, or rights that you would normally have. It will not cost you anything to participate in the research study. You will not be compensated for your participation in this research study.

This research study will be documented in the form of a research report. The report will be available on the website of the university library. If you would like a summary of this report, I will gladly 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,
Upenyu Toma

Researcher:
Upenyu Toma:
2401373@students.wits.ac.za

Dr Chiedza Ndlovu
Tjedza.mathiya@gmail.com

APPENDIX B: PARTICIPANT AGREEMENT FORM

Good Day Sir/Madam

Your input and participation in this study will be invaluable in understanding the factors influencing big data adoption in various South African financial institutions. The data collected will be kept strictly confidential and used solely for research purposes.

To continue with survey, please read the following statements and indicate your agreement by clicking on the appropriate circle.

I have been assured that my identity participation in this study will be kept strictly confidential.

I understand that my participation in this study will be kept strictly confidential.

I understand that my participation in this study is entirely voluntary and that I may withdraw at any time.

By participating in this study, I acknowledge that any data collected will be used solely for research purposes.

☐ Yes, I agree to participate in this study and provide my consent as outlined above

☐ No, I do not agree to participate in this study.

APPENDIX C: INSTRUMENT

SECTION A: The influence of technology on the adoption of big data in the banking sector in South Africa.

Please rate the following in terms of how much you agree or disagree with each statement.

		Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree
A1	The costs of implementing big data platforms affect its adoption in the banking sector						
A2	Maintaining data privacy influences big data adoption in the banking sector						
A3	Organisational technology readiness in the banking sector affects the adoption of Big Data						
A4	Big Data volumes influences its adoption in the banking sector						
A5	The benefits of Big Data in the banking sector affect its adoption						
A6	Big Data Velocity (how quickly data is generated and how it moves) influences adoption.						
A7	Big Data Variability (the number of inconsistencies in the data) influences adoption						
A8	Big Data computing power requirements influence adoption						

		Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree
A9	Big Data energy consumption requirements influence its adoption						
A10	Big Data processing and manipulation influences its adoption						
A11	Security Concerns in big data influence adoption						
A12	Big Data value influences its adoption in the banking sector						

SECTION B: Organisational specific factors that influence the adoption of Big Data in the banking Sector in South Africa.

		Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree
B1	Organisational culture influences the adoption of Big Data in the banking sector						
B2	Training and development interventions in my organisation influence the adoption of Big Data						
B3	Organisational Technology readiness affect the adoption of Big Data						
B4	Financial resources / budgets influence the adoption of Big Data adoption in the banking sector						
B5	The size of the organisation influences the rate of big data adoption						

		Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree
B6	Organisational Strategy influences big data adoption						
B7	Big Data adoption is influenced by the calibre of employees						
B8	Top management support affects big data adoption						
B9	Employee buy-in affects big adoption						
B10	Organisation's objectives influence big data adoption in the banking sector						
B11	The organisation's vision affects big data adoption						

SECTION C: The influence of external environmental factors on the adoption of big Data in the banking sector in South Africa.

		Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree
C1	Customers preferences influence the adoption of Big Data						
C2	Actions of other financial institutions influence your decision to adopt Big Data						
C3	Customers willingness to share their personal information with financial institutions influences Big Data adoption						
C4	Suppliers willingness to share information with the financial institutions						

	influence Big Data adoption						
C5	High competition levels influence Big Data adoption by financial institutions to gain competitive advantage						
C6	Access to external data storage facilities influences the adoption of Big Data in the banking sector						
C7	An increase in internet usage influence the adoption of Big Data by financial institutions						
C8	Global business trends influence the adoption of Big Data by financial institutions in South Africa						
C9	Government willingness to share data influences the adoption of Big Data in the banking sector in South Africa						
C10	Global business trends influence the adoption of Big Data by financial institutions in South Africa						
C11	Government polices influence the adoption of Big Data in the banking sector in South Africa						
C12	Government regulations on data collection affect big data adoption in the banking sector in South Africa						

SECTION D: CHARACTERISTICS OF RESPONDENTS

D1. Gender ☐ Female   Male

D2. Age ☐ Below 20 years ☐ 20-30 years ☐ 31-40 years

☐ 41-50 years ☐ 51-60 years ☐ 61 + years

D3. Work Experience ☐ 5 years and below ☐ 6-10 years ☐ 11-15 years ☐ 16-20 years ☐ +21 years

D4. Which institution category do you fall under?

☐ I work for one these financial institutions FNB, NEDBANK, CAPITEC or Discovery Bank.

☐ I work for a financial institution not listed above.

☐ I prefer not to mention.

D5. Which job category do you fall under?

☐ Junior staff

☐ Junior Manager

☐ Middle Manager

☐ Senior Manager

☐ Executive

We thank you for your time spent taking this survey. Your response has been recorded.

APPENDIX D: VARIOUS ANALYSIS TABLES AND CHARTS

Table 4.10 Correlation Analysis

		Big Data Adoption	H1	H2	H3	H4	H5	H6	H7	H8
Big data adoption	Pearson Correlation	1	-0.756	0.536	0.95	0.614	-0.542	0.784	-0.541	-0.845
	Sig. (2-tailed)		0.000	0.00	0.280	0.000	0.000	0.354	0.124	0.200
	N	173	173	173	173	173	173	173	173	173

Table 4.21 Hypothesis Testing Summary

Hypothesis	β	t-Statistic	Significance	Decision to Accept or Reject
Government regulations have a statistically significant influence on the adoption of big data in the banking sector in South Africa	2.33	0.0117	0.021	Accepted
Competitor's actions have a statistically significant influence on the adoption of big data in the banking sector in South Africa	0.28	2.23	0.004	Accepted

Customer demands have a statistically significant influence on the adoption of big data in the banking sector in South Africa	0.33	4.75	0.001	Accepted
Big data training needs significantly influence the adoption of big data in the banking sector in South Africa	0.04	2.20	0.004	Accepted
Costs associated with big data significantly influence the adoption of big data in the banking sector in South Africa.	0.19	4.78	0.000	Accepted
Organisational culture affects the adoption of big data in the banking sector in South Africa.	0.11	2.13	0.003	Accepted
Security and privacy risks negatively influence the adoption of big data in the banking sector in South Africa	0.25	3.45	0.015	Accepted
Big data characteristics influence the adoption of big data in the banking sector in South Africa	0.21	2.54	0.006	Accepted

APPENDIX E: YOUR ETHICS APPROVAL NOTIFICATION

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/DB2401373/112
This certificate is only valid with a legitimate ethics protocol number and signed by the Researcher (below).

Project title	The factors affecting the adoption of big data in the financial services sector in South Africa
Investigator / Researcher	Ms Upenyu Toma
Nature of Project	MM (Digital Business)
Decision of the Committee	Approved, provided stakeholders and participants are guaranteed anonymity and confidentiality.
Issue Date of Certificate	2023-01-24
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 Ethics Committee.

I fully understand the conditions under which I am authorized to carry out the abovementioned research and I 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.

	24 January 2023
Signature	Date: