Explaining the Big Data adoption decision in Small and Medium-Sized Enterprises: Cape Town case studies

Masters Dissertation

By

Lonwabo Matross
MTRLON001

Research Supervisor: Lisa Seymour
Lisa.Seymour@uct.ac.za

Department of Information Systems Faculty
University of Cape Town

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ABSTRACT

Problem Statement: Small and Medium-Sized Enterprises (SMEs) play an integral role in the economy of developed and developing countries. SMEs are constantly searching for innovative technologies that will not only reduce their overhead costs but also improve product development, customer relations and profitability. Literature has revealed that some SMEs around the world have incorporated a fairly new technology called Big Data to achieve higher levels of operational efficiency. Therefore, it is interesting to observe the reasons why some organizations in developing countries such as South Africa are not adopting this technology as compared to other developed countries. A large portion of the available literature revealed that there isa general lack of in-depth information and understanding of Big Data amongst SMEs in developing countries such as South Africa.

The main objective of this study is to explain the factors that SMEs consider during the Big Data decision process.

Purpose of the study: This research study aimed to identify the factors that South African SMEs consider as important in their decision-making process when it comes to the adoption of Big Data. The researcher used the conceptual framework proposed by Frambach and Schillewaert to derive an updated and adapted conceptual framework that explained the factors that SMEs consider when adopting Big Data.

Research methodology: SMEs located in the Western Province of South Africa were chosen as the case studies. The interpretive research philosophy formed the basis of this research. Additionally, the nature of the phenomenon being investigated deemed it appropriate that the qualitative research method and research design be applied to this thesis. Due to constraints such as limited time and financial resources this was a cross-sectional study. The research strategy in this study was multiple in-depth case studies. The qualitative approach was deemed appropriate for this study. The researcher used two methods to collect data, namely, the primary research method and the secondary research method. The primary

research method enabled the researcher to obtain rich data that could assist in answering the primary research questions, whilst the secondary research method included documents which supplemented the primary data collected. Data was analyzed using the NVivo software provided by the University of Cape Town.

Key Findings: The findings suggest that the process that influences the decision to adopt Big Data by SMEs follows a three-step approach namely: 1.) Awareness, 2.) Consideration, 3.) Intention. This indicates that for Big Data to be adopted by SMEs there must be organizational readiness to go through the process. This study identified the main intention for SMEs to adopt Big Data is to ensure operational stability. Improved operational efficiency was identified as the supporting sub-theme. This study has raised awareness about the process that SMEs, academic researchers, IT practitioners and government need to place emphasis on to improve the adoption of Big Data by SMEs. Furthermore, this study has raised awareness about the opportunities and challenges that SMEs, academic researchers, IT practitioners and government need to place emphasis on to improve the adoption of Big Data by SMEs.

Value of the study: The study adds value in both academia and the business industry as it provides more insight into the factors that SMEs consider in the Big Data adoption decision.

Key Words: Big Data, Big Data technologies, Innovation adoption, SMEs, Decision-making process, Operational efficiency

ACKNOWLEDGEMENTS

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Chapter 1: Introduction

1.1 Background to the study

Over the past 10 years, there has been a revolutionary change in the way data is produced and consumed, emanating from the substantial increase in data sources through the progressive development of computing devices used in virtually all aspects of human life (Almerares et al., 2014). Consequently, a greater volume of data has been produced over the past two years than in the entire history of recorded human existence (Jee & Kim, 2013; Shaw, 2014). Some characteristics of this newly generated data create challenges such as volume, velocity, and variety. According to Oliver and Vayre(2015), these three challenges (volume, velocity, and variety) are related to Big Data. Therefore, if organizations aim to achieve significant improvements in their product development, customer relations and ultimately profitability through the use of Big Data it isimperative that they should address the three challenges (Oliver & Vayre, 2015).

A report produced by Gartner (2015) on the worldwide adoption of Big Data, revealed that Big Data projects are being launched by a growing number of organizations in various industries, such as, manufacturing, insurance, pharmaceuticals, and retailing. On the other hand, a study produced by Malaka and Brown (2015) indicates that South African Small and Medium-Sized Enterprises (SMEs) are lagging in the adoption of Big Data.

Big Data can play an important role in SMEs by significantly increasing their competitive advantage (Makhele, 2018). For instance, Kessel (2014) stated that, Big Data can offer SMEs real-time analysis data analysis, which can improve their business decision-making processes. Furthermore, Big Data has the potential to give any organization (including SMEs) a competitive advantage through innovation and growth in future profit margins (Rising, Kristensen & Hansen 2014). Additionally, Big Data can transform an SMEs entire value chain through the digitization of customers, suppliers and other business partners, which can ultimately increase their efficiency and profitability (Brown, Manyika & Chui 2012).

In this study the main objective is to explain the factors that SMEs consider during the Big Data decision process. SMEs are selected as case studies based on the two reasons provided by Sen, Ozturk, and Vayvay (2016): a) a slight change in SMEs can result in significant macro level impact due to their value to the economy; b) They have the agility for quicker adaption to changes in the market towards efficiency.

1.2 Problem Statement

A survey of the literature revealed that there is a general lack of in-depth information and understanding of Big Data amongst SMEs in developing countries such as South Africa. According to Singh and El-Kassar (2019), this has led to the low Big Data adoption rate.

SMEs contribute to the development and sustainability of the South African economy by contributing more than 50 percent to the Gross Domestic Product (Maloka, 2015). Given the importance of SMEs to the national economy it is essential tounderstand the factors that have led to the low adoption of Big Data in Cape Town (South Africa).

1.3 Purpose of the study

The researcher aims to understand and explain the factors that SMEs deem to be important in their decision-making process when it comes to the adoption of Big Data. By being able to explain the factors that organizations consider when adopting Big Data, the researcher will be able to propose new constructs that can be added to the conceptual framework by Frambach and Schillewaert (2002) that has been used in this study. Therefore, for thisreason this will be an explanatory study.

An explanatory case study involves an in-depth examination of data to explain the phenomenon being observed by the researcher (Yin, 2012). Walsham (1995, pp.4-5) stated that interpretive methods of research are “aimed at producing an understanding of the context of information system, and the process whereby the information system influences and is influenced by the context”. This approach was chosen by the researcher as it will assist

in gaining an improved understanding of the decision process followed by SMEs when it comes to Big Data adoption.

The objectives of this study are summarized as follows:

- To investigate the factors that contribute to the Big Data adoption-decision amongst SMEs in Cape Town.
- To produce an updated conceptual framework that explains the process followed by SMEs in the Big Data adoption decision-making process.

1.4 The research questions

The study contains explanatory research questions to gain as much information from the interviewees during the research process.

Main Question: How do SMEs decide to adopt Big Data?

Sub-questions:

1. What factors do SME managers consider when deciding to adopt Big Data?
2. What is the process followed by SMEs when deciding to adopt Big Data?
3. What can be done to improve the Big Data adoption decision for SMEs?

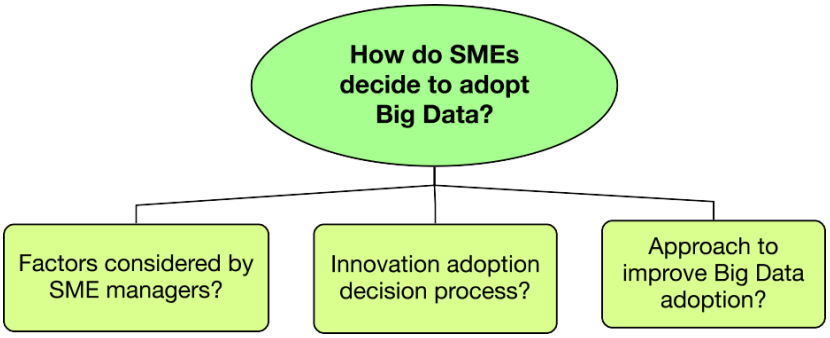


Figure 1: Research questions summary

In Figure 1, the research questions are visually illustrated to demonstrate the main question and the sub-questions. This illustration is important as it demonstrate the key areas that the researcher focused on throughout this research study.

The existing literature on Big Data adoption was surveyed to establish the key factors that SMEs consider when making the decision to adopt Big Data. It should be noted that limited published research has been found on the South African context. Therefore, this study was significantly informed by international research articles. This is important to consider since there may be cultural, socio-economic, and political dynamics found in international organizations which contribute to the decision to adopt Big Data by SMEs which might not be directly applicable to the South African context.

1.5 Summary

This chapter provided the background to the study. The researcher outlined the importance of Big Data and its potential benefit to adopters such as SMEs. This was done by presenting the problem statement, the purpose of the study, the research questions, the conceptual framework, and conceptual definitions used during this research. Subsequent Chapter 1, the researcher reviewed literature in Chapter 2, which produced the theoretical framework used in this study. In Chapter 3, the research methodology was defined, with emphasis placed on the issues such as the reliability and validity of the study. In Chapter 4, the empirical findings and discussion of the research were presented. Lastly, Chapter 5 providedan overview of the research findings, Summary of answers to the research questions, contribution and recommendations, and limitation of the study and future work.

Chapter 2: Literature Review

This chapter details the outcomes of the literature review performed by the researcher. The following section discusses the themes found in the research topic through the use of supporting literature.

2.1 Big Data

Big Data has gained prominence across various sectors of the global economy due to its unique ability to provide new insights for improved decision-making processes. Most organizations view Big Data as a platform to improve operational efficiency and gain a competitive advantage (Sivarajah, Kamal, Irani & Weerakkody, 2017). Gartner, Inc. provided a concise definition which states that "Big Data is high-volume, velocity and variety of information assets that demand cost-effective, innovative forms of information processing for enhanced insight and decision making." (Gartner IT Glossary, 2015,p1.). In layman's terms this means that BigData is not just found in relational databases such as, Structured Query Language (SQL), but also in unstructured formats such as, e-mail, online traffic, sensors, files, mobile devices,and social media (Gao et al., 2015).

There are numerous applications and tools such as Big Data Analytics and Big Data Capabilities found in literature which form a broad definition of Big Data (Mikalef et al., 2017). For the purpose of this research, we will refer to these tools and applications as Big Data.

A significant proportion of literature tends to focus specifically on the "three Vs" which characterise Big Data, namely: Volume, Velocity & Variety (Malaka & Brown, 2015). However, several scholars have further expanded the characteristics of Big Data to broaden the term. These are: value, variability, veracity & visualization (Mikalef, Pappas, Krogstie & Giannakos, 2017). Due to the consensus amongst scholars that the "three Vs" are at the core of the definition of Big Data, this research study will focus significantly on these characteristics.

Big Data can therefore be defined using the characteristics identified by organizations in decision making processes (Malaka & Brown, 2015). In the following section these characteristics are briefly discussed.

2.2 Characteristics of Big Data

Figure 2 depicts the three characteristics of Big Data (Dridi, Sassi & Tissaoui 2015).

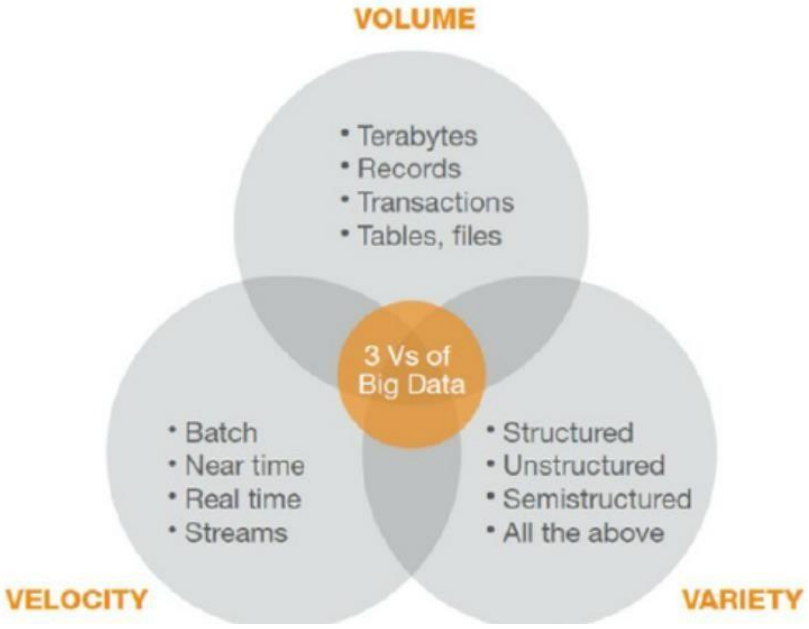


Figure 2: 3 V's of Big Data (Dridi, Sassi & Tissaoui 2015).

2.2.1 Volume

Big Data refers to high volumes of data (Gartner, 2013). Most traditional data storage units come in Gigabytes and Terabytes. However, it is predicted that the total amount of data collectively generated daily by organizations in the United States of America is in the region of Exabytes (that is approximately a billion times more than Gigabytes). The use of Hadoop Distributed File System (HDFS) has been proposed to technologically address the volume challenge (Storey & Song, 2017). According to Moorthy, Baby, and Senthamaraiselvi (2014), Hadoop is defined as a "framework that provides open-source libraries for distributed computing using MapReduce software and its own distributed file system, simply known as the Hadoop Distributed File System (HDFS)". The main value propositions of Hadoop are that it was created to run on personal computers, and it is a fault-tolerant data storage system (Moorthy et al., 2014).

2.2.2 Variety

Big Data is data that comes in multiple formats, such that it can be structured, semi-structured and unstructured (Sahin, 2006). These formats include videos, audio, documents, images, and log files (Oussous, Benjelloun, Lahcen & Belfkih, 2018). The use of software solutions has been identified as a method to address the variety challenge as software can integrate heterogeneous data (Storey & Song, 2017). Figure 3 summarizes these different formats.

	Structured	Unstructured	Semi-structured
Definition	Data that can be grouped into a relational table, i.e. rows and columns within a relational database	Data with no specific structure and are in formats that cannot easily be indexed into a relational table	Data that, unlike unstructured data, contain some implicit structures but not enough as in structured data
Example	• Customer Relationship Management (CRM) system • Payroll data • Inventory data	• Emails • Video • Website content • Health records • Sensor data • Satellite images	• Web logs, e.g. IP address, request time, page requested • Social-media feeds, e.g. hashtag • Resumes, e.g. education, work experience

Figure 3: Big Data formats (Loshin, 2013)

2.2.3 Velocity

Big Data refers to data generated at fast speeds, therefore technologies that are capable of capturing, storing, processing and analyzing them in an efficient and effective manner are needed (Wamba & Akter, 2015).

The challenge with traditional data is that data is captured in pre-determined intervals; therefore, there are time gaps between input and output. On the other hand, Big Data technology can process high-velocity data at faster speeds for improved decision making (Sivarajah et al., 2017). According to Oussous et al., (2018), the best way to deal with the

velocity challenge is to use a semi-technology solution, whereby the real-time processing of data is done through a software solution.

2.3 Benefits of Big Data

Big Data provide several benefits which can directly improve the functioning of an organization such as an SME (Hammer, Kostroch & Quiros, 2017). For instance, an organization using Big Data applications and tools may be able to generate insights to produce business value, such as unique customer experience, market enhancement and product and service innovation. Furthermore, business value can be derived through the use of Big Data to gain insights into the organization performance, which can improve decision making, increase return on assets and create a dynamic organizational structure to efficiently respond to environmental and market changes (Grover, Chiang, Liang & Zhang, 2018).

There are two Big Data benefits that are commonly referenced in literature, namely: (1) cost savings and (2) competitive advantage (Patel, Singh, Nunley & Minhas, 2016). Cost savings and profit maximization remain as key priorities for most business organizations especially SMEs (Hammer et al., 2017).

The literature survey performed in this study revealed that there are several more benefits that can be derived through the use of Big Data. For instance, Almedia (2017) mentioned that Big Data benefits can be grouped into three categories, namely: (1) technology benefits, (2) financial benefits, and (3) Competitive Advantage. Each of these categories have sub-categories of benefits that fall under the three main categories. The benefits of adopting Big Data are depicted in Figure 4 (Almeida, 2017).

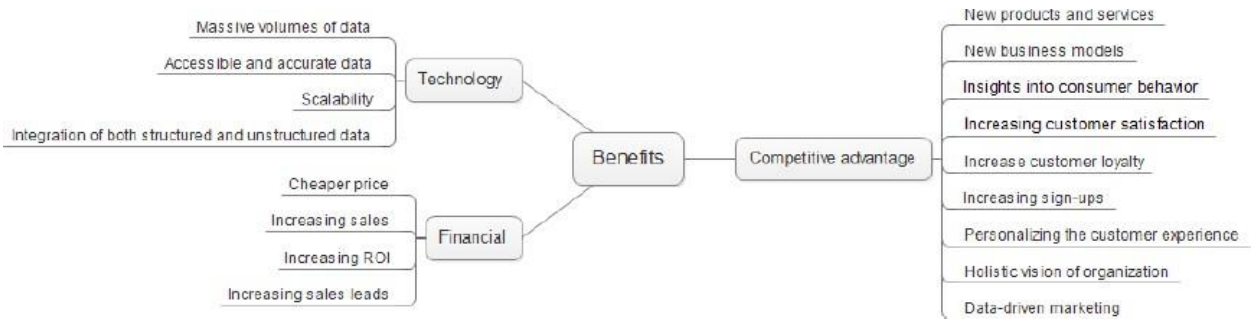


Figure 4: Big Data mind map grouping of benefits (Almeida, 2017)

2.3.1 Technology benefits

The technological benefits result from the processing of high volumes of data, integrating structured and unstructured data, and accessible and accurate data (Almeida, 2017). Interestingly, one of the key characteristics of Big Data is to handle high volumes of structured and unstructured data. Furthermore, the processing of high-volume data has resulted in the evolution of data storage systems, and this has led to high performance, scalability solutions, and high efficiency.

2.3.2 Financial benefits

The use of Big Data provides several financial benefits to adopters. According to Almeida (2017), organizations can process more data due to the availability of high volume of data storage space at affordable rates. As a result, they will earn more gross revenue, return on investment, and sales leads.

2.3.3 Competitive advantage

In many instances an organization with a competitive advantage can attract more customers and ultimately generate more revenue. Big Data can provide competitive advantages such as the creation of agile business models, innovative products and services, knowledge about consumer behavior, and data for better decision-making (Almeida, 2017).

2.4 Big Data Challenges

The extraction of Big Data provides several exciting opportunities for many organizations

(Oussous et al., 2018).

However, researchers have identified that there are several challenges when extracting data. For instance, there are challenges with the decision-making on what type of data collected (Crawford, 2013). Furthermore, there are challenges related to the issue of privacy and ethical consideration when mining data (Boyd & Crawford, 2012). Furthermore, highly skilled human analysis is required to sort through the data in order to generate valuable insights (Sivarajah, Kamal, Irani & Weerakkody 2017).

Some of the Big Data challenges found in literature are summarized in Figure 5. These challenges include Big Data management, Big Data cleaning, and Big Data aggregation. Below is a brief description of these challenges.

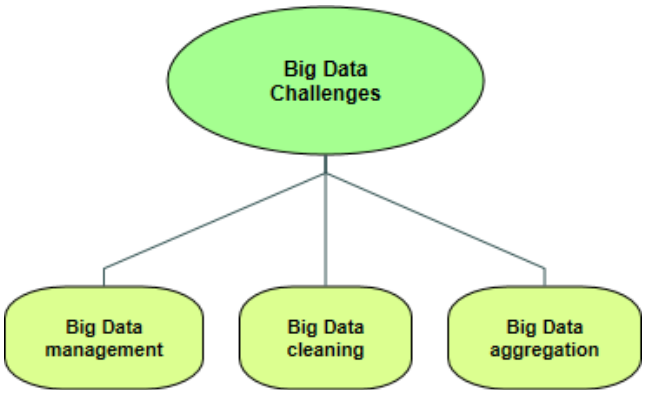


Figure 5: Big Data mind map grouping of challenges (Oussous et al., 2018; Chen et al., 2014; Khan et al., 2014)

2.4.1 Big Data management

The biggest challenge many data scientists face when working with Big Data is how to gather, integrate and store large data sets produced from multiple sources (Chen, Liu & Mao, 2014). It is important for organizations to adequately manage Big Data to be able to facilitate the mining of reliable insight and reduce operational costs (Chen et al., 2014). Furthermore, a good data management system results in clean reliable data, simpler aggregation of data, and simpler data encoding for security and privacy (Oussous et al., 2018). The ultimate objective of Big Data is to produce reliable data that is efficiently stored,easily accessible, and provides

meaningful insights (Oussous et al., 2018).

2.4.2 Big Data cleaning

Data sources that produce Big Data contain fragmented and erroneous data (Khan et al., 2014). As a result, data scientists are faced with the challenge of effectively managing the complexity of Big Data characteristics (velocity, volume, and variety) and the elimination of noises produced by the variable data sources (Khan et al., 2014). Furthermore, the other challenge is selecting the most cost-effective way to clean the huge data sets (Oussous et al., 2018).

2.4.3 Big Data aggregation

The aggregation of big data can be described as the ability to synchronize external data sources (e.g., as mobile phones, laptops, and radio signals) and distributed Big Data platforms with the organization's internal systems and infrastructure (Chen et al., 2014). According to Chen et al., (2014), analyzing the data produced by the organization often isnot sufficient. It is crucial that the internal data is aggregated with external data sources (Chen et al., 2014). The external data comes in many forms such as stock market data, third-party sources, traffic movement data, social network generated data, customer blogging comments and supplier pricing changes (Oussous et al., 2018).

2.5 Big Data Capabilities

As previously mentioned earlier in the chapter, Big Data Analytics is a sub-component of Big Data, which is defined as the ability of an organization to provide insights using infrastructure, data management, and specialized skills to transform a business into a competitive force (Akter et al., 2016).

Although there is limited published research on Big Data Analytics capability, some research studies tend to focus on the resources required to produce such capability. These resources are divided into three main categories: tangible resources, intangible resources & human skills

and knowledge (Mikalef, Pappas, Krogstie & Giannakos 2018).

There are several Big Data capabilities available that are suitable for large corporate organizations and SMEs. For instance, there are five popular Big Data capabilities which have been adopted by numerous business organizations across the globe. These include storage capability, database capability, processing capability, data integration capability, and statistical analysis capability (Bhadani & Jothimani, 2016).

2.6 Big Data Technologies

In this section we briefly discuss the technological migration from relational databases to non-relational (NoSQL) data storage technologies. The researcher will focus on the importance of Big Data and the three popular big data technologies that use NoSQL data storage solutions.

Over the course of the past decades, relational databases have been recommended as the best technology to perform data management functions on structured data (Deagustini, Dalibón, Gottifredi, Falappa, Chesñevar & Simari, 2013). Unfortunately, relational databases have not evolved fast enough to deal with the challenges presented by Big Data (Kaisler, Armour, Espinosa & Money, 2013). The nature of Big Data and emerging technologies is that it is captured from various portable devices which present challenges such as real-time processing and data integration (Kambatla, Kollias, Kumar & Grama, 2014). The support for the complex data structures has proven to be not satisfactory when using relational databases (Kaisler et al., 2013).

To overcome the inefficiencies of relational databases, researchers have proposed the use of NoSQL (not only SQL) databases as enterprise solutions (Siddiqa, Karim & Gani, 2017). NoSQL was designed to support non-relational data sources (Storey & Song, 2017). One of the most important benefits of using NoSQL databases is that unlike relational databases they are horizontally scalable, easier to integrate, and are relatively inexpensive data storage solutions (Yaqoob et al., 2017). Therefore, NoSQL databases have emerged as the mostly adopted technologies for the storage of Big Data.

Researchers have identified three popular Big Data technologies that use NoSQL data storage solutions. It is important to note that because there are new technologies introduced to the market every day, there is no standard list of technologies that work with Big Data (Khan et al., 2014). However, there are frequently used technologies that work with Big Data such as MapReduce, Hadoop, and Big Table which offer opportunities for efficient and cost-effective methods of processing large volumes of data in real-time (Khanet al., 2014).

MapReduce is a framework that contains a programming model (Lydia & Swarup, 2015). Data Scientists describe it as a programming paradigm that involves the processing of objects across various nodes (Moorthy et al., 2014). It is regarded as one of the first important steps for the development of new Big Data management tools (Khan et al., 2014). One ofthe benefits of using MapReduce is that it simplifies the complex processing of large volumes of data through its low-cost mechanisms (Oussous et al., 2018). The processing of data in a MapReduce framework is graphically illustrated in Figure 6.

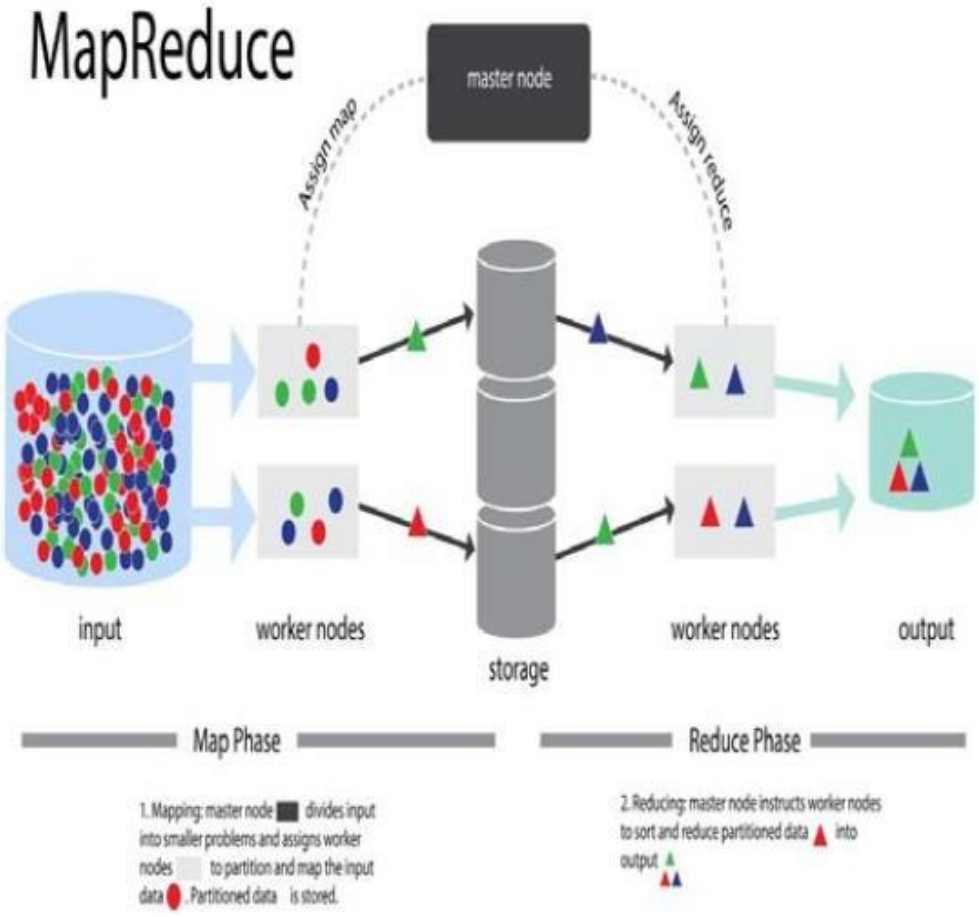


Figure 6: Illustration of MapReduce (Oussous et al., 2018)

Hadoop is a framework which includes open-source libraries that are used for distributed computing through MapReduce software (Moorthy et al., 2014). One of the benefits of using Hadoop is its ability to simultaneously process large volumes of data sets, due to its built-in distributed file system (Oussous et al., 2018). The processing of data in a Hadoop Distributed File Storage (HDFS) system is graphically illustrated in Figure 7.

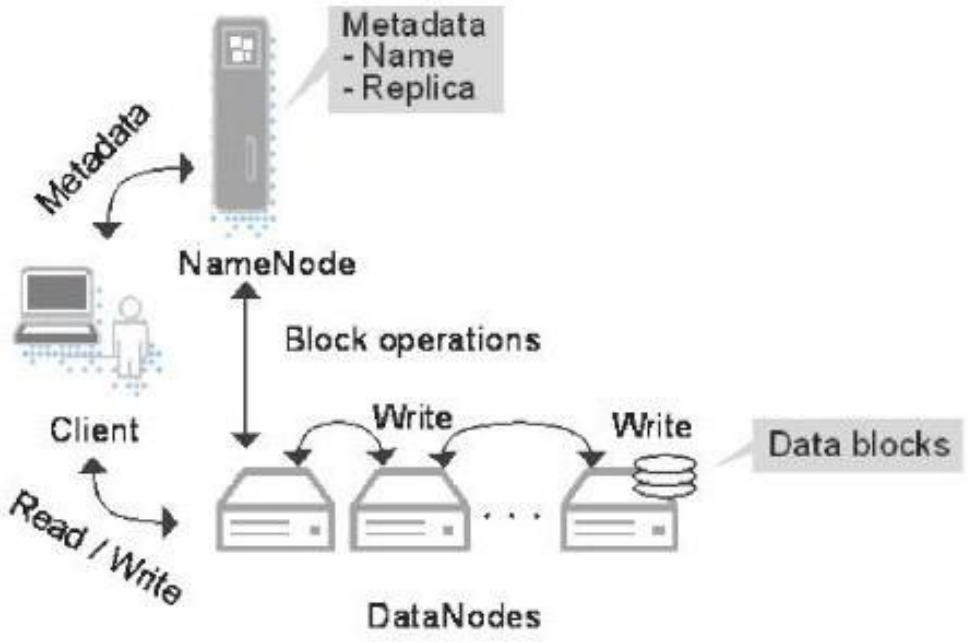


Figure 7: Hadoop Distributed File Storage (HDFS) system (Borthakur, 2005)

BigTable is a framework that was created by Google Inc. as a solution to the increasing need of an agile and cost-efficient storage for large-scale data placed in multiple commodity servers (Chang et al., 2008). A great benefit of BigTable is that it is very adaptable, reliable, and scalable storage system to manage data at a petabyte level across thousands of computers (Yaqoob et al., 2017). The architecture layout in a BigTable framework is graphically illustrated in Figure 8.

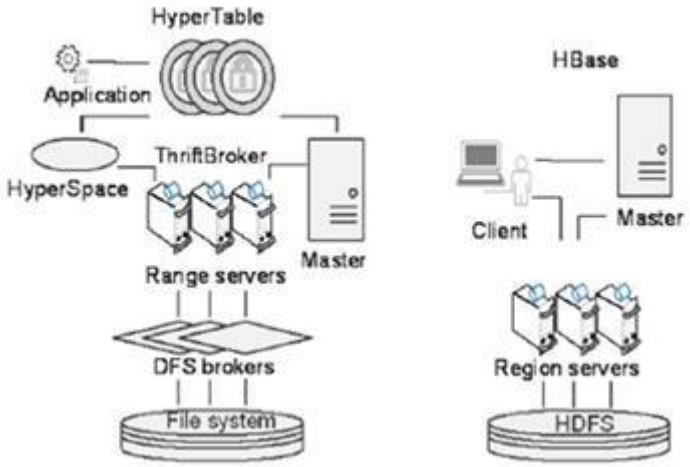


Figure 8: A BigTable framework (George, 2011)

Organizations that are seeking to adopt cost-efficient Big Data technology have the option to choose MapReduce, Hadoop, or BigTable. Research shows that these technologies simplify the processing of complex data and offer reliable storage systems to manage Big Data.

2.7 Small and Medium-Sized Enterprises

SMEs perform an integral role in an economy. They contribute to economic growth, establishment of new markets, and unemployment reduction (Small Enterprise Development Agency, 2016). Furthermore, a stable SME sector contributes significantly to the economy through generating higher production volumes, improving exports, and developing new products (Mahembe, 2011). Although, SMEs can be found in both developing and developed countries there is no single standard definition that can be applied to all (Storey, 2016).

In South Africa, an SME is defined as “any separate business entity, including co-operative enterprises and non-governmental organizations, managed by one owner or more and is predominantly carried on in any sector or subsector of the economy which can be defined as “a micro-, a very small, a small or a medium enterprise depending on the number of employees, total annual turnover, and total gross asset value” (National Small Business Act, 1996). According to Small Enterprise Development Agency (2019), in the first quarter of 2019, the total number of SMEs increased by 4.4%. As a result, SMEs have become an alternative source of employment for citizens seeking a job. Table 1 demonstrates the total number of SMEs.

Table 1: Number of SMEs (Million).

Indicator	2018Q1		2018Q4		2019Q1		Quarterly change		Yearly change	
	Number	Distrib.	Number	Distrib.	Number	Distrib.	Number	%	Number	%
Employer	843 253	5.1%	924 351	5.5%	872 711	5.3%	-51 640	-5.6%	29 457	3.5%
Own account worker	1 599 910	9.6%	1 633 411	9.8%	1 677 829	10.2%	44 418	2.7%	77 919	4.9%
SMME owners	**2 443 163**	**14.7%**	**2 557 762**	**15.3%**	**2 550 540**	**15.4%**	-7 222	**-0.3%**	107 377	**4.4%**
Working for someone	14 066 897	84.8%	14 102 663	84.2%	13 853 471	83.9%	-249 192	-1.8%	-213 425	-1.5%
Helping in household business	69 954	0.4%	88 994	0.5%	109 030	0.7%	20 036	22.5%	39 076	55.9%
Total employed	**16 580 013**	**100.0%**	**16 749 419**	**100.0%**	**16 513 041**	**100.0%**	**-236 378**	**-1.4%**	**-66 972**	**-0.4%**

During the first quarter of 2019, employment in the SMME sector of South Africa stood at 10.8 million, this amounts to 66% of all employment in the country (Small Enterprise Development Agency, 2019). A small portion of these jobs, 2.55 million belonged to SMME owners, whilst the majority of 8.3 million jobs fell to the employees. The total job creation by SMEs amounted to 22% increasefrom 2018 as can be seen in Table 2.

Table 2: Employment provided by SMEs

	2018Q1		2018Q4		2019Q1		Quarterly change		Yearly change	
	Number	Distrib.	Number	Distrib.	Number	Distrib.	Number	%	Number	%
Formal sector	4 972 307	56.0%	6 429 404	60.7%	6 631 459	61.2%	202 055	3.1%	1 659 152	33.4%
Informal sector	1 053 129	11.9%	883 026	8.3%	1 115 405	10.3%	232 379	26.3%	62 277	5.9%
Agriculture	417 417	4.7%	727 178	6.9%	537 157	5.0%	-190 021	-26.1%	119 740	28.7%
Private households	0	0.0%	0	0.0%	5 258	0.0%	5 258	n/a	5 258	n/a
Provided to others	**6 442 852**	**72.5%**	**8 039 609**	**75.9%**	**8 289 280**	**76.5%**	**249 671**	**3.1%**	**1 846 427**	**28.7%**
% Female*		37.7%		37.8%		38.0%		0.1% pts		0.3% pts
Employer	843 253	9.5%	924 351	8.7%	872 711	8.1%	-51 640	-5.6%	29 457	3.5%
Own account worker	1 599 910	18.0%	1 633 411	15.4%	1 677 829	15.5%	44 418	2.7%	77 919	4.9%
Total	**8 886 015**	**100.0%**	**10 597 371**	**100.0%**	**10 839 819**	**100.0%**	**242 449**	**2.3%**	**1 953 804**	**22.0%**

For this proposed study SMEs have been chosen as a subject for the following reason: SMEs contribute a significant portion to the GDP of South Africa (Mahembe, 2011). Malaka and Brown (2015) mentioned that some organizations have a significantly low adoption rate when it comes to Big Data compared to other developed countries. It is therefore worthwhile to establish which factors contribute to the SMEs low adoption of Big Data giventheir importance to the economy.

2.7.1 SMEs challenges in South Africa

SMEs perform an integral role in the stimulation of national economies, partly due to their

socio-economic value (Chittithaworn, Islam, Keawchana & Yusuf, 2011). SMEs contribute significantly to the stimulation of developing countries such as South Africa (Maziriri & Chinomona, 2016). For instance, SMEs contributed at least 45% to the South African Gross Domestic Product (Naicker et al., 2017). Literature has revealed that South African SMEs have one of the lowest sustainability-rates globally (Fatoki, 2014). In addition, there are other internal and external environment factors that SMEs encounter.

Internal environment factors – SMEs often face internal factors such as management competency, access to capital markets, limited financial knowledge and technological capabilities (Sitharam & Hoque, 2016). For instance, in South Africa start-up SMEs often lack access to financing (Mazania & Fatoki, 2012). Furthermore, the increasing complexity of South African financial institutions credit lending processes has made it difficult for SMEs to secure financial capital due to the management's limited financial planning knowledge (Haron et al., 2013).

External environment factors – SMEs also must deal with external factors such as politics and corruption, infrastructure and ICT development, and global economic market fluctuations (Sitharam & Hoque, 2016). For instance, a comparative study between Nigeria and the United Kingdom determined that external factors such as poor economic planning and corruption hindered the growth of Nigerian SMEs (Ihua, 2009). In South Africa, SMEs often must deal with a high corruption rate as compared to developed countries(Dumisa and Amao, 2013).

2.7.2 SMEs and Big Data

Innovative technology remains one of the key priorities for success amongst SMEs and Big Data is considered an important driver of it (Sen, Ozturk & Vayvay, 2016). According to

Wamba and Aktar (2015), the ability to analyze or predict market behavior using Big Datais an attractive aspect for SMEs. The successful implementation of Big Data can result in increased productivity, flexibility, and cost savings. Therefore, the adoption of Big Data in SMEs is essential to meet the business challenges (Wamba & Aktar, 2015).

SMEs are constantly in search of ways to reduce business cost, increase business profits, and achieve agility in the market. According to Soroka, Han & Haleem (2017), organizations that have previously adopted Big Data have seen an increase productivity, financial stability, and production efficiency.

The use of Big Data can enable SMEs to attain competitiveness through the integration of inter-organizational functions and supply chain partners (Provost & Fawacett, 2013). Furthermore, Big Data is important to SMEs as enables them to make informed decisions about the strategic direction of the organization (Provost & Fawacett, 2013). In addition, data-driven decision-making can assist in increasing employee confidence as their decisions will be based on reliable data rather than subjective knowledge (Mandinach, 2012). Therefore, one can see the importance of Big Data for achieving the objectives of SMEs.

2.7.3 Big Data analytics available for SMEs

Most Big Data tools available in the market are targeted at large corporations who have significantly higher budgets, however there are Big Data analytics tools available tailored for SMEs (Polkowski, Khajuria & Rohadia, 2017).

There are big data analytical tools available on the market targeted for small businesses which are now more intuitive and easier to use. Analytical tools now make it easier for non- data native users to leverage complex analytics, scaled at small businesses (Polkowski et al., 2017). Some of these analysis tools that would commonly be used by small businesses as demonstrated in Table 3:

Table 3: Big Data analytics tools for SMEs (Polkowski, Khajuria, and Rohadia, 2017).

Technologies open for SMES	Free	Company Size (Small)	Security and Privacy
Google Analytics™	Yes	Yes	Yes
Insight Squared™	No	Yes	Yes
IBM Cognos Analytics™	No	No	Yes

- **Google Analytics™** - Google have created a free Big Data platform that gathers and measures

consumer behavior data (Plaza, 2011). The platform caters to all business sizes which is convenient for SMEs as they can use it to measure customer behavior when browsing the business website. For instance, SMEs can collect data to establish which sections and products do customers frequency browse (Batrinca & Treleaven, 2014).

- **Insight Squared™ -** this is a tool that enables small businesses like SMEs to perform sound decision-making about customer preferences through synthesizing data and producing graphic sales reports (Roberge, 2016). This capability can enable SMEs to predict future consumer taste and needs.

- **Cognos Analytics™ -** is a platform designed to efficiently analyze data using a graphic interface to discover patterns and derive the meaning of complex business data (Volitich, 2008). This platform has a low cost to implement, and support compared to alternative Big Data analytics platforms which is beneficial to SMEs with limited financial resources (Roberge, 2016).

2.7.4 Big Data adoption level in SMEs

Despite an exponential increase in the adoption of Big Data amongst large corporations, SMEs had the lowest adoption rate of Big Data (Coleman et al., 2016). Large corporations who adopt Big Data have achieved benefits such as cost savings and improved sales performance (Chuah & Thurusamry, 2022). One of the best methods to increase the adoption of new innovations similar to Big Data amongst SMEs is through more research on the challenges of the adoption of Big Data in SMEs (Coleman et al., 2016).

2.7.5 Big Data adoption challenges amongst SMEs

SMEs experience numerous challenges that contribute to their low Big Data adoption rate. For instance, Coleman et al., (2016) stated that there exist some environmental factors such as SMEs awareness of Big Data, Big Data field specialist availability in SMEs, and legal issues. Each of these environmental factors are briefly explained in the following paragraphs.

A significant proportion of SMEs lack the adequate awareness of Big Data (Iqbal et al., 2018).

According to the researcher, SMEs often lack the capacity to perform Research and Development with regards to new technological innovations. Furthermore, there is a high level of uncertainty about the relevance of Big Data for SMEs. As a result, SMEs assume that the cost of adopting Big Data is significantly higher than the Return on Investment (Iqbal et al., 2018).

Due to the size of SMEs and their limited resources, many of these organizations operate in highly specialized markets (Iqbalet al., 2018). SMEs often have staff that possess skills and knowledge that is limited to a niche field. As a result, SMEs often avoid adopting innovations such as Big Data in fear of resistance to change within the organization and high capital expenditure investment.

There are many data protection laws and policies when dealing with customer information which may pose legal challenges for SMEs when performing Big Data analytics (Iqbalet al., 2018). These complex data protection laws act as a deterrent to SMEs who have limited or no in-house legal specialists. As a result, SMEs will most likely need to acquire legal expertise from third-party contractors at high-cost premium.

2.9 What is the process followed by SMEs when deciding to adopt Big Data?

Innovation can be best described as a novel idea, approach, or project that is considered new in the eyes of the individual or the organization (Rogers, 2003). Time span is not the most crucial element because an innovation may have been developed centuries ago, however if organizations perceive it as new, it can still be considered an innovation (Sahin, 2006). According to Rogers (2003), the innovation-decision process follows a five-step flow:
(1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation. These steps are illustrated graphically in Figure 9.

2.9.1 The Innovation-Decision Model

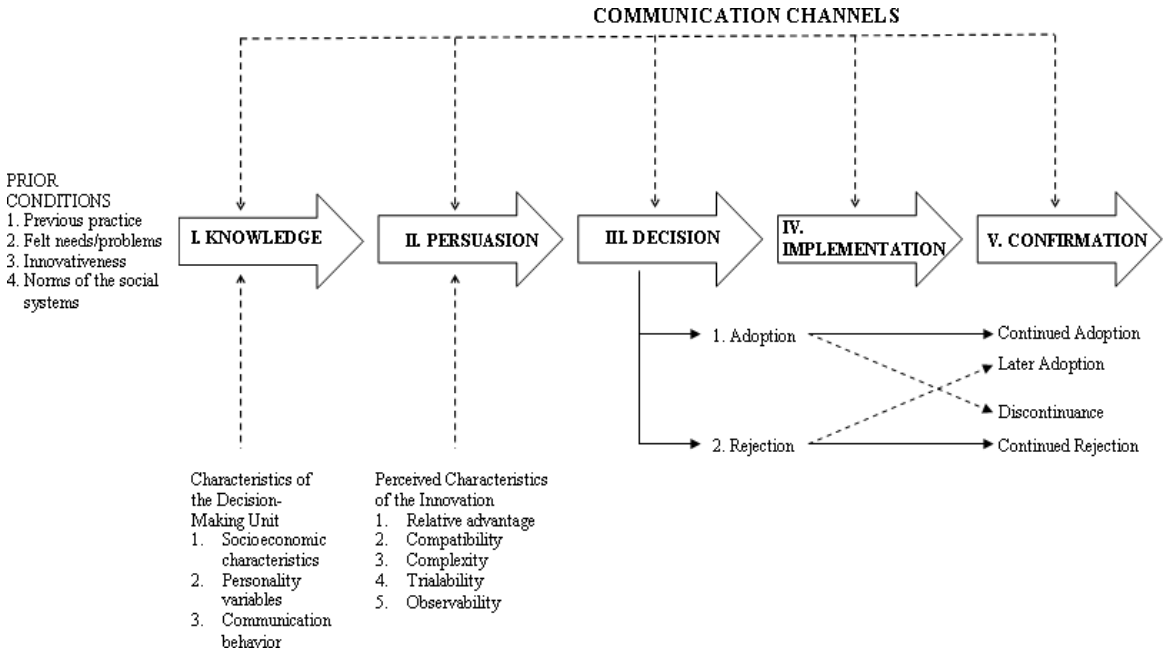


Figure 9: A Model of Five Stages in the Innovation-Decision Process (Rogers, 2003)

As per Figure 9, the different stages of the innovation-decision process that range from discovering knowledge about the innovation to the confirmation stage whereby support and use of the innovation is reinforced. Each of the five stages are briefly discussed below.

The Knowledge Stage

The Knowledge stage marks the beginning of the innovation-decision process. At this stage, the individual or decision-maker(s) in the organization gather as much information about the innovation. This knowledge can be obtained through traditional media outlets such as television and newspaper print or through the internet via search engines (Seale, 2017). During this stage, the knowledge seeker attempts to understand what the innovation is about and how they can benefit (Rogers, 2003). Rogers highlighted that it is important for the potential innovation adopter to gather as much knowledge about the innovation at this stage to avoid adoption resistance in the later stages due to misalignments with personality traits, organizational culture, or organizational objectives.

The Persuasion Stage

At the persuasion stage, the potential innovation adopter has a general perception of what the innovation is and how it can advance their agenda. At the same time, the individual or organization may have a negative or positive perception toward the innovation which may directly or indirectly influence the decision to adopt or reject the innovation (Rogers, 2003). The persuasion stage usually follows the knowledge stage as the potential innovation adopter has more enlightenment about the innovation. In addition, Rogers mentioned that while at the knowledge stage the potential innovation adopter is objective, at the persuasion stage they are more subjective as their decisions are made based on intuition or gut feeling (Rogers, 2003).

The Decision Stage

During the decision stage of the innovation-decision process, the potential innovation adopter applies their knowledge accumulated in the initial stage to either reject or adopt the innovation. At this stage, there is little to no persuasion that can be done to convince the adopter to change their decision (Rogers, 2003). Yates (2004) mentioned that this is one of the crucial stages as it involves key stakeholders such as the potential adopter, the users, and the suppliers of the innovation. At this stage information is presented and analyzed to reach a decision to adopt or not adopt an innovation (Yates, 2004).

The implementation Stage.

Once the potential innovation adopter makes the decision to adopt the innovation, they enter the implementation stage. At this stage, the innovation is deployed. The implementation stage is usually influenced by the previous past trial and error experiences (Rogers, 2003). The individual's information consumption behavior and the relationship with the change agent can significantly influence the individual's perception and use of the innovation. It is therefore crucial to reinforce support and positive feedback to the adopter to ensure the success of the implementation stage (Rogers, 2003). Sahin (2006) wrote that although the diffusion of innovation theory mentions the importance of this stage, Rogers provides little information on how potential adopters can practically implement an innovation.

The Confirmation Stage

At this stage, the decision to adopt has been made and the innovation has been implemented (Seale, 2017). However, at the confirmation stage the innovation adopter remains uncertain about their decision to adopt. The decision makers might reverse their decision to adopt at this stage (Seale, 2017). According to Nutley, Davies, and Walter (2002),this decision may still be changed if the adopter receives significant negative feedback aboutthe decision to adopt the innovation. The innovation adopter tries to reaffirm their decision by looking for support for his or her decision (Rogers, 2003). It is therefore crucial tocontinue providing support and ensure that there is a change management process in place with low levels of distribution to the core business operation. The implementers and users of the system should feel that they made the right decision by using the system (Rogers, 2003).

2.9.2 Criticism of the Diffusion of Innovation Theory

Over the past two decades there have been numerous researchers who have published literature criticizing the Diffusion of Innovation theory. For instance, Waterman (2004) wrotein his study that the theory fails to factor in the possibility that people might reject an innovation even in instances where they fully understand how it works. Furthermore, Lyytinen and Damsgaard (2001) raised criticism at the assumption made by the Diffusion of Innovation Theory, that adoption decisions are directly influenced by available information, risk, and preference functions. The researchers state that this is not always the case as they cite the case of an attempt to create a strategic Electronic Data Interchange (EDI) network in Hong Kong. The new network aimed to transform the information sharing patterns in the major parts of the sea cargo transportation sector in Hong Kong (Lyytinen & Damsgaard, 2001). Most of the key stakeholders were against the development of the new network although they were aware of the costs involved and the potential benefits that could be enjoyed. In this case, the decision was heavily influenced by the business strategy rather than the available information (Lyytinen & Damsgaard, 2001). Another assumption that is criticized by Damsgaard and Lyytinen (2001) in the Diffusion of Innovation theory is that technologies diffuse in sequential stages. The researchers believe that complex technologies such as Big Data will not diffuse in sequential stages.

The Diffusion of Innovations (DOI) theory enables the researcher to understand the different characteristics and categories of the adopters of innovation by classifying them into categories based on similar attributes (Rogers, 2003). Although, this theory is highly effective in assessing the adoption of technology, it is incapable of adequately explainingthe factors that organizations consider in the process of an innovation adoption such as Big Data (Sahin, 2006). Botha and Atkins (2005) state that the model focuses on "individual blame" as an explanation of the effect of social structures on the innovation adoption- decision. On the other hand, Shove (1998) wrote that the decision to adopt an innovation is a social process. Furthermore, researchers have stated that Rogers' Diffusion of Innovation (DOI) theory provides limited information on the decision-making process when it comes to the adoption of an innovation (Alotaibi & Wald, 2013).

There are many similarities between the factors found in the DOI theory and the Technology Organization Environment (TOE), such as the Relative Advantage, Complexity, Compatibility, and the Technology dimension. These similarities have been cited as one of the reasons why researchers apply these models in their studies. However, these models rarely address the process of decision-making (Aboelmaged & Mouakket, 2020).

It is for this reason that the Diffusions of Innovations theory has been deemed not appropriate for the purpose of this study. On the other hand, the conceptual framework of organizational innovation adoption by Frambach and Schillewaert (2002) will be analyzed to assess its appropriateness for this study.

2.9.3 Conceptual Framework of Organizational Innovation Adoption

There are numerous reasons why organizations chose to innovate. For instance, an organization will innovate to increase productivity gains and increase profits while lowering production expenditure (Talukder et al., 2008). The organizational decision to adopt has been divided into types: (1) a decision taken by an individual in a senior management position, (2) a decision that is unanimously taken by members of an organization (Frambach & Schillewaert, 2002).

2.10 What factors do SME managers consider when deciding to adopt Big Data?

According to the conceptual framework proposed by Frambach and Schillewaert (2002), the decision to adopt an innovation occurs at an organizational level as opposed to the individual level as described by Rogers in the DOI theory. The decision occurs between the initiation stage and the implementation stage. Similarly, to the DOI theory, knowledge is accumulated and analyzed at the initiation stage. At this stage, the organization becomes aware of the innovation, formulates an understanding, and assesses the need to adopt the innovation based on the objectives of the organization (Frambach & Schillewaert, 2002).

At the organizational level there are various factors that have a direct influence on the decision to adopt an innovation (Frambach & Schillewaert, 2002). The decision makers in the organization such as the Chief Information Officers view these factors through a perception of innovation (Frambach & Schillewaert, 2002). The decision makers consider the potential benefits that can be derived from the innovation, the direct and indirect costs introduced by the innovation, and the time required to implement the innovation (Diamond Jr, 2003).

Organizational factors heavily influence the decision to adopt an innovation. The conceptual framework by Frambach and Schillewaert (2002) provides five factors that are highly regarded by organizations: (1) social networks, (2) supplier marketing efforts, (3) perceived innovation characteristics, (4) adopter characteristics, and (5) environmental influences.

Figure 10 demonstrates the conceptual framework proposed by Frambach and Schillewaert (2002).

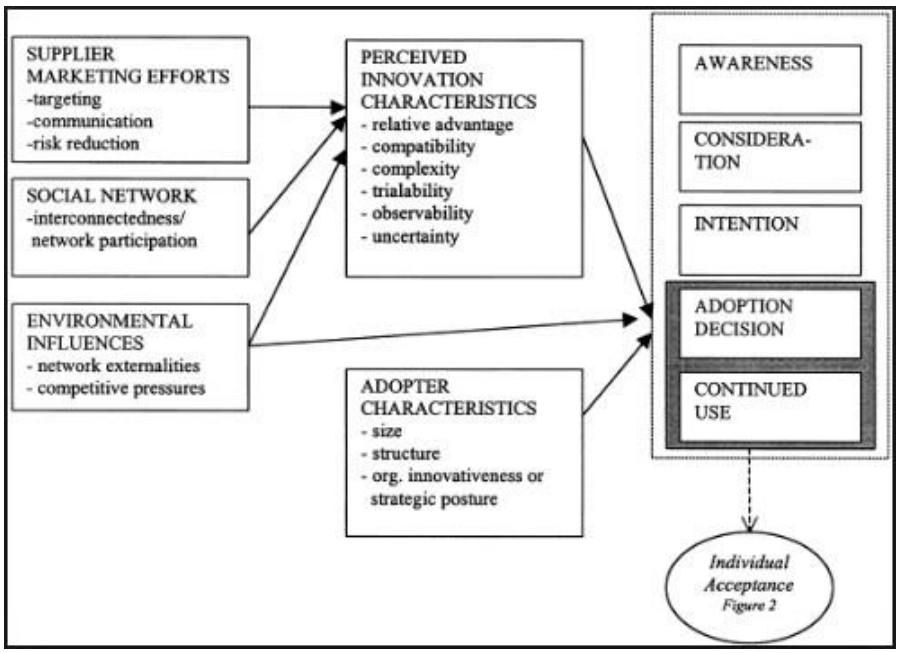


Figure 10: Conceptual framework proposed (Frambach & Schillewaert, 2002)

2.10.1 Perceived Big Data characteristics

A survey through literature has revealed that the perceived characteristics of an innovation remain at the center of the adoption model (Frambach & Schillewaert, 2002). It can be argued that the perceived characteristics of innovation mentioned in the Diffusion of Innovations theory presented by Rogers (2003) has been extensively analyzed and influenced many adoption theories. The conceptual framework by Frambach and Schillewaert (2002) borrowed and adapted Rogers (2003) five perceived characteristics of innovation: relative advantage, compatibility, complexity, observability, and trialability.

Big Data Relative Advantage

Relative Advantage has been noted in many studies as a significant contributer on technology adoption. At its core it reflects the advantages of adopting a new technology through the comparison of its benefits relative to an existing technology (Chen et al., 2015). Relative advantage can be described as "the degree to which an innovation is perceived as being better than the idea it supersedes" (Rogers, 2003, p.229). Organizations take into consideration the advantages that will be incurred after the adoption of an innovation like Big Data (Paley, 2017). According to Zomaya and Sakr (2017), organizations that have adopted Big Data experienced the following benefits: improved data integrity, data capturing accuracy,

improved customer service, and efficient decision support. Therefore, organizations that adopt Big Data are expected to experience greater competitive advantage (Davenport, 2014).

Big Data Compatibility

Compatibility focuses on "the degree to which a new system is consistent with the current system within the company" (Maroufkhani et al., 2020, p.3). In many studies, compatibility has been often cited as a driver of technology adoption (Bian et al., 2020).

Compatibility plays an integral role in the adoption process as organizations are more willing to adopt an innovation such as Big Data if they perceive that there is compatibility with their culture, norms, work practices, and business objectives. Rogers (2003, p.16) mentioned that "compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters".

The higher the compatibility of an innovation to an organization the greater the adoption rate (Lynn & Rosati, 2017; Guarisco & Langabeer, 2017). Furthermore, if the implementationof Big Data requires a technology infrastructure like the one that exists in the adopter's environment, then the adoption process becomes less complicated (Guarisco & Langabeer, 2017).

Big Data Complexity

Complexity has been defined as "the degree to which an innovation is considered as difficult to understand and use (Kapoor et al., 2014, p.83). According to Alsetoohy et al., (2019), one of the most significant obstacles in the adoption and implementation of technological innovation is the complexity of technology. Furthermore, some studies have shown that there is a negative effect of complexity on the adoption of cutting-edge technologies such as intelligent agent technology (Alsetoohy et al., 2019), cloud computing (Oliveira, Thomas & Espadanal, M. (2014), and big data (Chen et al., 2020).

New technological innovation is often met with resistance because it is perceived as

intimidating by the organizational employees, especially if it involves learning new business practices and acquiring new skills (Beatty, Shim & Jones, 2001).

According to Rogers (2003), there is a negative correlation between complexity and the rate of adoption. In addition, potential adopters are discouraged by several issues that are perceived to be complex in the adoption of Big Data, namely: the security and privacy of data, time to process Big Data, availability of architecture, and the diverse techniques to extract Big Data (Broeders et al., 2017; Zhang et al., 2017).

Big Data Trialability

Trialability is defined as "the degree to which an innovation may be experimented with on a limited basis" (Rogers, 2003, p.243). According to Rogers (2010), potential adopters are more likely to adopt an innovation like Big Data when they are allowed to experiment with an innovation. Furthermore, when organizations such as SMEs have the capability to trialBig Data platforms, they tend to understand the challenges that could be experienced during implementation (Walker & Brown, 2019).

Most technological innovations offer pilot testing or beta versions which allow potential adopters to test the innovation in smaller departments before rolling them out to the entire business organization (Beatty al., 2001). It has been established that there is a positive correlation between the rate of adoption and trialability (Rogers, 2003). According to Sun et al., (2018), the adoption rate of an innovation increases when the potential adopter can test an innovation prior to adoption. Furthermore, trialability of an innovation reduces uncertainty associated with adoption (Ahmad et al., 2016).

Big Data Observability

Observability is regarded as one of the five characteristics of innovations. Observability is defined as "the degree to which the results of an innovation are visible to others" (Rogers, 2003, p.232). It has been established that there is a positive correlation between observability and the rate of adoption of an innovation. According to Leavitt (2013), Big Data provides immense business value, but SMEs perceive the innovation to be too complex and expensive.

Therefore, it is essential to improve the observability of Big Data to improve adoption amongst SMEs. In short, Rogers (2003) claimed that innovations that provide greater relative advantage, compatibility, simplicity, trialability, and observability will be adopted at a higher proportion compared to those that do not offer these attributes.

Big Data Uncertainty

Literature reveals that there is uncertainty that exists in all the stages of Big Data learning (Wang & He, 2016). For example, big data often has much noise which has made it hard for existing data processing machines to compute all this noise data. Furthermore, there are several models that can be used for big data processing. Due to the growing uncertainty existing in the selection process, choosing an appropriate model is a challenge due to the many perceived uncertainties. The third challenge is how to well represent the highly voluminous data without creating uncertainty (Wang & He, 2016).

2.10.2 Adopter characteristics

An organization has characteristics that define and separate it from its immediate competitors (Damanpour, 1991). Organizational characteristics can range from size, net revenue, and number of employees. For most organizations, size has a significant influence on the decision to adopt an innovation (Damanpour, 1991). According to Damanpour (1991), there are three distinct characteristics at the organizational level which have a directbearing on the decision to adopt an innovation. These characteristics are: (1) organization structure, (2) strategic posture, and (3) size. Throughout these characteristics, size has been identified as the single most influential aspect in the decision to adopt. For instance, larger corporate organization are more willing to innovate and adopt cutting edge technology, but SMEs are reluctant to risk adopting new technologies due to the size of the organization (Arts & Tammo, 2011).

2.10.3 Supplier marketing activity

The ability to adequately spread knowledge about an innovation increases the chances of it being adopted by more organizations (Frambach & Schillewaert, 2002). Supplier marketing

activity therefore has a significant impact on the probability of an innovation being adopted by the organization (Frambach & Schillewaert, 2002). In literature, there are three factors that are constantly mentioned as having a significant impact on the probability to adopt an innovation: (1) targeting, (2) communication, and (3) risk reduction (Arts & Tammo, 2011).

Suppliers commonly use *Targeting* efforts to communicate the benefits of adopting an innovation (Frambach & Schillewaert, 2002). Specially designed *targeting* efforts enable suppliers to influence the decision of the potential innovation adopter at an organizational level. SMEs often require as much knowledge as they can about the potential risks and benefits of adopting an innovation, therefore *targeting* becomes a vital method for suppliers to provide the required information.

There are numerous *communication* channels available to individuals which may sometimes provide negative information about an innovation to direct potential adopters towards alternative products (Rogers, 2003). These *communication* channels come in the form of traditional media and the internet. At the organizational level, there are more formal platforms on which decision makers communicate with suppliers to gather information about an innovation (Rogers, 2003). According to Rogers (2003), supplier communication helps create awareness of the innovation and influences the prospective adopter's perceptions of the innovation. Therefore, the *communication* is a powerful tool for suppliers to spread knowledge about an innovation.

By providing effective communication the supplier can inform the prospective adopter about the potential risks associated with the innovation (Rogers, 2003). *Risk reduction* increases the likelihood of an innovation being accepted by the prospective adopter (Arts & Tammo, 2011). Due to the limited resources available to SMEs, innovations that are perceived to contain significant risk are less likely to be adopted. These perceived risks may be associatedwith the implementation process, financing, and operations risk. Therefore, suppliers must directly address these perceptions to increase the prospect of innovation adoption by SMEs (Frambach & Schillewaert, 2002).

2.10.4 Social Network

Social networks play a pivotal role in connecting the organization's staff and suppliers of innovative technologies (Ruiz, Mars, Arroyo & Serena, 2016). When both parties interact in these social systems the probability of an increase in the speed of adoption increases significantly. The potential adopters of innovation feel much more comfortable about expressing their concerns in these informal gatherings which allows the suppliers of innovation the opportunity to address these concerns (Ruiz et al., 2016). Furthermore, these informal meetings facilitate the distribution of knowledge about an innovation, which increases the chances of an organization adopting the innovation (Ruiz et. al, 2016).

2.10.5 Environmental influences

The presence of network externalities in the environment in which social networks are formed is significant; because they have an influence on the innovation adoption decisions (Frambach & Schillewaert, 2002). For instance, an organization may be pressured into adopting due to the business strategy that is deployed by its competitors. According to the theory of innovation by Rogers (2003), the number of users in an environment determines the value of the observed innovation. This implies that the greater the number of users, the greater the probability of an organization adopting the innovation due to the fear of being perceived as having outdated technology.

2.11 Summary

This chapter presented literature which detailed the factors and process that SMEs consider in the adoption of Big Data. The researcher provided argument over the choice of the Conceptual Framework by Frambach and Schillewaert (2002) as the main framework of the study. Firstly, a description of the Conceptual Framework including its constructs was performed. Secondly, a description of the Innovation-Decision Model by Rogers (2003), was provided. Subsequently, the researcher substantiated the reason for choosing the Conceptual Framework as the main framework for this study through a comparison of both models. Over the course of this study the researcher identified that there is a very limited volume of academic literature which focuses on the appropriate framework to use in the study of Big

Data adoption amongst SMEs in developing countries. As a result, further research in this field must be performed. The following section provides a description of the research methodology followed in this study.

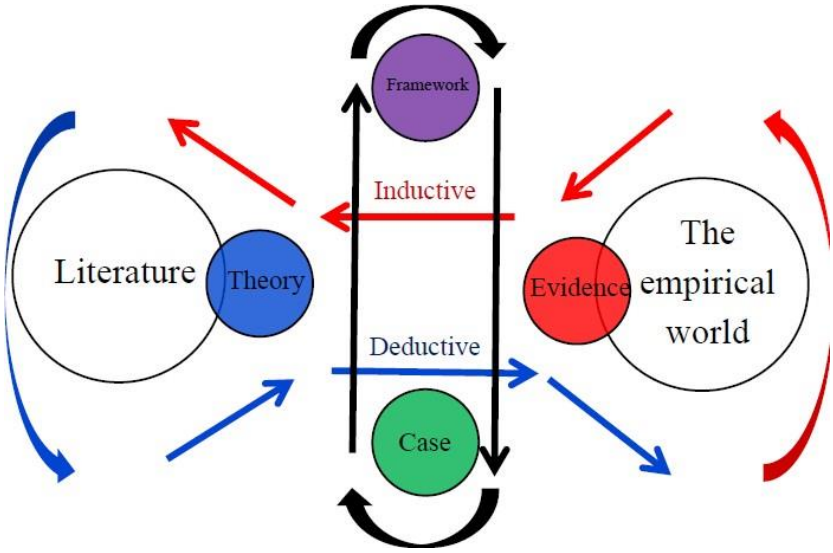
Chapter 3: Research Methodology

This chapter details the research method used by the researcher. The following section provides an introduction and outline of the research method with arguments from literature that support the use of the chosen methodology for the purpose of this study.

3.1 Introduction

Within research there are several approaches available to the researcher and no single one can accommodate all studies (Saunders, Lewis, and Thornhill, 2012). It is imperative for a novice researcher to select an appropriate research paradigm as this will shape the direction of the study. This chapter details the design followed by the researcher for this study. To effectively structure the research design used in this study, the researcher followed the abductive research process with amendment from (Dubois & Gadde, 2002). In contrast to the deductive reasoning approach which reaches specific conclusions based on outlined general rules, and inductive reasoning which is based on unique observations to reach broader generalizations (Soiferman, 2010), abductive reasoning allows the researcher to combine both approaches. Figure 11 depicts the abductive research process applied in this study.

Figure 11: Amended abductive research process used in this study (from (Dubois & Gadde, 2002, p. 555).



3.2 Research Purpose: Explanatory

This study was explanatory in nature because the researcher identified that the concept of Big Data adoption is new especially in the context of a developing country such as South Africa, and therefore the researcher embarked on a quest to understand and explain the phenomenon. The study tried to identify and explain the key factors around the Big Data adoption decision-making process followed by SMEs. According to Saunders et al., (2012), an explanatory approach is most appropriate for identifying fundamental relationships between different factors, which is true for this study.

3.3 Research Philosophy:

Research philosophy refers to the nature of knowledge and the development of knowledge, in simple terms, it is what the researcher considers knowledge and the process in which the knowledge is developed (Saunders et al., 2012). According to (Bhattacherjee, 2012; Saunders et al., 2012), there are two stances linked to the research philosophy, namely ontology and epistemology. The following section will discuss the philosophical approach taken by the researcher.

3.3.1 Ontology

Ontology refers to the nature of reality and views of how the world operates (Saunders et al., 2012). According to Saunders et al., (2012), there are two fundamental views of how the world operates, namely, subjectivism and objectivism. Subjectivism posits that “social phenomena are created from the perceptions and consequent actions of those social actors concerned with their existence” while objectivism accepts that “social entities exist external to social actors concerned with their existence” (Saunders et al., 2012, p. 110). Furthermore, subjectivists perceive that reality is a subjective experience that is unique for everyone (Guba & Lincoln, 1994). In addition, subjectivists consider knowledge to be meaningful even

if it cannot be measured (Brannick & Coghlan, 2007). In this study the researcher is attempting to gain an understanding of the Factors that most SMEs consider in the Big Data adoption decision-making process; therefore, the researcher does not believe that the phenomenon under observation exists as a meaningful reality that is not linked to any social actors, but rather the phenomenon exists due to the perceptions and actions of social actors. It is for this reason that this study has taken the subjective philosophical stance.

3.3.2 Epistemology

Epistemology refers to what can be regarded as valid knowledge in the field of study (Bhattacherjee, 2012). According to Klein and Myers (1999), within Information Systems there are three dominant philosophies: positivist (also referred to as objectivism), critical research and interpretive (also referred to as subjectivism). A positivist stance is rooted in the belief that the truth is objective and is comprised of measurable properties that exist independently from the observer (Saunders et al., 2012). On the other hand, critical research aims to critique the observed phenomenon through exposing structural contradictions with social systems (Bhattacherjee, 2012). For this study, the researcher is not attempting to socially critique the phenomenon, but rather to understand the phenomenon, therefore critical research is not suitable for this study. Lastly, interpretive research assumes that individuals create subjective meanings as they interact with the world surrounding them (Bhattacherjee, 2012). The interpretive paradigm has been deemedappropriate because the study will examine Big Data adoption factors based on the opinionsof senior IT managers in SME organizations.

3.4 Research Strategy: Case Study Approach

A strategy is an important component of a research project as it will guide the researcher with presenting a cohesive thesis. “A strategy is a plan of action to achieve a goal” (Saunderset al., 2012, p. 173). It is a plan that outlines the process the researcher will use to answer the research question, including the researcher’s philosophical stance, data collection method and steps to analyze the data (Saunders et al., 2012).

A case study can be described as research approach that is applied to produce an in-depth

understanding of a complex problem (Crowe et al., 2011). Simons (2009, p.21) defined a case study as "an in-depth exploration from multiple perspectives of the complexity and uniqueness of a particular project, policy, institution, program or system in a 'real life'". According to Myers (2013), a case study method is appropriate for Information System as it enables the researcher to investigate Information Systems projects implemented in organizations. Furthermore, Eisenhardt (1989) stated that a case study offers the researcher flexibility as it can accomplish numerous objectives at once such as generation and testing of theory. However, one of the common criticisms of the case study method is that case selection is heavily biased (George & Bennett, 2005).

The consensus amongst critics is that this method relies on subjective case selection which creates room for so-called selection bias (George & Bennett, 2005). However, it has been argued that the selection of a case based on existing knowledge may lead to a more refined research plan (Bonney, 2015). Although there is extensive criticism focused on case study research (Flyvbjerg, 2006), the method remains widely employed in organizational studies within the Information Systems field (Lee & Baskerville, 2003). The researcher has selected this method because literature shows that case studies are generally effective in qualitative studies.

The multiple case study strategy was followed by the researcher. This strategy allows the researcher the ability to analyze each case as though it is a singular study then evaluate it against other cases (Mesec, 1998).

The data analysis process followed in this research was informed by the within- and cross-case analysis approach recommended by Dube and Pare (2003). To begin with, each case was analysed separately in order to understand the data collected. Subsequently, each of the findings were aggregated by the researcher to understand and establish the connecting themes between the cases.

The following section will present the population sampled and the sampling technique used in this study.

3.5 Approach to theory: Abductive method

In academia a researcher has the option of following several approaches to theory namely, abductive, deductive, inductive, and retroductive (Bhattacherjee, 2012). Furthermore, some research studies have combined both the inductive and deductive approaches in the same research study (Saunders et al., 2012). According to Johnston (2014), a deductive approach formulates a hypothesis though the use of predetermined theories andsubsequently tests the hypothesis to resolve the initial research question. In contrast, an inductive research approach draws theoretical concepts and patterns through the data analysis process as opposed to the deductive approach that makes use of pre-existing theory. As a result, inductive research is labelled "theory-building" instead of "theory- testing" which describes deductive research (Bhattacherjee, 2012). Considering the researchpurpose of this study, the researcher made use of the abductive research process.

Abductive reasoning not only allows the researcher the ability to combine both inductive and deductive approaches. Abductive reasoning enables one to combine the two approaches and derive conclusions with regards to the cause-and effect of the phenomenon under observation in the study (Dubois & Gadde, 2002). Furthermore, abductive reasoning references from empirical observation to derive the most logical interpretation of the observed phenomenon (Dubois & Gadde, 2002). Therefore, the abductive reasoning approach was ideal for this study as it allowed the researcher to reference from pastresearch to guide the direction of the study, whilst simultaneously allowing for new themes to be identified inductively by analyzing the empirical data.

3.6 Target population and sample

The following section contains details of the unit of analysis, target population and case selection, and sampling techniques used in this study.

3.6.1 Unit of Analysis

"A unit of analysis may be a person, group, organization, country, object, or any other entity

that you wish to draw scientific inferences about" Bhattacherjee (2012, p.65). This definition has been applied to this study as it identifies a geographical section which in this study is Cape Town and institutions such as SMEs that will be used to source the target population. In this study the Organization will be the unit of analysis.

3.6.2 Target population

The targeted population includes all the members who meet the criteria set out by the research inquiry (Onyiuke, 2005). The population contained in this study has been pulled from the Small Enterprise Development Agency database. Table 4 demonstrates the provincial distribution of SMEs within South Africa (Statssa.gov.za, 2016).

Table 4: SMEs by province

SMMEs	Number (2008Q1)				Number (2015Q2)			
	Total	Formal	Informal	Other	Total	Formal	Informal	Other
Total	**2 182 823**	**666 501**	**1 420 933**	**95 389**	**2 251 821**	**667 433**	**1 497 860**	**86 528**
Western Cape	223 933	114 976	95 212	13 745	230 324	110 107	110 188	10 030
Eastern Cape	218 865	56 579	154 631	7 655	197 366	50 670	141 739	4 957
Northern Cape	29 894	11 450	11 768	6 676	20 611	8 534	9 058	3 019
Free State	114 949	31 040	76 127	7 783	96 846	26 224	60 816	9 806
KwaZulu-Natal	418 406	102 591	289 347	26 468	373 434	74 976	283 165	15 293
North West	109 860	25 817	76 855	7 188	112 856	27 430	79 153	6 273
Gauteng	687 556	270 093	405 180	12 283	785 321	306 231	465 100	13 989
Mpumalanga	193 259	29 760	156 814	6 685	185 399	35 208	141 129	9 063
Limpopo	186 101	24 193	155 001	6 907	249 663	28 054	207 512	14 098

Source: (Statssa.gov.za, 2016)

Table 4 demonstrates the total population of SMEs that can be used in this study. However, due to limitations such as time and money the researcher has opted to focus on Cape Town as a sample population.

3.6.3 Case selection

The population to be used in this study consists of the 230 324 formal and informal SMEs located in the Cape Town. Due to the limited number of willing participants and limited time to complete this study the final sample consists of four SMEs across diverse industries such as manufacturing, retail, and finance. For this research, the sample includes organizations that fall in the SME classification within Cape Town.

The researcher used the following criteria to narrow down the search for desired cases:

- SMEs must be in Cape Town.
- The ideal SME had to allow the researcher access to staff members to conduct interviews within the period 22nd December 2018 to 20th December 2020.
- The ideal SME had to allow the researcher access to organizational documents that may provide insight on the research objectives.
- The ideal SME should have an independent IT department.

All four of the organizations that participated in this study met the previously listed criteria used to select cases. The next section details the sampling techniques used in this study.

3.6.4 Sampling techniques

Sampling can be described as the process of selecting a representative unit of observation from a significantly abundant research population (Babbie & Mouton, 2001). Purposive sampling was used in this study to choose respondents who were best suited to answer the research question and fulfil the research objectives (Saunders et al., 2012). Purposive sampling is commonly used in qualitative research amongst other sampling methods which include, convenience sampling, theoretical sampling, criterion sampling and snowball sampling (Patton, 2002). The researcher used purposive sampling to choose participants in each case. Due to the limitation of time and financial resources the data collection stopped without reaching saturation.

In qualitative research saturation is used as the standard for discontinuing data collection and or analysis (Saunders et al., 2012). According to Saunders (et al., 2012), there are four prominent models of saturation recognized in qualitative research. The first model stems from the traditional grounded theory. This model uses emerging theory and the development of new categories during the analysis process as a standard for further data collection. This model has been labelled as theoretical saturation (Saunders et al., 2012). The second model closely resembles the first model, however, in this instance saturation depends on the identification of new themes and codes. This model is based on the number of identifiable themes and codes as opposed to the first model which focuses more on the completeness of

existing theoretical categories. This model has been labelled inductive thematic saturation (Saunders et al., 2012). The third model of saturation takes on a completely different perspective from the first two models. In this model data is collected tosupport theory, at the point of lower-order themes and codes, instead of developing new theory from the ground. This model has been labelled priori thematic saturation (Saunders et al., 2012). The fourth model is commonly referred to as data saturation, whereby saturation focuses on identifying redundancy in the data, whilst simultaneously negating thereference to theory linked to the data (Saunders et al., 2012). The data collection and analysis of this study was concluded without reaching any of the four prominent models of saturation in qualitative research. This was due to the limitation of time and financialresources.

The researcher made a conscious effort to select participants from different levels of management within each case to ensure that the information obtained is not skewed to one level of seniority.

The sample for this study was drawn from a selected group of employees in organization A, B, C, and D. This sample was selected because of their unique knowledge of the research focus that formed the population. Once the researcher received the ethics approval form to conduct the study, an email invite was sent to the senior managers of the organizations containing an invite to participate in the research study. The participants were drawn from all race groups, age, and gender. Table 5 demonstrates the sampling process used in this study.

Table 5: Sampling of respondents

Name of organization	Description of respondent	Targeted Sample	Actual number of respondents
A	Senior managers Mid-level managers	5 3	3 1
B	Mid-Level managers Skilled employees	5 2	2 2
C	Senior managers Skilled employees	3 3	1 1
D	Mid-level managers Senior Managers Skilled Employees	3 4 2	2 1 1
Total			**14**

Once the researcher identified the sample to be used in this study the process of data collection commenced. The next section discusses the data collection method used in this study.

3.7 Data Collection

In the world of academic research there are two data-collection strategies, namely, quantitative, and qualitative data. This study focused on relatively personal and sensitive subjects like perceptions and beliefs, moral values, and motivation. According to Creswell et al. (2011), studies where researchers aim to understand personal experiences are more

encouraged to adopt a qualitative approach. Furthermore, Qualitative research is designed to enable researchers to comprehend the views of people and the socio-culturalphenomenon in the environment in which they exist (Myers, 2013). In contrast, quantitativeresearch, aims to numerically quantify data using statistical analysis (Churchill & Iacobucci, 2006).

The aim of this research is to understand the factors that SMEs consider in the Big Data adoption decision-making process. Due to the nature of this study, the researcher decided that the qualitative research method would be the most appropriate approach, as it has been identified as the method that assists providing in-depth detail on the phenomenon of which limited knowledge exists (Strauss & Corbin, 1990). Based on the literature survey conducted by the researcher, it became evident that there was little known about the factors that are considered by decision-makers during the adoption of an innovation like Big Data. Qualitative data provides the researcher in-depth knowledge of the factors that are considered critical by SMEs in the Big Data adoption decision-making process. Hence, the qualitative approach is deemed appropriate for this study.

The researcher used two methods to collect data, namely, the primary research method and the secondary research method. The primary research method enabled the researcher to obtain rich data that could assist in answering the primary research questions, whilst the secondary research method included documents which supplemented the primary data collected.

The primary data collection instrument employed in this study was semi-structured interviews with participants that were part of an Information System adoption decision-making process. The aim of the researcher was to collect data that could provide rich insights into respondents' opinions by using semi-structured interviews to collect data. Each participant was emailed a copy of the semi-structured interview questionnaire to familiarize themselves with the questions for the interview.

3.7.2 Semi-structured interviews

Semi-structured Interviews with open-ended and semi-structured questions were used to collect data from the research participants. According to Marshall and Rossman (1999), interviews allow the researcher the ability to gather large amounts of data in instances where more than one individual is interviewed. Likewise, the flexibility provided by semi- structured interviews, enable the researcher to investigate phenomena that occur spontaneously during the research process (Doody & Noonan, 2013). A combination of unstructured and structured questions formed the semi-structured questions, thereby allowing the researcher to pose both closed and open-ended question (Appendix A).

This study adopted the semi-structured interview approach for several reasons. Firstly,semi-structured interviews provide more in-depth feedback from participants than structured interviews (Cresswell & Plano Clark, 2011). Moreover, semi-structured questions allow the interviewees the freedom to discuss the nature of the topics and themes in-depth without limiting the discussion to predetermined parameters (Polit & Beck, 2004). Furthermore, semi-structured interviews allowed the researcher an opportunity to select questions that were relevant to the research objectives (Saunders et al., 2012). In addition, the researcher was able to pose questions to the participants without the need for structuring questions in a chronological order (Myers, 2013). Lastly, semi-structured interviews are frequently used for qualitative research in Information Systems (Myers, 2013). Therefore, the approach of semi-structured interviews was deemed appropriate for this study.

Participants were given a code to denote the role of each participant in each case study. For instance, the letter ‘A’ was used as a prefix to denote Case Study A, while a short code ‘IT1’ was used as a suffix to denote IT Manager. This resulted in a full code for the IT Manager in Case Study A to appear as ‘AIT1’. Table 6 demonstrates the different codes assigned to each participant interviewed across the four case studies.

Table 6: Codes for participants interviewed.

Case Study	Participant Role	Code
A	IT Manager	AIT1
	Group Risk Manager	AGRM2
	Senior Business Analyst	ASBA3
	IT Project Manager	AITP4
B	Senior Business Analyst	BSBA1
	Senior Business Analyst	BSBA2
	Project Manager	BPM3
	Chief Information Officer	BCIO4
C	Principle Business Analyst	CPBA1
	Marketing Manager	CMM2
D	Information Security Officer	DISO1
	Technical Support Manager	DTSM2

3.7.3 Research instrument

The semi-structured questionnaire was adopted from Khalifa and Davison (2008). The researcher structured the questionnaire to begin with simple open-ended questions followed by questions that required more in-depth responses during the interview process. Appendix A demonstrates the questionnaire used to perform the interview.

The researcher divided the interview questionnaire into five sections. The first section was aimed at obtaining data about the interviewees demographics. The second section focused on the influence of Supplier Marketing on the Big Data adoption decision-making process.

The third section looked at the impact of Social Networks on the Big Data adoption decision-making process. The fourth section dealt with Environmental influences that have an impact on the SMEs need to remain competitive. The last section focused on the Perceived

Innovation Characteristics that would encourage or discourage an SME from adopting Big Data. The next section focuses on the content of the interviews.

The interview guide (Appendix A) has been used as a guide for the case study analysis to determine the factors that most SMEs consider in the Big Data adoption decision-making process. The questions have been listed into the following categories:

- The impact of supplier marketing efforts
- Social network influence on Big Data discovery
- The influence of Environmental factors on the Big Data adoption.
- The perceived Big Data characteristics

The analysis focuses on issues related to the categories mentioned previously that have resulted in the low adoption of Big Data amongst SMEs in Cape Town. The next section discusses the organizational documentation review process.

3.7.4 Organizational documentation review

Researchers can make use of a broad range of data collection methods such as interviews, direct observation, focus groups, archival records, and documentary sources (Myers, 2013). The use of multiple sources of data is recommended to triangulate data and allow for meaningful insights to emerge (Myers, 2013). According to Walsham (2006), interviews should be supported by secondary forms of field data such as media, publications, and press releases that are directly linked to the organizations being studied. Furthermore, Walsham (2006) states that to improve robustness interpretive research should incorporate internal documents such as strategies, plans, and evaluations. In this study the researcher collected secondary data from multiple sources such as financial statements, public press statements and interviews, newspapers and social media, podcasts, and white papers published by the organizations.

In the process of data collection, the researcher requested permission from each SME

organization to collect and review documentation that detailed the IT innovation adoption strategy used currently and in the past. The researcher was able to obtain documents such as operations strategy minutes, steering committee minutes, project charters and weekly systems planning meeting minutes. These documents allowed the researcher to have an in-depth view of the stages that most SMEs follow in the IT innovation adoption decision- making process. Furthermore, these documents broadened the researcher's understanding of the key factors that SMEs consider during the Big Data adoption decision-making process.

Secondary documents were also allocated a short code to denote the name of each document collected. For instance, the letter 'A' was used as a prefix to denote Case Study A, while a short code 'OSM1' was used as a suffix to denote Operational Strategy Minutes. Thisresulted in a full code for the Operational Strategy Minutes document in Case Study A to appear as 'AOSM1'. Table 7 categorizes the different codes assigned to each document collected from the three case studies.

Table 7: Codes for secondary data documentation

Case Study	Document type	Year	Code
A	Operations StrategyMinutes	2019	AOSM1
	IT Budget Proposal	2018	AIBP2
	Project Charter	2017	APC3
	Operational Expenditure Plan	2017	BOEP2
	Project Charter	2018	BPC3
	White Paper	2016	BWP4
C	Business Case	2012	CBC1
	Operations StrategyMinutes	2019	COSM2
	Project Charter	2017	CPC3
	Weekly Systems Planning Minutes	2019	CWSPM4
D	Project Plan	2019	DPP1
	Budget Costing Sheet	2019	DBCS2
	IT Project Risk Charter	2019	DIPRC3
	IT Security DiscussionsMinutes	2019	DISDM4
B	Steering Committee Minutes	2019	BSCM1

3.8 Data Analysis

The process of data analysis commenced shortly after the first interview was concluded. The data was processed and analyzed using the NVivo 11 software to establish the common links between the responses from the interviewed senior managers. Access to the data was granted on condition that the researcher will maintain the anonymity of the subjects throughout the research process. As a result, the researcher coded each case study as A, B and C.

Considering the research method employed by the researcher, this study followed the qualitative data analysis approach. According to Marshall and Rossman (1990, p.13), qualitative data analysis is a "process of bringing order, structure and meaning to the mass of collected data". The researcher regarded coding as a crucial process of organizing the qualitative data to identify patterns and derive meaningful insights from the transcribed text. Codes can be defined as "tags or labels for assigning units of meaning to the descriptive or inferential information compiled during a study" (Miles & Huberman, 1994, p.56). Coding is a process of going through interviews or documents to identifying phrases and words with similar meanings (Miles & Huberman, 1994). Subsequently, these words or phrases are categorized into themes depending on the level of similarity and relevance between them.

When conducting data analysis, the qualitative researcher tries to understand and explain the phenomena according to the meaning placed by the participants (Creswell, 2009). Several qualitative data analysis techniques can be used by the researcher such as thematic analysis, content analysis, grounded theory, and hermeneutic analysis (Bhattacherjee, 2012).

The researcher made use of the thematic analysis process when analyzing the primary data obtained through semi-structured interviews and secondary data collected in the form of organizational documents. Themes emerged through a process of reading the data repeatedly and were classified according to categories (Fereday & Muir-Cochrane, 2006). Furthermore, a qualitative analysis software tool called NVivo, was used to process the data upon capturing and importing the interview transcripts.

For this research, the researcher made use of the deductive and inductive approaches when

working with the literature (Saunders et al., 2012). Firstly, a deductive approach to thematic analysis was carried out using pre-defined theory to establish questions and objectives, whereby the interview data was analyzed to identify prominent factors that are taken into consideration by SMEs in the Big Data adoption decision-making process. This approach enabled the researcher to assess the interview data findings with existing research findings. Secondly, the use of inductive thematic analysis enabled the researcher to establish the relationships that exist between Big Data adoption and SME decision-making processes. The use of both approaches resulted in a hybrid process of inductive and deductive thematic analysis (Fereday & Muir-Cochrane, 2006). The researcher made use of Fereday and Muir-Cochrane's (2006) six-step hybrid method of thematic analysis to analyze the primary data and the secondary data. The six-step method used in the analysis is described in the following section.

1. "Developing the code manual.
2. Testing the reliability of codes
3. Summarizing data and identifying the initial themes
4. Applying the template of codes and additional coding
5. Connecting the codes and identifying themes
6. Corroborating and legitimizing coded themes" (Fereday & Muir-Cochrane, 2006, p. 84)

3.8.2 Developing the code manual.

The development of the code manual was a crucial endeavor for this study, largely becauseit operated as a data management tool that assisted in the interpretation of the primary and secondary data collected by the researcher (Crabtree & Miller, 1999). Using a code manual, the researcher gained the ability to demonstrate a trail of evidence which improved the rigor and credibility of the study (Fereday & Muir-Cochrane, 2006). Fereday and Muir- Cochrane's (2006) coding approach was adopted, with each code being produced in the following steps:

1. The code label or name,
2. The definition of what the theme concerned,

3. A description of how to know when the theme occurred.

The code manual was structured into two sections, which are, high-level segments for SME characteristics dimensions and the Big Data characteristics. The code label for adopter characteristics, were presented by using the letter 'S' as a prefix to denote SME, conversely a short code 'AC' was used to denote the high-level category adopter characteristics, thus formulating the full code 'SAC'. Likewise, 'B' was used as a prefix to denote the code names for Big Data characteristics, while a short code 'VOL' was used to denote volume, thus formulating the full code 'BVOL'. Table 8 demonstrates an example of a code generated from the Big Data dimension.

Table 8: An example of a code developed from the Big Data dimension

Codes relating to the Big Data dimension	
Code 1	BVOL
Label	Big Data Volume (Dridi, Sassi & Tissaoui 2015)
Definition	The volume characteristic of Big Data (Dridi, Sassi & Tissaoui 2015)
Description	Big Data refers to high volumes of data (Gartner, 2013). Most traditional data storage units come in Gigabytes and Terabytes. However, it is predicted that the total amount of data collectively generated daily by organizations in the United States of America is in the region of Exabytes (that is approximately a billion times more than Gigabytes). The high volume of data has led to abundant data emerging from multiple streams containing different forms of data that is being generated at an extremely high velocity (Storey & Song, 2017) . These data streams include cloud-based platforms, mobile devices, enterprise data warehouses, and NoSQL databases (Vasiliev, 2013).

3.8.3 Testing the reliability of the codes.

The NVivo software was used to create the code manual before the codes were tested for reliability. Once the codes were created, reliability was tested through a process of applying the codes to the first set of interview transcripts that were imported into NVivo (Fereday & Muir-Cochrane, 2006). The reliability test was a crucial step in the assessment of the applicability of codes to the collected data (Fereday & Muir-Cochrane, 2006). For instance, the template of codes was applied to an interview transcript in Table 9.

Table 9: An example of coding using the template of codes.

Code produced from theory. (High level categories)	Quotation from Data	Source
Environmental influences	"The most immediate environmental issue we saw was that none of our competitors have adopted Big Data yet and that there were no local organizations that had a Big Data product developed yet"	ASBA3

3.8.4 Summarizing data and identifying the initial themes.

The process of summarizing each individual piece of data is crucial as it enables the researcher to enter information "into your unconscious, as well as consciously processing the information" (Boyatzis, 1998, p.45). This process involved reading, listening to interview transcripts, and summarizing the data to identify initial themes (Fereday & Muir-Cochrane, 2006). The voice recordings of the semi-structured interviews were transcribed into the Microsoft Word program which was then followed by the thematic analysis process in NVivo (Braun & Clarke, 2006). The researcher made sure that each word was transcribed as raw as it was collected during the voice recording of the interview process (Braun & Clarke, 2006). This was crucial in ensuring the integrity of the data (Braun & Clarke, 2006). The researcher then compared the transcribed data to the initial voice recordings to ensure that there was accuracy throughout the process (Braun & Clarke, 2006).

3.8.5 Applying template of codes and additional coding.

To extract meaningful pieces of text, the researcher applied the template analytical technique to the transcribed interviews and organizational documents (Crabtree & Miller, 1999). The application of the codes generated from the codebook was the first level of coding (Fereday & Muir-Cochrane, 2006). The transcribed interviews and organizational documents were imported into NVivo, then the codes developed for the code manual were captured as nodes and subsequently coded by matching the codes with sections of the data that were

representative of the code, as demonstrated in Table 10.

Table 10: Applying the codebook to the coding of sources (Fereday & Muir-Cochrane, 2006)

Theory-driven code	Definition	Description	Text
Social Networks	"A Social Network is defined as a set of persons who are linked pairwise, so that each person can reach any other through an active tie" (Ruiz, Mars, Arroyo & Serena, 2016).	"Social networks play a pivotal role in connecting the organizations staff and suppliers of innovative technologies" (Ruiz, Mars, Arroyo & Serena, 2016).	"Social networks give us a unique avenue to not only share information with our employees, but to also engage on issues that affect the business" (BSBA2).

The initial codes served as a guide throughout the analysis process. During the coding of the interview transcripts, inductive codes were allocated to segments of the data which revealed a new theme as it emerged from the transcript, thus merging the two approaches of 'theory-driven' code produced by literature and 'data-driven' codes that emerged from the data analysis process (Braun & Clarke, 2006; Fereday & Muir-Cochrane, 2006). An example of a new theme that was assigned inductively is given in Table 11.

Table 11: An example of new themes assigned inductively.

Code name	Data	Data source
Risk Management	"We have identified that the project charter and the business case are the two most fundamental guidelines to use in mitigating risk factors".	AGRM2

For this study the coding of the transcribed text and organizational documents was performed using the NVivo software package. The data analysis performed through the use on NVivo generated several codes and nodes which can be observed in Figure 12.

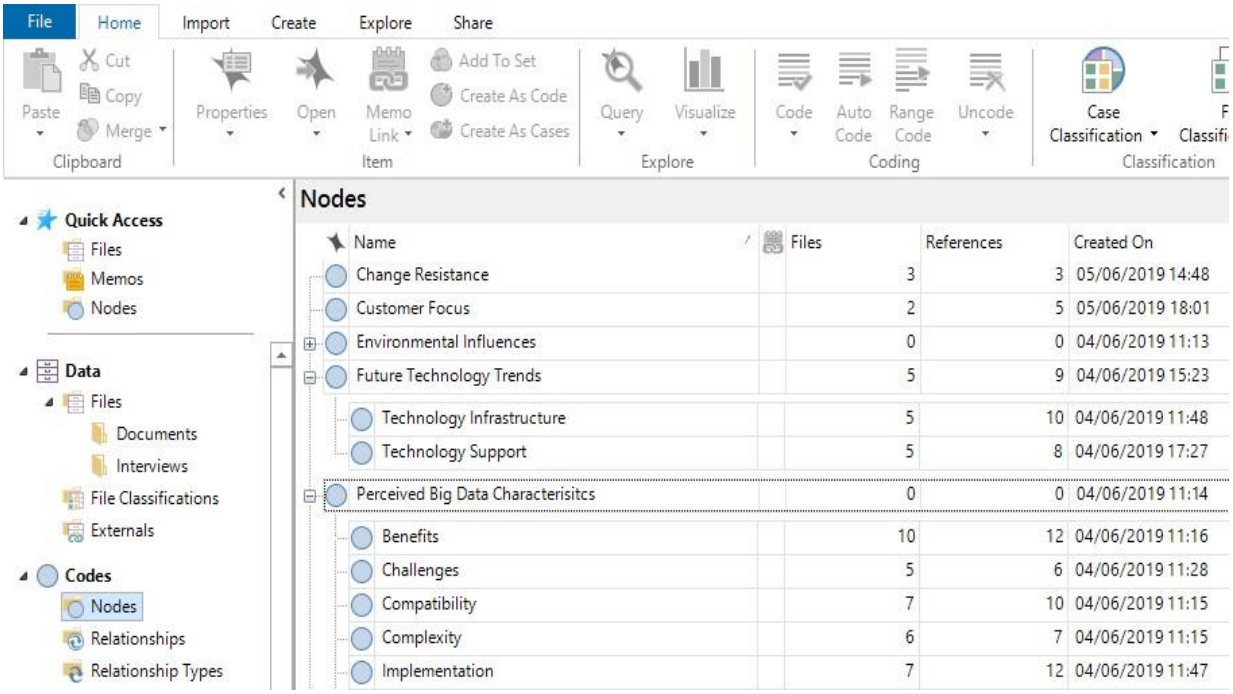


Figure 12: Nodes generated from NVivo data analysis.

3.8.6 Connecting the codes and identifying themes.

The process of identifying new themes and patterns in the data is called connecting codes (Crabtree & Miller, 1999). Since, high-level themes and sub-themes were produced deductively and based on pre-determined literature, additional themes were produced inductively. A new category was created to place all new codes that were not aligned to the pre-determined theme (Braun & Clarke, 2006). In Figure 13, an example of new code categories is produced, where codes such as IT steering committee an operations meeting; IT events and vendor e-mails; and IT Research and Development emerge. At this stage, the researcher started to identify similarities and differences between the different groups of data (Braun & Clarke, 2006).

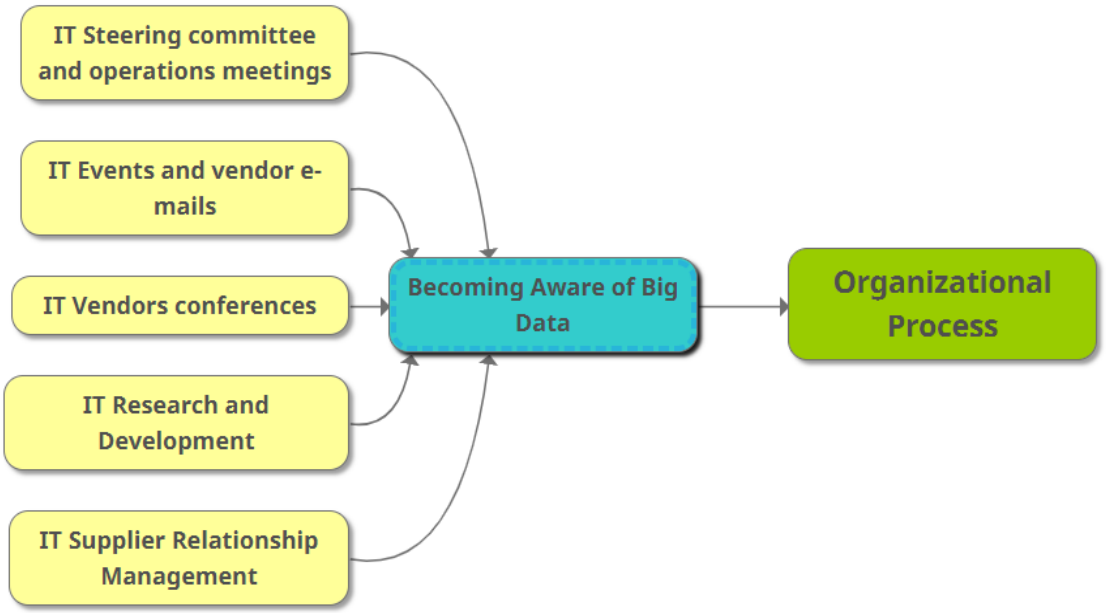


Figure 13: Example of new code categories

3.8.7 Corroborating and legitimizing coded themes.

The sixth and final stage demonstrates the continued process of clustering themes that were initially identified from the coded transcripts (Crabtree & Miller, 1999). According to Fereday and Muir-Cochrane (2006, p. 90), "Corroborating is a term used to describe the process of confirming the findings". During this stage, the researcher is advised to re-read the entire data set to ensure that themes are inclusive of the entire data set (Braun & Clarke, 2006). During this stage, the researcher reviewed the coded data extracts and performed a coherency check (Braun & Clarke, 2006). Upon forming a coherent pattern and deciding on themes, level two of the analysis began (Braun & Clarke, 2006). NVivo was used to produce a matrix coding query to determine co-occurrences of code in the transcripts. Figure 14 demonstrates the outcome of the matrix coding query.

	A : Case A - Interview 1	B : Case A - Interview 2
1 : Environmental Influe...	5	9
2 : Perceived Big Data C...	4	8
3 : Social Networks	8	11
4 : Supplier Marketing Ef...	7	0

Figure 14: Corroborating and legitimating coded themes

3.8.8 Producing the report.

Having applied the deductive and inductive approaches to identify themes that existed, the researcher was then able to begin the final stage of producing a report (Braun & Clarke, 2006).

3.8.9 Summary of the thematic analysis process

The primary and secondary data was collected over a four-month period due to complications with obtaining approval from an organization which had concerns about the protection of their private data. In Table 12, the researcher summarized Fereday and Muir- Cochrane's (2006) thematic analysis steps used in this study with the actions taken.

Table 12: Summary of the thematic analysis (Fereday & Muir-Cochrane, 2006).

Step	Action
1. Developing the code manual	Each code was allocated a label, definition, and a description
2. Testing the reliability of codes	The template of codes was applied to each interview source to extract relevant information for each theme
3. Summarizing data and identifying the initial themes	Reading, listening to interview transcripts, and summarizing the data to identify initial themes
4. Applying the template of codes and additional coding	Capturing the developed codes as nodes in NVivo and matching each section of data with the codes
5. Connecting the codes and identifying themes	Identifying similarities and differences between the different groups of data to formulate themes
6. Corroborating and legitimizing coded themes	Reviewing the coded data and performing a coherency check

Fereday and Muir-Cochrane (2006) describe the thematic analysis processes as one that has steps with a linear flow, however the researcher identified that some of these steps overlap and some run in parallel to each other. For instance, whilst listening through the interviews collected from 'Case Study C', the researcher was generating themes from the data collected from 'Case Study A' and 'Case Study B'.

3.9 Time Frame

Sedgley (2007) states that in Information Systems there are two important research timeline approaches, namely, cross-sectional, and longitudinal. A cross-sectional study is conducted at one point in time or over a short period of time (Levin, 2006). In contrast, longitudinal studies are carried out over an extended period to obtain the data and make the necessary adjustments. This study adopted the cross-sectional approaches because it offers the researcher many benefits. For instance, they are inexpensive and less time consuming than longitudinal studies (Mann, 2003). In addition, this approach allows the researcher to assess many outcomes and risk factors of the study (Levin, 2006). The resources and time available to complete this study were deemed appropriate for a cross-sectional approach.

3.10 Issues of reliability and validity

Over the past decade, several studies have documented the importance of evaluating the accuracy and dependability of research instruments recognized as validity and reliability (Singh, 2017). In qualitative research there are four measures used to maintain quality and rigor: namely credibility, transferability, dependability, and confirmability (Anfara, Brown & Mangione, 2002). The following section details each measure and describes how it has been applied in this research.

3.10.2 Credibility

Credibility is an element that describes the level of truthfulness of the findings. Credibility can be determined and tested with accurate recording of the interviews, word-for-word transcription of the interviews and triangulation of the collected data (Bhattacherjee, 2012). The triangulation process involved the use of multiple data sources such as interviewing

participants twice without changing the interview questions. According to Creswell (2009), if themes were identified from a combination of data sources, then this process has enhanced the credibility of the study. In this study the primary data and secondary data were both used to identify themes.

3.10.3 Transferability

Transferability has been described as the level to which research findings can be generalized (Bhattacherjee, 2012). According to Anfara et al., (2002), amongst other procedures, transferability involves providing a detailed description and the use of purposive sampling. The researcher provided detailed case descriptions and made use of purposive sampling, whereby cases that matched the research objectives were targeted and subsequently interviewed. To assess the replicability of the research within a similar context and similar participants in future, the research methods and data analysis procedures were clearly documented (Henning et al., 2004).

3.10.4 Dependability

In qualitative research dependability has been defined as the level to which two independent researchers observing the same phenomenon at a different time-period can reach the same conclusion (Bhattacherjee, 2012). In this study, dependability will be assured by the researcher through an audit trail (Anfara et al., 2002), by chronological collecting data and documenting of all data analysis results (Creswell & Miller, 2000). Furthermore, to enhance dependability, the researcher made use of triangulation (Anfara et al., 2002).

3.10.5 Conformability

Conformability has been described as the level to which research findings can be independently verified by other researchers (Bhattacherjee, 2012). Triangulation is often used to ensure conformability (Anfara et al., 2002). The researcher demonstrated thatresearch findings were obtained through a detailed coding process not through the researcher's own views. Triangulation was used to reduce the researcher's bias. The following section describes the ethical considerations considered by the researcher during the research process.

3.11 Ethical considerations

Qualitative research often raises the issue of ethics because the researcher in most cases deals with human subjects. Once the ethics approval process was completed, the targeted SMEs were contacted via email and informed about the purpose of the study and the interview questions were disclosed.

To minimize ethical issues in this study a research proposal, ethics form, and research instrument was compiled and submitted to the Ethics committee of the University of Cape Town. The Ethics Committee assessed the contents of the submitted proposal and granted approval (see Appendix C).

Participants were given the opportunity to withdraw from the research at any stage of the research process. A consent form (see Appendix B) was sent to the participants requesting written permission to conduct the study. It stated that should any of the SMEs request the redaction of some of their documents, this would be done accordingly. Furthermore, if any participants requested that their identity had to be made anonymous this would always also be followed. In addition, the researcher gave each organization a code name instead of using the original name. For instance, organization A was given the code name OA and organization B is called OB. The following section details the research limitations encountered by the researcher during the research process.

3.12 Research Limitations

During the data collection process, the researcher identified that some interviewees struggled with differentiating between the concept of Big Data and high volumes of data stored within traditional Structured Query Language (SQL) databases. Since Big Data is a new concept and most SMEs are not readily exposed to the platform, the researcher had to explicitly define and explain what Big Data is about in order to get feedback that was relevant to the study. In addition, during the first set of interviews with participants from the first organization interviewed some participants had challenges with distinguishing between the complexity and compatibility issues regarding Big Data. These participants provided similar answers to

both questions, therefore in subsequent interviews the researcher had to clarify what was meant by complexity and compatibility issues. As a result, there were few similar pieces of text coded in both the complexity and compatibility nodes during the initial data analysis process.

Although the researcher sent out approximately 120 email invites to prospective SMEs deemed suitable for the study, only five organizations were willing to participate in the study but four were finally involved since the fifth organization later declined to participate due to concerns with information security in relation to the Protection of Personal Information Act (2013). The researcher attempted to provide assurance that to the fifth organization that steps such as name anonymization and document redaction will be taken to ensure information security, however the organization's senior management still declined to participate.

The researcher acknowledges that at a post-graduate level, small scale interviews do not accurately reflect the beliefs and views of the greater population. Furthermore, it is not contested that the greater the number of participants increases a research study robustness (Ware & Mabe, 2015). However, due to limited financial and time resources, the researcher commenced and concluded the research with the four organizations without reaching saturation.

3.13 Summary

This chapter detailed the research methodology followed by the researcher in this study. The interpretive research philosophy formed the basis of this research. Subsequently, the nature of the phenomenon being investigated deemed it appropriate that the qualitative research method and research design would best suit this study. Given the limited time and financial resources available to conclude the research process this was a cross-sectional study. The research strategy in this study was multiple case studies. The following chapter provides the findings of the study.

Chapter 4: Findings and Analysis

This chapter aims to provide data that will answer the research questions stated in Chapter 1. The researcher has structured this chapter in the following layout. Section 4.1 describes the cases used in the study. Subsequently, section 4.2 presents all the findings of the study. This is followed by section 4.3 which discusses the factors considered by SMEs when making innovation adoption decision. Subsequently, section 4.4 discusses processes followed by SMEs when making innovation adoption decision. Lastly, the researcher provides a conclusion to the chapter.

4.1 Description of case studies

The researcher attempted to obtain interviews with six SMEs, however only fiveorganizations agreed to be part of this study. Of the five organizations that agreed to be partof this study four were interviewed as the fifth organization withdrew after one interview session was performed due to information security concerns. This section provides a description of each case study. Interestingly, the researcher identified similarities between the four case studies which are listed in Table 13.

Table 13: Similarities between the four cases

Similarities between Cases
1. Case study A and C are in the same business district in the Cape Town. Both case studyA and C are direct competitors operating in the same industry
2. Case C and D recently performed a migration to Microsoft Office 365 operating system around the same period, although Case D experienced some technical implementation challenges which delayed their "go-live" date.
3. Case A and D host their systems data on a cloud storage platform.
4. Both Case Study B and C have adopted the same ERP system in the past which was implemented by the same vendor
5. Case Study A, C, and D are listed on the JSE stock exchange
6. All four SMEs have headquarters situated in Cape Town
7. All four SMEs have a predominantly white male senior management structure
8. All four SMEs were started before 1994

4.1.1 Case Study A

Case A is an entity that operates in the Print Manufacturing industry. The organization has an annual turnover of approximately R2 billion based on the 2018 year-end financial statements. The organization has an IT department with its own allocated operational and capital expenditure. The organization adopts a new IT system approximately every three years with many systems currently in operation across its plants. Case A's senior managers view technology as a tool to improve operational efficiency, therefore they are constantly on the lookout for new IT systems.

4.1.2 Case Study B

Case B operates in the food and beverages industry and is owned by a French based parent company. Goods produced by this organization are exported internationally with Germany, France, the United States of America, and Britain being their main target market. Case B's senior management indicated that business applications are adopted based on the strategic objectives of the organization. The ERP systems used in this organization are supported by

external vendors and 60% of these vendors are internationally based. ERP systems support cost is described as one of the most important costs for the IT department of this organization.

4.1.3 Case Study C

Case C is an entity that was established in the early 1970's. Similarly, to Case A, this organization operates in the Print Manufacturing industry. The organization had its first plant in the Cape Town and expanded to a total of four plants across South Africa. This has been listed on the JSE stock exchange since the early 21st century. The IT department of this organization has been described as "cutting-edge" by the senior management. Case C has an ERP system with approximately 15 modules and is in the process of adopting an internationally recognized financials ERP.

4.1.3 Case Study D

Case D is an organization that produces and exports a variety of customized furniture products. A significant proportion of the organization's clientele is based in Europe and the United States of America; therefore, the organization relies heavily on technological innovations. The organization has a vast network of contracted IT specialists based in the Cape Town and Johannesburg. The Information Security Officer highlighted that a significant proportion of the organization's IT capital expenditure is allocated to maintaining and upgrading various ERP systems.

Table 14 summarizes the characteristics of all the four case studies that participated in this study including the type of data that the researcher was provided.

Table 14: Case Study Summary

Name of Organization	Core Industry	Annual Turnover for the 2018 financial year-end	Data provided to the researcher
Case A	Print Manufacturing	R1.5 – 2 billion	• Interviews • Organizational documents
Case B	Food and Beverages	R1 – 1.5 billion	• Interviews
Case C	Print Manufacturing	R1 – 1.5 billion	• Interviews • Organizational documents
Case D	Furniture Manufacturing	R600 – R900 Million	• Interviews • Organizational documents

4.2 Presentation of the findings

This section presents the findings which emerged from the study. The findings are divided into two main sections namely factors and processes. The factors were analyzed first, and the processes were analyzed last. Each process contains different stages, namely, becoming aware of Big Data; formulating a budget; presenting a business case; adhering to compliance policies; and ensuring operational stability.

Several themes emerged from each category. The researcher described each theme and subsequently provided a summary of the results from the data coding. The discussions section that follows explains the findings through a brief description of how the theme was established. Furthermore, each theme is then supported and or contrasted with literature findings.

In the process of analyzing each theme, the researcher drew diagrams to illustrate how one

theme is connected to another theme in some instances. The following section demonstrates an analysis of the factors which emerged from the study that SMEs take into consideration when making the Big Data adoption decision.

4.3 Factors considered by SMEs when deciding to adopt Big Data.

Over the course of the study the researcher used the conceptual framework by Frambach and Schillewaert (2002), as a guideline to prepare the interview questions. During the data collection and data analysis themes such as Government Contracts, Relative Advantage of Big Data, and Network Participation emerged which further expanded the understanding of the factors that SMEs consider in the Big Data adoption decision-making process.

This section focuses on the factors which were identified through research. As stated previously, each theme contains sub-themes which emerged during the interview coding process.

Table 15 provides an overview of the five factors categories and themes that emerged from the transcripts of the four cases.

Table 15: Factors themes found in this study

	Categories	Theme(s)
Factors	**1. Environmental Influences**	1.1 Competitive Pressure
		1.2 Regulatory Environment
	2. Perceived Big Data Characteristics	2.1 High Cost of Big Data
		2.2 Big Data Compatibility
		2.3 Big Data Complexity
		2.4 Relative Advantage of Big Data
	3. SME Characteristics	3.1 Organizational Change Resistance
		3.2 Organizational IT Strategy
		3.3 Communication Channels
	4. Social Networks	4.1 External Network Participation
		4.2 Training Courses
	5. Supplier Marketing Efforts	5.1 IT Vendor Presentations

Table 16 provides a summary of benefits evident in each case; the total number of text appearances found in the transcript per case and benefit (conversational density) as well as the total number of text appearances for each realized benefit across all the cases investigated.

Table 16: Summary of Big Data adoption factors in each case

Factors	Cases analyzed and matching text				Total appearancesper factor
	C1	C2	C3	C4	
1. Environmental Influences					
1.1 Competitive Pressure	X2	X2	X0	X2	6
1.2 Regulatory Environment	X3	X0	X2	X0	5
2. Perceived Big Data Characteristics					
2.1 High Cost of Big Data	X0	X2	X3	X0	5
2.2 Big Data Compatibility	X2	X3	X2	X2	12
2.4 Big Data Complexity	X3	X2	X3	X2	10
2.5 Relative Advantage of Big Data	X0	X0	X2	X3	5
3. SME Characteristics					
3.1 Organizational Change Resistance	X3	X0	X2	X3	8
3.2 Organizational IT Strategy	X0	X2	X3	X2	7
3.3 Communication Channels	X2	X0	X2	X0	4
4. Social Networks					
4.1 External Network Participation	X2	X3	X2	X2	9
4.2 Training Courses	X2	X3	X2	X2	9
5. Supplier Marketing Efforts					
5.1 IT Vendor Presentations	X2	X2	X3	X2	9

Key

X	2	The factor was evident in the case. It was mentioned 2 times in the interview sessions
X	3	The factor was evident in the case. It was mentioned 3 times in the interview sessions
X	1	The factor was evident in the case. It was mentioned once in the interview sessions
X	0	The factor was not evident in the case. It was not mentioned in the interview sessions

As demonstrated in Table 16, green appears more frequently. This suggest that a significant proportion of the respondents were knowledgeable about the factors that affect the adoption of Big Data. Yellow appears less frequently, suggesting that some respondents had some form of knowledge about the factors that affect the adoption of Big Data. Red appearsa few times which suggests very few respondents were aware of the factors that affect the adoption of

Big Data.

4.3.1 Environmental Influences

This section focuses on an organizational factor called Environmental Influences which emerged from the study. In this section, existing literature will be used as a reference point to either support or counter the findings that emerged in this study.

4.3.1.1 Competitive Pressure

This theme describes the influence of competitors with regards to the decision to adopt Big Data by SMEs. The theme was mentioned in three of the cases. The quotes mentioned in the following table reveals the SMEs views in the cases analyzed:

Table 17: Summary of the Competition Pressure theme quotes

Respondent	Quote
AGRM2, C1	… "If our competitors adopt Big Data this might encourage us to do more research on Big Data, but we would also need to understand the cost of this platform."
BCIO4, C2	… "To a certain degree our competitors perform the same operations we do, and they use similar technology infrastructure we use. Therefore, we must closely pay attention to the IT strategy of our competitors. Failure to do this would result in us failing to adapt to the changes in the market."

Concerning the influence of competition on the SMEs decision to adopt Big Data, a significant proportion of the respondents indicated that the pressure to stay on par with the technological advancements made by competitors positively encourages their organization to adopt new technology like Big Data. For instance, Respondent AGRM2 mentioned, "If our competitors adopt Big Data … we would also need to understand the cost of this platform." Some respondents also mentioned how some IT systems have been considered and adopted because of the IT systems acquisitions by indirect competitors where they are in the same industry. These findings are supported by literature which states that SMEs need to invest in

long-term competitive strategies to survive and grow in the macro economy (Pansiri & Temtime, 2008). Furthermore, it is essential that SMEs perform an analysis of the dynamics of competition within the industry they operate (Olawale & Garwe, 2010).

However, there were few respondents who indicated that competition does not always directly influence their decision to adopt a new IT innovation. For instance, Respondent BCIO4 mentioned, "To a certain degree our competitors perform the same operations…. adapt to the changes in the market". These views seem to agree with literature which statesthat firms with a large market share tend to adopt a new technology due to their ability to leverage profits from the adoption. While relatively smaller firms such as SMEs struggle withkeeping up with these corporations due to the high upfront costs (Hall & Khan, 2002).

4.3.1.2 Regulatory Environment

This theme describes the effect of the regulatory environment with regards to the decision to adopt Big Data by SMEs. The theme was mentioned in three of the cases. The quotes mentioned in the following table reveal the SMEs views in the cases analyzed:

Table 18: Summary of the Regulatory Environment theme quotes

Respondent	Quote
DTSM2, C4	… "As a SME organization we operate on a modest budget, and we depend on Government contracts to fund expensive IT projects. There has been a recent change in one of our government contracts which has forced us to reduce costs within every department including IT. This added to the pressure to drop the adoption of new innovations like Big Data."
AGRM2, C1	… "At the executive level there are many things happening externally that we have to be aware of with things likegovernment contract amendments always have a direct impact on the business."

With regards to the effect of the Regulatory Environment with regards to the decision to adopt Big Data by SMEs, many respondents indicated that government contractsboost their

income and increase their capability to adopt an innovation like Big Data. For instance, Respondent DTSM2 stated, “As a SME organization we operate on a modestbudget, and we depend on Government contracts…adoption of new innovations like Big Data”.

These findings are supported by Literature which reveals that Government contracts and policies have a significant impact on the sustainability and growth of SMEs, through the revenue they generate when undertaking government projects (Hoekman, Saab & Tas 2019). In addition, government spending and grants represents a meaningful source of income for SMEs as it promotes job creation, investment in new technology, and increase in productivity (Ferraz Finan & Szerman, 2015). Lastly, government spending tends to incentivize SMEs uptake of risky business adventures (Slavtchev & Wiederhold, 2016).

However, there is evidence in literature which states that SMEs need more than financial backing from Government through contracts. For example, Small Enterprise Development Agency (2019) indicated that SMEs need Government business mentorship programs, reduction in business development red tape, and market access and networking.

4.3.2 Perceived Big Data Characteristics

This section focuses on an organizational factor named Perceived Big Data characteristics of the study. The Perceived Big Data characteristics have been adapted from the conceptual framework proposed by (Frambach & Schillewaert, 2002). Themes emerged during the study such as High Cost of Big Data, Big Data Compatibility, Big Data Complexity, and the Relative Advantage of Big Data. However, some of the themes that were proposed by Frambach and Schillewaert (2002) did not emerge in this study. These themes include Big Data Trialability, Big Data Observability, and Big Data Uncertainty. These themes did not appear due to the data collected reflecting that the respondents did not mention them in their responses.

4.3.2.1 High Cost of Big Data

One of the most common themes to emerge from the study is the High Cost of Big Data. This theme describes the challenges of the high cost that SMEs encounter when they consider adopting Big Data. The theme was mentioned in all the cases. The quotes mentioned in the following table reveal the existence of Big Data cost challenges in the cases analyzed:

Table 19: Summary of the High Cost of Big Data theme quotes

Respondent	Quote
CMM2, C3	… "It is my understanding the cost to implement Big Data is significantly high and I suspect that this may be one of the reasons why management chose to scrap the idea completely."
BSBA2, C2	… "The task of possibly having to redesign and reconfigure our infrastructure has proven to be one of the stumbling blocks in our quest to adopt Big Data. The cost alone is in the region of millions and possibly in foreign currency, so we are very unclear as to the worthiness of taking on such a task."

A large proportion of the respondents expressed that Big Data presents many financial challenges when considering the adoption of Big Data. These challenges include the high cost of implementation, integration, and maintenance. For instance, Respondent CMM2 mentioned, "It is my understanding the cost to implement Big Data is significantly high…management chose to scrap the idea completely".

These findings are supported by literature which states that the data complexity aspect of Big Data platforms presents significant challenges such as processing and analyzing data (Alharthi, Krotov & Bowman, 2017). Another major challenge that SMEs face when considering adopting Big Data is financing the high-cost infrastructure (Wang & Weibe, 2016). Furthermore, financial challenges are one of the crucial resources' challenges which SMEs encounter (Rangone, 1999).

4.3.2.2 Big Data Compatibility

This theme describes how the compatibility of Big Data impacts on the SMEs decision to adopt. The theme was mentioned in all the cases. The quote mentioned in the following table reveal the existence of the theme in the cases analyzed:

Table 20: Summary of the Big Data compatibility theme quotes

Respondent	Quote
DTSM2, C4	… "Most of the IT systems we use are adopted based on the hardware or machinery we use in production. The concern is that Big Data might force us to change the hardware we have on the shop floor presses which would be massively expansive."

Based on the feedback from the respondents it was evident that the perceived compatibility of Big Data to the IT infrastructure has a significant influence on the decision to adopt Big Data. For instance, Respondent DTSM2 mentioned that "... The concern is that Big Data might force us to change the hardware we have on the shop floor presses which would be massively expansive."

These findings are supported by literature which states that the compatibility of Big Data is positively associated with adoption (Nedev, 2014). In fact, the greater the perceived compatibility of Big Data, the quicker the adoption rate increases (Yaqoob et al., 2017).

Furthermore, compatibility has frequently been a factor that affects the adoption of new technologies like Big Data (Chen et al., 2014). For instance, the greater the perceived compatibility of Big Data, the greater the adoption rate (Yaqoob et al., 2017).

4.3.2.3 Big Data Complexity

Amongst the several key themes identified in the study, Big Data Complexity has been mentioned the most. This theme describes how SMEs perceive the complexity of Big Data. The theme was mentioned in all the cases. The quotes mentioned in the following table reveal the existence of the theme in the cases analyzed:

Table 21: Summary of the Big Data complexity theme quotes

Respondent	Quote
BPM3, C2	… "Our IT environment is largely built on legacy systems which host and support the network throughout the plant. Based on what I have heard Big Data requires state of the art cloud computing. It seems too complicated to introduce it to our business and that is partly why adoption is lagging."
BCIO4, C2	… "The more complex a system looks from the onset then resistance comes naturally to most people. There is apparent resistance to technology like Big Data in this organization because it comes down to the question "How will Big Data fit into our business Model". Big Data appears to be complex and at the same time we are running on legacy systems so there are questions around whether Big Data will fit into the business. These are the main concerns I have observed around Big Data."

Many respondents indicated that the complexity of Big Data presents challenges that negatively influences the adoption of Big Data. These challenges include the complex implementation and resistance to change. For instance, Respondent BPM3 stated that, "Our IT environment is largely built on legacy systems … It seems too complicated to introduce it to our business and that is partly why adoption is lagging.".

These findings seem to suggest that there is a relationship between the perceived complexity of Big Data and the adoption rate. Literature states that the lower the perceived complexity of Big Data, the greater the chance that SMEs, the greater the possibility of adoption (Ahmad et al., 2016).

However, Walker and Brown (2019) stated, it is not always possible to quantify the value of Big Data upfront which plays a significant role in complexity tolerance of most organizations. They state that each organization has a complexity tolerance that influences its focus from Big Data awareness to the actual adoption.

4.3.2.4 Relative Advantage of Big Data

Over the course of this study the researcher identified that the Relative Advantage of Big Data was frequently mentioned in literature. This theme describes how SMEs can achieve relative advantage across their organizations using Big Data. The theme was mentioned in three of the cases. The quotes mentioned in the following table reveal the existence of the theme in the cases analyzed:

Table 22: Summary of the Relative Advantage of Big Data theme quotes

Respondent	Quote
DISO1, C4	… "A third-party contractor once came to our department to present and demonstrate how effective Big Data can be used in our business. The demo had a live feed of some data we normally store on the QA SQL environment. My point is we were able to see how our customer data can be used to provide us with better understanding of their needs and how best we can approach the market to reach more customers."
BSBA2, C2	… "The one I can immediately think of is how Big Data can collect the information we produce in each of the sensors installed on the production machine to help us make sense of this data. Currently this data is used to identify breakdowns and issues in production, but we think there is unused potential value that Big Data would enable us to view."
AITP4, C1	… "There are perceived real-time reporting benefits according to my knowledge. I would say that if it can help us as senior manager to make informed decision in real time that would be a crucial benefit incurred."

It was interesting to observe how frequently this theme was mentioned by respondents. One could infer that their responses correlated with literature which views relative advantage as a positive influence on the adoption of Big Data. For instance, Respondent DISO1, stated that "A third-party contractor once came to our department to present and demonstrate how effective Big Data can be used in our business… we were able to see how our customer data

can be used to provide us with better understanding of their needs and how best we can approach the market to reach more customers." Furthermore, … "The one I can immediately think of is how Big Data can collect the information we produce in each of the sensors installed on the production machine to help us make sense of this data..."

These findings are supported by literature that reveals that the adoption of new technology is majorly influenced by the perceived relative advantage (Koren, Hallin, Perel & Bendet, 2019) .Interestingly, in the case of Big Data adopters have incurred benefits such as enhanced data sourcing, robust data sharing, and improved decision-making support (Ahmad et al., 2016).

4.3.3 SME Characteristics

This section focuses on an organizational factor called SME characteristics. During the study three sub-themes emerged such as Organizational Change Resistance, Organizational IT Strategy and Communication Channels as summarized in this section. However, some of the themes that were proposed by Frambach and Schillewaert (2002) did not emerge in this study. These themes include SME Size, SME Structure, and SME Strategic Posture. The possible explanation for these missing themes in the collected data is that the respondents were not referring directly to these themes in their answers although their responses could be traced back to these themes.

4.3.3.1 Organizational Change Resistance

Organizational Change resistance is another theme that the respondents mentioned frequently. This theme describes how SMEs encounter change resistance across the organization due to the proposed adoption of Big Data. The theme was mentioned in three of the cases. The quotes mentioned in the following table reveal the existence of change resistance in the cases analyzed:

Table 23: Summary of the Organizational Change resistance theme quotes

Respondent	Quote
BPM3, C2	… "The more complex a system looks from the onset the resistance comes naturally to most people. There is apparent resistance to technology like Big Data in this organization."
DTSM2, C4	… "I think whenever you introduce something new like Big Data, people have questions about whether this will replace their job or whether they will now be burdened with more work in addition to what they already do. The concerns rest around job security in most cases."

The respondents in the study expressed a negative feeling towards the introduction of a change in their work environment.

It was interesting to observe that many respondents shared a common view that change resistance influences the adoption of Big Data. One can deduct from the data that complexity has a significant impact on the resistance to adopt Big Data by SMEs. For instance, Respondent BPM3 shared that "The more complex a system looks from the onset then resistance comes naturally to most people...".

These findings are supported by literature which states that a well-managed change management program is essential for the sustainability of SMEs in a highly competitive economy (Luecke, 2003). Furthermore, to achieve sustainability, it is imperative to incorporate the change management program at the core of the business (Alesi, 2008). On the other hand, there is an argument, which states that firms must adapt and develop a resilience capacity which will give them the capability to capitalize on improved reaction to change within the environment (Lengnick-Hall & Beck, 2011).

4.3.3.2 Organizational IT Strategy

This theme describes the value of the Organizational IT Strategy in the adoption of Big Data by SMEs. The theme was mentioned in three of the four cases. The quotes mentioned in the

following table reveal the existence of IT Strategy in the cases analyzed:

Table 24: Summary of the Organizational IT Strategy theme quotes

Respondent	Quote
AIT1, C1	… "Yes, to a certain extent it is nearly impossible to draft the IT strategy without considering the latest trends in the market and how we will adapt to move with the trends as the failure to do this would put as at a great risk of becoming irrelevant in the market."
BSBA1, C2	… "At the high-level we have an IT Plan which is commonly referred to as the IT Strategy by most people and I am assuming that is what you are referring to in this question. Basically, this document points to the key areas that need investment and support to achieve the plan of the business. So much so it also outlines the budget to spend on new projects, equipment upgrades, license fees renewals etc."

Based on the data one could identify a pattern of a significant proportion of the respondents expressing that the IT strategy performs an integral role in many aspects of their organizations ranging from IT security, competitive strategy, business continuity plans, the development and training of staff, and the adoption of next generation technology like Big Data. For instance, Respondent BSBA1, reported that "…this document points to the key areas that need investment and support to achieve the plan of the business. So much so it also outlines the budget to spend on new projects, equipment upgrades, license fees renewals etc.".

These findings are supported by literature which states that to achieve success in the macro economy, SMEs need a clear ICT strategy which will facilitate the process of adoption(Wong, 2005). Furthermore, there needs to be clear alignment between business and information technology for improved business performance (Kappelman, McLean, Johnson& Gerhart 2014). In addition to this, a well-defined and implemented IT Strategy has an influence on the adoption of Big Data (Chen et al., 2014).

4.3.3.3 Communication Channels

The coding process revealed the Communication Channel theme. This theme demonstrates the value of Communication Channels as part of the decision to adopt Big Data. The quotes mentioned in the following table reveal the existence of Communication Channels in the cases analyzed:

Table 25: Summary of the Communication Channel theme quotes

Respondent	Quote
CMM2, C3	… "We do not have a dedicated research and development department, so we rely on the research and analysis conducted by our Business Analysts. This information is usually shared in the form of presentations at the various meetings we host amongst senior management."
ASBA3, C1	… "There are the formal communication channels such as the operations meetings and there are informal channels such as having a discussion with the project managers or business analysts depending on who is available at the time."
AIT1, C1	… "On a monthly basis we send out survey throughout the organization that gauges the satisfaction from the service we provide as the IT department. This survey also serves as a method we use to get people's opinion and ideas on how we can improve the business from an IT perspective. Employees can give feedback and suggestions, so this is the channel available to members of the group."

The respondents indicated that there are formal and informal channels of communications that exist within their organization which provide them with opportunities to discover new innovations such as Big Data. Interestingly, one respondent mentioned that their organization uses surveys as a form of gauging employee satisfaction from the services provided by the IT department to the entire organization. The responded indicated this platform enables them to share new ideas. Therefore, one can see the relevance and importance of

communication channels in creating awareness about Big Data amongst SMEs.

These findings agree with the literature which states that a balance between formal and informal communication and key stakeholders increases trust and reduces conflict of interest (Naidoo, 2012). Furthermore, Aulich (2013), stated that the presence of a communication channel between project managers and staff is crucial to the success of projects. Therefore, communication channels provide a positive contribution to the success of projects, by encouraging the participation of project members (Aulich, 2013).

4.3.4 Social Networks

This section focuses on an organizational factor called Social Networks. During the study two sub-themes emerged as summarized in this section

4.3.4.1 External Network Participation

This theme describes the value of Network Participation amongst SMEs in relation to the adoption of Big Data. The theme was directly mentioned in one of the cases. However, in two cases it was indirectly mentioned. The quotes mentioned in the following table reveal the existence of Network Participation in the cases analyzed:

Table 26: Summary of the External Network Participation theme quotes

Respondent	Quote
BPM3, C2	… "By being part of a vast network of IT suppliers, contractors, and IT support teams, we have been exposed to new technology and developments within the IT Field that have transformed business models. Things like 5G networks, cloud computing, blockchain, and many more were concepts introduced to us through one of these network systems."
BSBA2, C2	… "Speaking from experience business improves significantly if there are two things present being capital and a solid network. Having access to people and information in a timely fashion helps the business achieve its goals quicker. For instance, itwould not be possible for us to be clued up on exactly what Big Data or if it can be of any value to our business. In a network you can just call up someone with expert knowledge and get clued up immediately."

It was interesting to observe that some respondents referred to the value of Network Participation not only in relation to the adoption of Big Data, but also in the general approach to innovation adoption. For instance, respondent BPM3 stated that "Our IT Manager shared the good news about the HR system we have now installed in the business after one of his former colleagues recommended it…". This demonstrates that network participation does encourage the adoption of innovation amongst SMEs.

These findings agree with the literature which states that networks form an integral role amongst SMEs with scarce resources as they require support from external organizations (Mäläskä Saraniemi & Tähtinen, 2011). In addition, by participating in networks, SMEs are exposed to the latest trends in the world of IT as well as information that will enable them to grow their business operations (Chittithaworn et al., 2011). Furthermore, networks are strategic for thegeneration of new ideas and innovation (Freytag & Young, 2018).

However, there is also literature which argues that there is limited academic research to

demonstrate the true value of network participation on the performance of the firm. For instance, many studies focused on the impact of networking on the performance of SMEs in so-called 1st world countries, but little evidence exist of these same studies on the value of networking on the performance of SMEs in developing countries (Tooksoon & Mudor 2012).

4.3.4.2 Training Courses

This theme emerged because of the consistent reference to the importance of training courses with regards to the adoption of Big Data. Interestingly, some respondents linked the importance of going through training courses as a remedy to change resistance. The quotes mentioned in the following table demonstrates the references in the cases analyzed:

Table 27: Summary of the Training Courses theme quotes

Respondent	Quote
BCIO4, C2	… "The organization discovers new technological innovations from the IT seminars and conferences that the Business Analysts attend when they go for training courses overseas."
DTSM2, C2	… "Better training and better awareness workshops would be the best solution as this will provide people with better understanding of how to integrate Big Data to the current IT setup."

A significant proportion of the respondents expressed that training courses support their understanding of Big Data. In some, cases some respondents mentioned that these courses help them perform better when a new system is introduced. For example, Respondent BCIO4, stated that "The organization discovers new technological innovations from the IT seminars and conferences ...".

These findings are supported by literature which states that there is a link between high employee performance and training (Litz & Stewart, 2000). In addition, structured training courses should be developed in SMEs to improve and generate new skills (Afolabi & Macheke, 2012). Furthermore, Ongori and Nzonzo (2011), stated that training and development is essential for SMEs given the high levels of competition in the international economy.

However, there is also literature which argues that SMEs are not always able to accumulate the benefits from the high cost of training programs (Hodorogel, 2009). Furthermore, SMEs fear carrying the high cost of training courses for employees who will eventually leave them for more lucrative opportunities (Organisation for Economic Co-operation and Development Staff, 2002). One can identify that these differing costs and benefits explain why SMEs place low priority on employee training courses and development (Storey, 2004)

4.3.5 Supplier Marketing Efforts

This section focuses on an organizational factor called Supplier Marketing Efforts which emerged from the study.

4.3.5.1 IT Vendor Presentations

Several respondents indicated that the visual and live presentations conducted by IT vendors gave them an understanding of the different capabilities of Big Data. Through the analysis of the feedback from the respondents the "IT Vendor Presentations" theme emerged. This theme describes how presentations by IT vendors enable SMEs to discover information about Big Data. The theme was mentioned in three of the four cases. The quotes mentioned in the following table reveal the existence of IT Vendor Presentations in the cases analyzed:

Table 28: Summary of the IT Vendor Presentations theme quotes

Respondent	Quote
BPM3, C2	… "I first came to hear about the Big Data concept at seminar hosted by one of our key vendors where they presented to senior management how most IT departments will look like in the next 10 years."
DTSM2, C4	… "They can start by simplifying how they present Big Data as a new technology and by also demystifying people's general perceptions of how it works. If you check online there isso much information sort of conflicting each other about what Big Data really is. Some sources say it is a Big Data Base engine and others say it's a Data processing platform for high volume data. As a business you are not sure what it is and how it will improve the business. So, I think they can take a leaf out of companies like Apple and market Big Data in a simplified uniform way."

It was interesting to observe how respondents linked IT vendor presentations to the adoption of Big Data within their organizations. Many respondents mentioned that presentations help them gain a better understanding of Big Data, whilst a few stated thatthe presentation formats could be simplified to make the information about Big Data less technical. For instance, Respondent BPM3, mentioned "I first came to hear about the Big Data concept at seminar ..."

These findings agree with the literature which states that presentations by IT vendors help create contact between a potential client and serve as a platform to clarify misconceptions through question-and-answer sessions (Hershey, 2005). Furthermore, presentations by IT vendors help managers to make an informed decision when acquiring an innovation like Big Data (Gordon, Perrey & Spillecke, 2013).

4.4 Process followed by SMEs when making innovation adoption decision.

This section focuses on the five organizational processes which were identified through research. As stated previously, each theme contains sub-themes which emerged during the interview coding process.

The processes identified were categorized into a sequence based on the conceptual framework adopted in Chapter 2. According to Frambach and Schillewart (2002), the processes of adoption follow a sequence of phases where a potential adopter of an innovation learns and assesses the new service or product before making an adoption decision. As a result, a potential adopter like an SME organization follows three stages before reaching the adoption decision, namely: 1. Awareness, 2. Consideration, and 3.Intention. Figure 15 depicts the three organizational process's themes and the sub-themes.

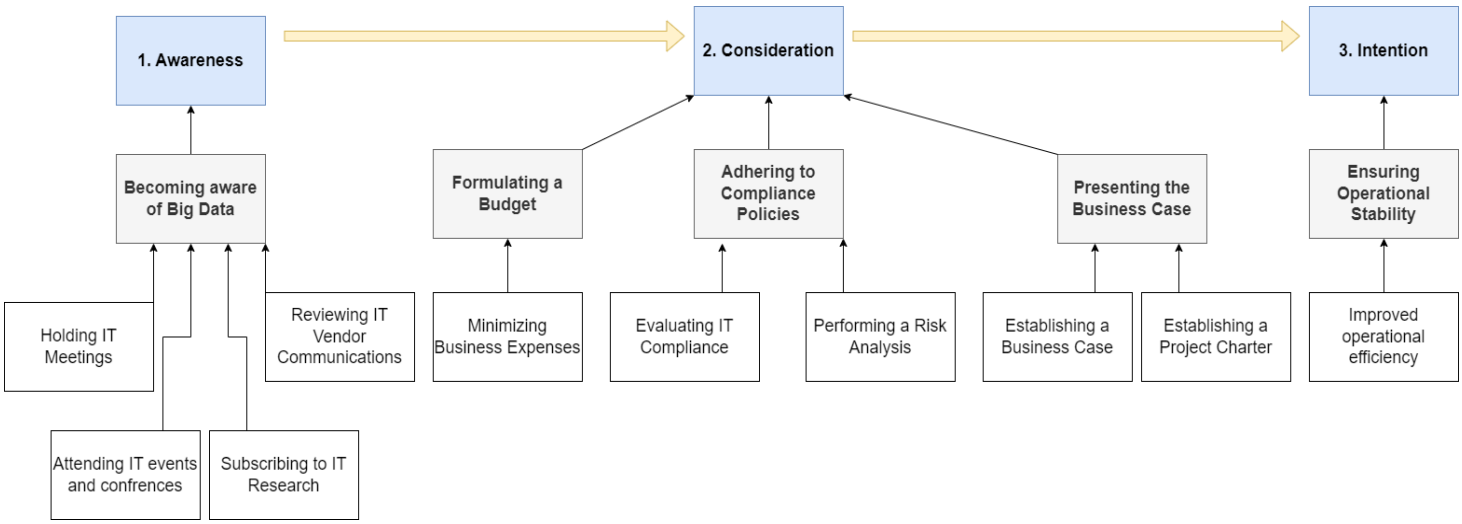


Figure 15: Organizational process influencing the Big Data adoption decision

Table 29 provides an overview of the three organizational process categories and sub-themes that emerged from the transcripts of the four cases.

Table 29: Organizational Process themes found in this study

	Process Name	Main theme	Sub-themes
Organizational Process	**1. Awareness**	Becoming Aware of Big Data	1.1 Holding IT Meetings
			1.2 Reviewing IT vendor communications
			1.3 Attending IT events and conferences
			1.4 Subscribing to IT Research
	2. Consideration	Formulating a budget	2.1 Minimizing Business Expenses
		Adhering to compliance policies	2.2 Evaluating IT Compliance
			2.3 Performing a Risk Analysis
		Presenting the Business Case	2.4 Establishing a Business Case
			2.5 Establishing a Project Charter
	3. Intention	Ensuring Operational Stability	3.1 Improved Operational Efficiency

Table 30 details the five processes and the total number of text appearances evident in each of the four cases analyzed.

Table 30: Summary of the Big Data adoption process evident in each case study

Processes		Cases analyzed and matching text				Total appearances per factor
Number	**Theme and Sub-theme**	**C1**	**C2**	**C3**	**C4**	
1	**Becoming Aware of Big Data**					
1.1	Holding IT Meetings	X2	X2	X3	X2	9
1.2	Reviewing IT vendor communications	X2	X0	X3	X2	7
1.3	Attending IT events and conferences	X3	X2	X1	X3	11
1.4	Subscribing to IT Research	X0	X3	X0	X2	5
2	**Formulating a Budget**					
2.1	Minimizing business expenses	X3	X2	X2	X2	8
3	**3. Presenting a Business Case**					
3.1	Establishing a Business Case	X2	X2	X2	X2	8
3.2	Establishing a Project Charter	X0	X0	X3	X2	5
4	**Adhering to Compliance Policies**					
4.1	Evaluating IT Compliance	X2	X2	X3	X2	13
4.2	Performing a Risk Analysis	X2	X0	X0	X0	2
5	**Ensuring Operational Stability**					
5.1	Improved Operational Stability	X0	X0	X2	X3	5

Key

X	2	The process was evident in the case and explicitly mentioned 2 times in the interview sessions
X	3	The process was evident in the case though it was not named explicitly. It was mentioned 3 times in the interview sessions
X	1	The process was not evident in the case though It was mentioned once in the interview sessions
X	0	The factor was not evident in the case. It was not mentioned in the interview sessions

As shown in Table 30, the green appears frequently. This suggests a significant proportion of the processes mentioned were known to the respondents. Yellow is scattered indicating that fewer respondents were knowledgeable about the process. Red appears less frequently meaning the process was not significantly evident in the cases analyzed.

The following section discusses Awareness as the first stage an SME organization follows before reaching the adoption decision.

4.4.1 Becoming Aware of Big Data

Brand awareness enables potential customers to make an informed decision with regards to the purchase of goods and services (Hassan et al., 2010). Knowledge and awareness of Big Data is highly influenced by personal experience. Personal experience encompasses the ability to interpret the definition of Big Data, understanding the formation of Big Data and being able to identify the different types of data within an organization (Izhar & Shoid, 2016). Improved understanding of Big Data can increase insights and lead to competitive advantage (Assunção et al., 2015).

Table 31: Summary of the Becoming Aware of Big Data theme quotes

Respondent	Quote
AITP4, C1	… "It is interesting to share how I came to know of Big Data. We have these sessions in the morning in the IT department where we have stand ups and sprint sessions. After one these sessions the scrum master posted in the group chat a link to ITWeb which spoke about this new technology called Big Data. Being an inquisitive person, I went on to read and actually discovered that its potential is unlimited."
BSBA2, C2	… "As a Business Analyst one of my job requirements is to research and identify new technology that can improve business performance. In one of my analyses, I had identified that Big Data is quite a dynamic tool. If I could be honest, at the time it sounded like one of those fantasy innovations but the potential to improve business performance was there."

Many respondents indicated that their personal experiences enabled them to discover Big Data through various platforms. These platforms include sprint meetings and the internet. For instance, Respondent AITP4, stated that "It is interesting to share how I came to know of Big Data. We have these sessions in the morning in the IT department where we have stand ups and sprint sessions. After one these sessions the scrum master posted in the group chat a link to ITWeb which spoke about this new technology called Big Data...".

The findings support the literature which states that knowledge and awareness of Big Data is highly influenced by personal influence. For instance, one Business Analyst indicated that they became aware of Big Data through analysis they performed. This demonstrates that the awareness of Big Data can be enhanced through improving on personal experiences amongst SME managers.

4.4.1.1 Holding IT meetings

Over the course of the coding process several themes emerged with Meetings being one of them. This theme describes how SMEs became aware of Big Data through various formal and informal meetings within each SME. The theme was mentioned in all the cases. However, in case 3 (C3), the theme was mentioned less frequently. The dominant factors that had an influence on this theme were found to be Organizational Information System (IT) Strategy and External Network Participation in section 4.3. This is because most if not all the IT meetings held by the interviewed SMEs were informed by both these factors. The quotes mentionedin the following table reveal the existence of meetings in the cases analyzed:

Table 32: Summary of the Holding IT Meetings theme quotes

Respondent	Quote
BPM3, C2	… "There are informal discussions that occur between the IT steering committee and IT vendors during the quarterly meetings, whereby current business challenges are discussed, and the IT vendors provide information on how other organizations solved these issues."
AITP4, C1	… "We host weekly operations meetings whereby non- executive management discuss ideas to improve the operations of the organization. Around four months back at one of our weekly operations meetings, we had an informal Discussion about Big Data as we were discussing the latest tech trends in the market."

Many respondents indicated that they became aware of Big Data through formal andinformal meetings. For instance, Respondent BPM3, indicated that they became aware of Big Data

through “There are informal discussions that occur between the IT steering committee and IT vendors during the quarterly meetings, whereby current business challenges are discussed ...”. Respondent AITP4, also stated that “We host weekly operations meetings whereby non-executive management discuss ideas to improve the operations of the organization … we had an informal Discussion about Big Data as we were discussing the latest tech trends in the market.”

These findings agree with the literature which states that social gatherings in the form of face-to-face IT meetings can be one of the most effective techniques used in the dissemination of information in SMEs (Ngah & Ibrahim, 2010). Furthermore, SMEs often have a few people with technological knowledge leading to low knowledge transfer across the organization, as result IT meetings assist in the transfer of knowledge (Desouza &Awazu, 2006).

4.4.1.2 Reviewing IT vendor communications

This theme describes how SMEs became aware of Big Data through advertisements from 3rd party organizations. The theme was mentioned in three of the four cases. The dominant factors that had an influence on the theme was through IT vendor presentations and Communication Channels in section 4.3. This is because the IT vendor presentations and communication channels to SME informed the process of reviewing IT vendor communication. The quotes mentioned in the following table demonstrate the existence of advertisements theme in the cases analyzed:

Table 33: Summary of the Reviewing IT vendor communications theme quotes

Respondent	Quote
BSBA2, C2	… "The vendors or suppliers that we work with send us information about trending technological advancements in the form of email. This is the standard format in which we become aware of new innovations … this is the common form of advertisement we receive from our vendors."
CPBA1, C3	… "One of our major suppliers whom I cannot name for various reasons inform us regularly through emails that contain information packages and posters. This information helps us to become knowledgeable about new innovations."

Most of the respondents expressed that their awareness of Big Data was enhanced through marketing information obtained from the suppliers of IT services. For instance, Respondent CPBA1, stated that "One of our major suppliers whom I cannot name for various reasons informs us regularly through emails that contain information packages and posters...". Furthermore, Respondent BSBA2, stated that … "The vendors or suppliers that we work with send us information about trending technological advancements in the form of email...".
This in turn, demonstrates evidence that the relationship between suppliers of IT services and SMEs is essential to raise awareness about new innovations like Big Data.

These findings agree with the literature which states that knowledge sharing by suppliers is vital to the successful completion of an SME innovation project (Ngah & Ibrahim, 2010). Furthermore, information sharing enhances the coordination between supply chain processes, thus improving the performance of SMEs with regards to costs (Carr & Kaynak, 2007).

4.4.1.3 Attending IT events and conferences.

This theme depicts how SMEs become aware of new technological innovation through conferences regularly hosted by IT vendors. The theme was mentioned three times in one case and indirectly mentioned two times in two other cases. The dominant factors that had

an influence on the theme were found to be IT vendor presentations and Training courses in section 4.3. This is because the IT vendor presentations to SMEs informed the process of becoming aware of new innovations like Big Data. The quotes mentioned in the following table demonstrate the existence of the IT vendor conference theme in the cases analyzed

Table 34: Summary of the Attending IT events and conference's theme quotes

Respondent	Quote
BCIO4, C2	… "The organization discovers new technological innovations from the IT seminars and conferences that the Business Analysts attend when they go for training courses overseas. TheAnalysts who attend these conferences not only read about the new innovations, such as Big Data, but they also interact with prototype products which enhances their understanding immensely."
BPM3, C2	… "There is obvious value we have incurred from the conferences in our field. Its ever changing with new concepts and ideas either floating around or being introduced. Take the case of our migration from paper-based accounting systems to cloud based system. It all came down to an idea which was presented at a conference in the US which gave us a glimpse to the potential future value of the system seeing as the system migration was long overdue anyway."

The researcher observed that many respondents place value on attending IT events and conferences as platform to gain awareness of new innovations like Big Data. For instance, Respondent BCIO4, reported that "The organization discovers new technological innovations from the IT seminars and conferences that the Business Analysts attend when they go for training courses overseas...". Furthermore, Respondent BPM3, stated that "There is obvious value we have incurred from the conferences in our field. Its ever changingwith new concepts and ideas either floating around or being introduced...".

These findings demonstrate the effectiveness of using conferences as a platform to acquire more knowledge about new innovations such as Big Data. One may argue that although SMEs operate with limited resources, it is imperative to create opportunities for staff to attend IT

conferences. For instance, conferences are a great way of getting face-to-face interaction with subject matter experts and they are a great way to start collaborations on projects (Oester et al., 2017). Furthermore, uniting people with unique expertise has resulted in enhanced understanding of complex issues (Oester et al., 2017).

4.4.1.4 Subscribing to IT Research

Literature has revealed that Research and Development is one of the key priorities for organizations that seek to maintain a strong competitive edge. This theme demonstratesthe value that SMEs place on Research and Development. The dominant factor that had an influence on the theme was found to be Communication Channels in section 4.3. This is because the communication channels that are established in SMEs contributed to the knowledge acquired by SMEs on Big Data. Two respondents mentioned the theme in one case. The quotes mentioned in the following table demonstrate the existence of subscribing to IT Research theme in the cases analyzed:

Table 35: Summary of the Subscribing to IT research theme quotes

Respondent	Quote
BCIO4, C2	… "We subscribe to ITWeb and Gartner. These research firms provide us with rich information about the technology trends in the market. They also give us insight into the next generation hardware and software that will be used in the industry."
DISO1, C4	… "We have a standing contract with a company called Aragon which is a research-based company. Most of the senior IT management rely on their research when it comes to IT related research issues."

A large proportion of the respondents expressed that Research and Development provide valuable insight into the new innovations such as Big Data which then increases their awareness. For instance, Respondent BCIO4, stated that "We subscribe to ITWeb and Gartner. These research firms provide us with rich information about the technology trends in the market...".

These findings demonstrate the value that most SMEs place on collaborative IT Research and Development as a mechanism to acquire more knowledge about new innovations such as Big Data. This is supported by literature which states that, Research and Development and strategic alliance formation remains one of the most important strategic actions to undertake to ensure the success and survival SMEs (Dickson et al., 2006).

4.4.2 Formulating a Budget

As discussed in the literature review (chapter 2), SMEs often operate with a limited budget and lack of access to capital markets. Budgeting enables SMEs to effectively select potential investments (Verbeteen, 2006). This theme was evident in the cases analyzed as can be seen in the following quote:

…" The budgeting process on our annuals, quarterlies and so on is crucial to where we go next as an entity. You must remember that as an organization our size every expense and revenue counts, so yes budgeting does contribute to the decisions of what to do next in the IT department" … (BCIO4, C2)

The following section describes the theme that emerged, namely, minimizing business expenses.

4.4.2.1 Minimizing business expenses

This theme describes how SMEs aim to minimize business expenses has impacted the decision to adopt Big Data. The respondents indicated that it is important to consider how adopting an innovation like Big Data impacts their drive to minimize business expenses. The theme was mentioned in all the cases. The dominant factor that had an influence on the theme was found to be Organizational IT Strategy in section 4.3. This is because the process of minimizing is informed by the IT Strategy that the SMEs have implemented. The quote mentioned in the following table reveals the SMEs views in the cases analyzed:

Table 36: Summary of the Minimizing business expenses theme quotes

Respondent	Quote
BCIO4, C2	… "We adopted a system in 2019 due to its proven potential to streamline the process of paper storage across the department…all the systems we adopt must demonstrate a proven record of efficiency and this is one of the difficulties of considering Big Data since it is so new."
BPM3, C2	… "Due to the underperformance of the business and the increasing staff costs we had as a result of all the manual back- end task that we had to run when capturing new orders for clients, we had to implement a new order requisitioning system that automates the back end-off manual task of capturing new orders as this would lower the manual workload for our staff."

This theme has been widely reported by the respondents to be a major influencer in their decision to adopt Big Data. It is evident from the responses that SMEs factor in business expenditure in their budget when deciding to adopt an innovation like Big Data. For instance, Respondent BCIO4, mentioned that "We adopted a system in 2019 due to its proven potential to streamline the process of paper storage across the department…all the systems we adopt have to demonstrate a proven record of efficiency and this is one of the difficulties of considering Big Data since it is so new."

The analysis of the findings demonstrated that SMEs strongly consider the adoption of an innovation like Big Data when it minimizes business expenses. For instance, Respondent (BCIO4, C2) stated that a new system was adopted by their HR department since it demonstrated the potential to save the business money.

The following sections discuss the task that from part of Consideration, the second stage an SME organization follows before reaching the adoption decision.

4.4.3 Presenting the Business Case

This theme emerged from the data when the respondents were asked about the importance of documents when assessing the adoption of an innovation like Big Data. It was interesting to observe how many respondents referred to the business case as most SMEs often referto this document as a business plan. The discussions presented in this section highlight the importance of presenting a business case as an instrument to increase awareness of Big Data amongst SMEs which can ultimately increase the adoption rate. The following section describes the sub-themes that emerged, namely, establishing a business case and establishing a project charter.

4.4.3.1 Establishing a Business Case

Literature has revealed that most organizations place significant importance on the presentation of a Business Case document in the event of potentially adopting a new technological innovation. Interestingly, most of the respondents in the study indicated that they had some knowledge on the documentation of the Business Case. For instance, in two of the cases business case documentation was mentioned once, whilst in the fourth case it was mentioned twice. This theme describes the value of the Business Case document to SMEs with regards to the decision to adopt Big Data. The dominant factors that had an influence on this theme were found to be Competition Influences, Relative advantage of Big Data, and Availability of Government Contracts in section 4.3. This is because these factors were considered by the SMEs when establishing a business case.

The quotes mentioned in the following table reveal the SMEs views in the cases analyzed:

Table 37: Summary of the Establishing a business Case theme quotes

Respondent	Quote
AGRM2, C1	… "The Business Case document informs us of the risks in undertaking any project in the IT environment. I think this not only applies to our organization, but all JSE listed companies. It is one of the shareholder requirements to document these things."
BSBA2, C2	… "A business case needs to be presented by a project manager at the executive committee meeting, whereby details such as cost. A final decision is made in the following meeting where a list of priority projects is presented to the delegates..."

This theme emerged as result of the respondent's revelation that the Business Cases determined the outcome in the decision to adopt IT innovations like Big Data. Many respondents revealed that the Business Case is often presented to demonstrate the value of an innovation like Big Data to reach an informed decision in the adoption process. For instance, Respondent BSBA2, mentioned that "A business case needs to be presented by a project manager at the executive committee meeting, whereby details such as cost and risk analysis are mentioned explicitly...". Furthermore, Respondent AGRM2, also added that … "The Business Case document informs us of the risks in undertaking any project in the IT environment...".

These findings agree with literature which states that a Business Case plays a significant role in the explanation of the value creation and decision-making processes, within organizations (Ward & Daniel, 2006).

4.4.3.2 Establishing a Project Charter

A project charter is a tool that is used as a form of stakeholder agreement, enabling the authorization to commence with a project (McKeever, 2006). The researcher has established that some SMEs' use this tool as control to determine which IT project will be adopted. In this

study, this theme represents the perception of the SMEs toward the use of a project charter as a measure to minimize overspending on new projects. The dominant factor that had an influence on this theme was found to be Big Data Complexity in section 4.3. This is because one factor was considered by the SMEs when establishing a Project Charter.

The theme was mentioned in three of the four cases. The following quote demonstrates the existence of the project charter theme in the cases analyzed:

Table 38: Summary of the Establishing a Project Charter theme quote

Respondent	Quote
AGRM2, C1	… "We have identified that the project charter and the business case are the two most fundamental guidelines to use in mitigating risk factors. The project charter provides details on who will be involved in the project and what time frame will be used to deliver the project. The business case provides details on what business challenge will be solved, how much it will costand how will we deal with change management issues that may arise. In some cases, we use one of these guides or combine them depending on the size of the project."

This theme was mentioned by one of the respondents as one of the contributing factors to the decision to adopt Big Data. The respondent indicated that the Project Charter is presented upfront with details of the required items for the completion of the project. For instance, Respondent AGRM2, stated that "We have identified that the project charter and the business case are the two most fundamental guidelines to use in mitigating risk factors. The project charter provides details on who will be involved in the project and what time frame will be used to deliver the project...".

These findings demonstrate that some SMEs place importance on using the project charter as a guideline for the successful implementation of IT innovations like Big Data. This is supported by literature which states that, a project charter plays the role of an enabler of a project's alignment with organizational goals (Dobriansky, 2008).

4.4.4 Adhering to Compliance Policies

IT adoption strategies are significantly different between SMEs and larger corporations due to IT compliance requirements (Azmi et al., 2016). IT compliance manifests itself in various forms depending on the nature of the business. For instance, some organizations refer to best practices and organizational governance policies when describing their ITcompliance policies (Foorthuis & Bos, 2011). The following section outlines the three themes that emerged out of the study, namely, Evaluate IT Compliance, securing a Service Level Agreement, and Performing a Risk Analysis.

4.4.4.1 Evaluating IT Compliance

This theme describes how SMEs evaluate IT compliance with regards to the decision to adopt Big Data. The theme was mentioned in two of the cases. The dominant factors that had an influence on this theme were found to be Organizational IT Strategy and Big Data Compatibility in section 4.3. This is because these factors were considered by the SMEs when evaluating IT compliance of Big Data to their organization.

The quotes mentioned in the following table reveal the SMEs views in the cases analyzed:

Table 39: Summary of the Evaluating IT Compliance theme quotes

Respondent	Quote
DISO1, C3	… "There is an IT compliance metric form that was drawn up by the Chief Information officer which contains guidelines around project risks. We usually reference this form when analyzing the appropriateness of a project adoption."
CPBA1, C3	… "Usually if the IT compliance metric identifies that an innovation places significant burden to the business due to things like asset depreciation, tax costs and maintenance costs then the innovation gets rejected. In the past five years there have been several innovations that fit into this category."

One of the tools used by the SMEs as a criterion for selecting and approving the adoption of IT projects like the adoption of Big Data is the IT Compliance. Many of the respondents

expressed the importance of using an IT Compliance Metric as a tool to address IT security concerns when acquiring an innovation like Big Data. This is evident from the data, for instance, Respondent CPBA1, "Usually if the IT compliance metric identifies that an innovation places significant burden to the business due to things like asset depreciation,tax costs and maintenance costs then the innovation gets rejected...". Furthermore, Respondent DISO1, stated that "There is an IT compliance metric form that … we usually reference this form when analyzing the appropriateness of a project adoption."

These findings agree with the literature which states that IT Compliance Metrics perform an effective role in identifying the effectiveness of IT security protocols (Ahmed, 2016).

4.4.4.2 Performing a Risk Analysis

This theme describes the effect of the Risk Analysis with regards to the decision to adopt Big Data by SMEs. The theme was mentioned in three of the cases. The dominant factors that had an influence on this theme were found to be Organizational IT Strategy and Big Data Complexity in section 4.3. This is because these factors were considered by the SMEs when performing a risk analysis of Big Data to their organization.

The quotes mentioned in the following table reveal the SMEs views in the cases analyzed:

Table 40: Summary of the Performing a Risk Analysis theme quotes

Respondent	Quote
AITP4, C1	… "For each project that we undertake, the mandate is always to meet project deadline and stay within budget. We operate on a thin budget and the technology might still be unproven. So, the Project Risk Analysis approach enables us to reduce the risk of not meeting these objectives."
CPBA1, C3	… "Each project has special requirements and scope. After we have established the size of the project, we then perform a risk analysis which is done by the Business Analyst like me. We list all the risks and categories them according to potential business impact. Level one is for minor risks like 2-week delay in implementation. Level two I would say is more medium. Level three is more serious risks like new orders not integrating to our payment systems. The higher the risk the less chances we will take with purchasing the system."

Respondents indicated that the Risk Analysis enables them to make an informed decision when adopting an innovation like Big Data. This was corroborated by Respondent CPBA1, who stated that "Each project is unique. Each project has special requirements and scope. After we have established the size of the project, we then perform a risk analysis which is done by the Business Analyst like me…The higher the risk the less chances we will take with purchasing the system."

These findings are supported by literature which states that it is essential for SMEs to establish risk analysis to ensure the success of their IT projects (Napp, 2011). Furthermore, SMEs that have perform a risk analysis experience significant positive outcome on projects (Roque & De Carvalho, 2013).

The following section discusses Intention as the third stage an SME organization follows before reaching the adoption decision. This stage is called intention. This stage describes how SMEs consider the intention factors that contribute the desire to adopt an innovation like Big Data.

4.4.5 Ensuring Operational Stability

Over the course of this study, the researcher identified that both SMEs and larger corporations share a common interest in ensuring the financial and operational stability of the business. The sub-theme mentioned in this section feed back to the main theme of Ensuring Operational Stability.

4.4.5.1 Improved Operational Efficiency

This theme describes the prospect of improved operational efficiency with regards to the decision to adopt Big Data by SMEs. The theme was mentioned in three of the cases. The dominant factors that had an influence on this theme were found to be Organizational IT Strategy and the Relative Advantage of Big Data in section 4.3. This is because these factors were considered by the SMEs in the process of ensuring that there is continuous operational

efficiency improvement.

The quotes mentioned in the following table reveal the SMEs views in the cases analyzed:

Table 41: Summary of the Improved Operational Efficiency theme quotes

Respondent	Quote
DTMS2, C4	… "Improved operational efficiency and the ability to reduce manufacturing costs would be a considerable motivator for the organization to adopt Big Data."
CPBA1, C3	… "The design of our operational processes needs to be reviewed as we speak. This is because we have been operating on a blueprint that was designed a decade ago. Big Data is one of the most advanced systems I am aware of and if it can be incorporated into a new process design it would improve our operations."

A large proportion of the respondents indicated that operational efficiency within their organizations can be improved by Big Data. According to Porter (1996), operational effectiveness refers to the ability of setting processes, based on core capabilities within the organizations, which work well.

These findings agree with the literature which states that an efficient use of resourcesallows SMEs to eliminate waste, adequately adapt to technological advancements and perform better than most competitors (Porter, 1996). Furthermore, firms that operate efficiently experience higher productivity which results in greater profit (Berger, Hunter & Timme, 1993). According to Ifeanyichukwu (2011), organizations like SMEs can achieveoperational efficiency through well optimized business processes and reducing production costs.

4.5 Summary

An updated conceptual model was developed in this study and applied to provide answers to the initial research questions. The conceptual model was adapted from the framework proposed by Frambach and Schillewaert (2002). The initial framework proposed by Frambach

and Schillewaert (2002) detailed the factors considered by organizations in the adoption decision but did not detail the processes followed by SMEs in the adoption decision as can be seen in Figure 16. The conceptual framework further expands on the initial framework to also show the relationship between the organizational factors and the organizational processes considered by SMEs.

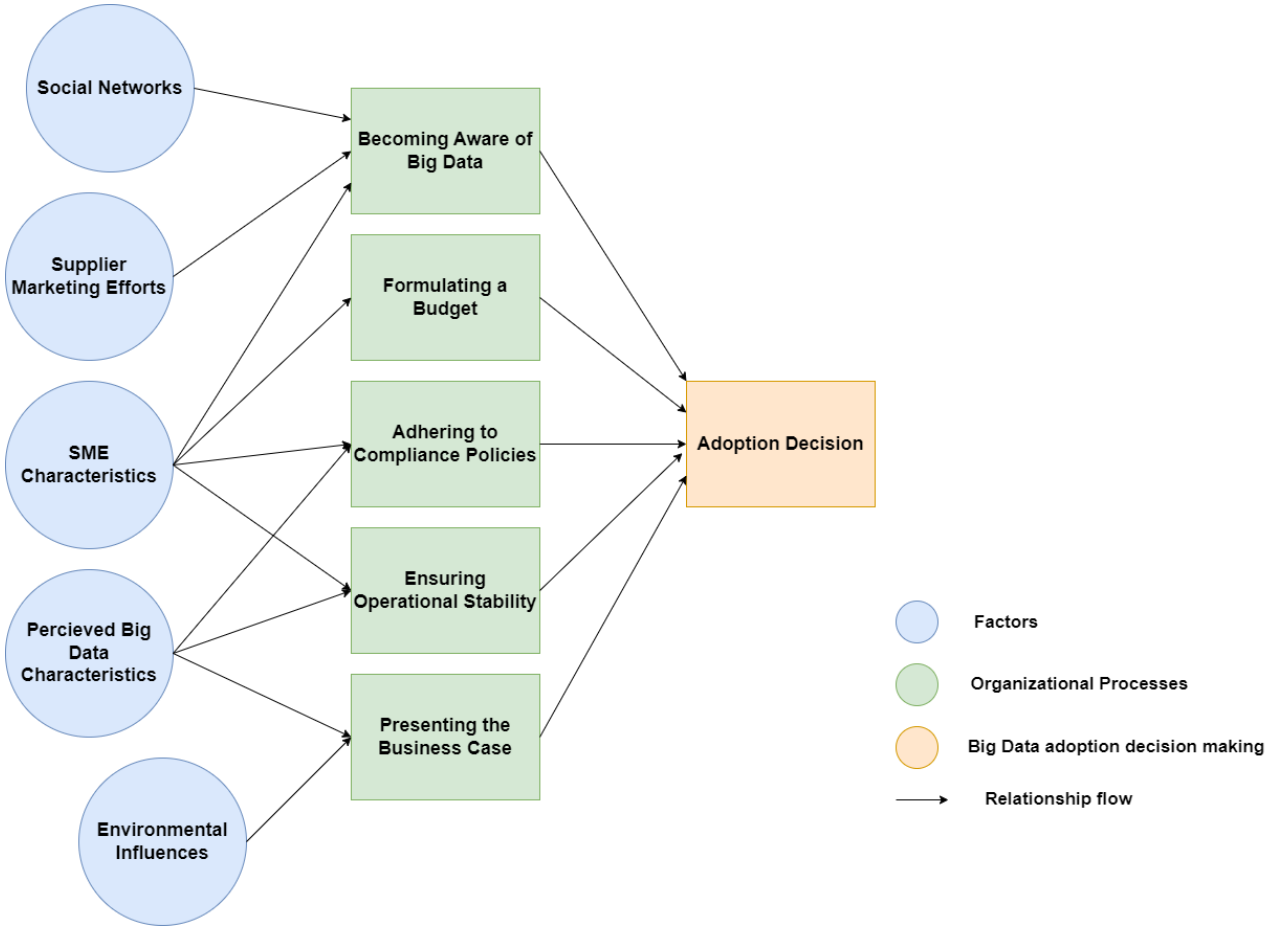


Figure 16: Relationship between Organizational Processes and Factors in the Big Dataadoption decision-making process.

This chapter detailed the findings derived from the data analyses procedure followed by the discussions based on these findings. As per the introduction, the findings were divided into two main sections namely factors and processes. The factors were analyzed first, and the processes were analyzed last. Each process contained different categories. Processes were segmented into five categories, namely, becoming aware of Big Data; formulating a budget; presenting a business case; adhering to compliance policies; and ensuring operational stability. Similarly, five categories were formulated for factors. These included environmental

influences, perceived Big Data characteristics, SME characteristics, social networks, and supplier marketing efforts. Interestingly, over the course of the analysis new themes emerged which resulted with the proposal of a Conceptual Framework in the last section of this chapter. In Figure 16, the relationship between the Organizational Processes and Organizational Factors is represented through the links between the two.

The following section provides conclusions, recommendations, and areas for further study.

Chapter 5: Conclusions, Recommendations and Areas for Further Study

5.1 Introduction

This thesis aimed to explain the factors that SMEs consider during the Big Data decision process, as presented in Chapter 1. Literature related to the study was presented in Chapter 2. In Chapter 3, the research methodology was explained. Subsequently, the research findings and discussions were presented in Chapter 4. This chapter provides a conclusion and summary of the findings gathered throughout the study to identify the level to which the research questions have been answered.

The remainder of this chapter is structured as follows: section 5.2 provides the summary of answers to the research question, section 5.3 presents the contribution and recommendations, section 5.4 provides a conclusion by outlining the limitations and future work that can enhance the understanding of the Big Data adoption decision process by SMEs.

5.2 Summary of answers to the research questions

5.2.1 What is the process followed by SMEs when deciding to adopt Big Data?

The findings suggest that the process that is followed in the decision to adopt Big Data by SMEs follows a three-step approach. This indicates that for Big Data to be adopted by SMEs there must be organizational readiness to go through the process. The first step in the adoption decision-making process is Awareness, this is where SMEs become aware of Big Data. This study identified themes that contribute to the awareness of Big Data by SMEs such as holding IT meetings, reviewing IT vendor communications, attending IT events and conferences, and subscribing to IT Research. The second step in the adoption decision- making process is Consideration, this is where SMEs consider several items in the adoption

of Big Data. This study identified themes that contribute to the consideration of Big Data by SMEs such as formulating a budget, adhering to compliance policies, and presenting the business case. Furthermore, sub-themes were identified such as minimizing business expenses, evaluate IT compliance, securing a service level agreement, performing a risk analysis, business case documentation, and project charter. The third step in the adoption decision-making process is Intention, this is where SMEs analyze the intention to adopt Big Data. This study identified the main intention for SMEs to adopt Big Data is to ensure operational stability. Improved operational efficiency was identified as the supporting sub-theme.

As the three-step adoption process is brought to focus, this study has raised awareness about the process that SMEs, academic researchers, IT practitioners and government need to place emphasis on to improve the adoption of Big Data by SMEs.

5.2.2 What factors do SME managers consider when deciding to adopt Big Data?

The findings suggest that the factors that influence the decision to adopt Big Data by SMEs are both organizational and environmental. This indicates that for Big Data to be adopted by SMEs there must be organizational and environmental readiness. Organizational factors include SME Characteristics, Perceived Big Data Characteristic, Social Networks, and Supplier Marketing Efforts. The identified factors were discussed in terms of opportunities and challenges. For instance, as opportunities, organizational factors identified in this study include network participation, training courses, IT vendor presentations, and the relative advantage of Big Data. With regards to challenges, this study identified change resistance, Big Data compatibility, Big Data complexity, and Big Data challenges. Environment factors that influence the decision to adopt Big Data by SMEs include competition influences, and lack of government contracts.

As the organizational and environmental factors are brought to focus, this study has raised awareness about the opportunities and challenges that SMEs, academic researchers, IT

practitioners and government need to place emphasis on to improve the adoption of Big Data by SMEs.

5.2.3 What can be done to improve the Big Data adoption decision for SMEs?

The findings revealed that SMEs should focus more on the "SME characteristics" and "perceived big data characteristics factors as they both influences several organizational processes. The suppliers of Big Data platforms also need to focus on providing as much information to organizations such as SMEs to increase awareness of Big Data and reduce uncertainty which can improve the adoption rate.

5.3 Contribution and recommendation

Academic literature: This study adds value to the existing body of knowledge through the information collected from the participants which gives SMEs an insight to the factors that are important to consider in the Big Data adoption decision making process. Furthermore, researchers who are interested to get the views of SMEs in developing countries will be able to have more information to guide their future studies. The conceptual framework developed in this study can also be used for future research to produce new and improved research frameworks.

Industry: A large portion SMEs in South Africa operate with limited budgets and often do not have the financial capital to conduct research and development into innovative technologies that can drive their business forward. SMEs that are aiming to use technology to improve business operations will be able to get an understanding of the Big Data technology and the benefits it can provide their organization.

Conceptual Framework: In Chapter 4 an updated conceptual framework was presented to further expand on the initial framework discussed in Chapter 2 Figure 10. The updated conceptual framework in Figure 16 shows the relationship between the organizational factors and the organizational processes considered by SMEs in Cape Town.

The diagram demonstrated that there are five factors considered by SMEs in the adoption of

Big Data namely, environmental influences, perceived Big Data characteristics, SME characteristics, social networks, and supplier marketing efforts. Furthermore, there are five organizational processes followed by SMEs in the adoption of Big Data namely, becoming aware of Big Data; formulating a budget; presenting a business case; adhering to compliance policies; and ensuring operational stability.

The diagram in Figure 16 demonstrated how the factors and processes interlink through a relationship flow to answer the first two research sub-questions raised in Chapter 1. This conceptual framework can be further expanded in future studies.

5.4 Limitation of the study and future work

Over the course of this study the researcher identified several limitations. Firstly, the researcher limited the study to SMEs located in the Western Province. As a result, the

sample used in this study was limited to SMEs that met the research requirement of size, annual revenue turnover, and past innovation adoption. Future research should encompass participants from other provinces as this will provide more insight and answers to the research question. Additionally, there was limited time to conduct the study which further limited the number of participants involved in the study. Secondly, the research participants had different work schedules which meant that the researcher had to follow strict timelines, and this resulted in participants not fully expressing their knowledge. Thirdly, the data collection process was identified as a limitation of this study. Participants were interviewed through interviews and document reviews.

Future research can be done over longer periods to improve insight into the factors that SMEs consider when adopting Big Data.

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Appendix A - Cover letter and Interview protocol

Explaining the Big Data adoption decision in Small and Medium-Sized Enterprises: Cape Town case studies

Explaining the Big Data adoption decision in Small and Medium-Sized Enterprises in Cape Town

This is a research project being conducted by Lonwabo Matross at the University Cape Town. We are inviting you to participate in thisresearch project because you have been identified as a potential decision maker in the adoption of Big Data. This research has been approved by the Commerce Faculty Ethics in Research Committee.The purpose of this research project is to analyse the factors that Smalland Medium-Sized Enterprises consider when choosing to or not to adopt Big Data. Your participation in this research is voluntary. You can choose to withdraw from the research at any time.

The interview will take approximately 45 minutes to complete

By providing feedback to this study, you agree to the following:

1. I confirm that I have read and understand the information sheet explaining the above research project and I have had the opportunity to ask questions about the project.

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without there being any negative consequences. In addition, should I not wish to answer any question or questions, I am free to decline. (If I wish to withdraw, I may contact the lead researcher at any time)

3. I understand my responses and personal data will be kept strictly confidential. I give permission for members of the research team to have access to my anonymized responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the reports or publications that result for theresearch.

4. I agree for the data collected from me to be used in future research.

5. I agree for to take part in the above research project.

For further clarity contact:
Principal researcher: Lonwabo Matross
Mobile: +27 815124076
Email: MTRLON001@myuct.ac.za

Contact details of the senior research supervisor:
Prof. Lisa Seymour
University Cape Town
Department of Information Systems
Email: lisa.seymour@uct.ac.za

SECTION 1: Interviewees Demographics

Interviewee	
Full Name:	
Position:	
Organisation:	
Division:	
Department:	
Business Unit or Team:	
Career	
Number of Years with organisation:	
Previous Position (in organisation , elsewhere):	
Organisation	
Sector	
No of employees	
Total Turnover	
Location	
Year Of Incorporation	
Interview Data	
Date:	
Venue:	
Duration:	

SECTION 2: Supplier Marketing Efforts

What supplier marketing factors made your organization aware of Big Data?
(These factors could be competitive advantage, operational efficiency, cost saving etc.)

Targeting

1. How does your organization learn about a new technological innovation such as Big Data?
2. Are you aware of any suppliers that send marketing information to the IT department?

Communication

1. What communication channels does your organization use to discover new technological innovation such as Big Data? (E.g. Conferences, forums, and supplier presentations)
2. Has there been any formal communication about Big Data amongst IT staff members in the past 2 years?
3. What communication channels are available if any IT staff member wishes to propose the adoption of a new technological innovation as Big Data?

Risk reduction

1. What policies or guidelines does your organization use to reduce business risk when deciding to adopt a new technology like Big Data?

2. Are there any innovations that have not been adopted because they pose a risk to the business?

SECTION 3: Social Network

What social networks enabled you to discover Big Data? (E.g. company workshops, operations meetings, executive committee, board meetings etc.)

Network participation

1. Does your organization subscribe to any IT research and advisory company such as, Gartner, International Data Corporation (IDC), Forrester research, and IHS Markit?

SECTION 4: Environmental Influences

What environmental factors contribute to your organizations decision to adopt or not adopt Big Data? (e.g. Implementation support, post adoption support, consumer spending, tax laws etc.)

Network Externalities

1. If the organizations competitors choose to adopt Big Data will this motivate your organization to also adopt?
2. Is the IT innovation adoption strategy in your organization influenced by the IT strategy of your organization's competitors?

SECTION 5: Perceived Innovation Characteristics

What are the Big Data characteristics that will encourage or discourage your organization to adopt the technology?

Relative Advantage

1. Are there any operational improvements that can be made by introducing Big Data?

Compatibility

1. Are there any technology compatibility concerns that will lead to Big Data not being adopted by your organization?

Uncertainty

1. What are the uncertainty concerns that you have observed in your organization that may influence the Big Data adoption decision?
2. How can potential Big Data suppliers reduce uncertainty with regards to Big Data adoption?

Complexity

1. What are the implementation and integration complexity concerns that may lead your organization to not adopt Big Data?
2. How can the supplier reduce the complexity of implementing and use of Big Data (better documentation, better training, simplified presentations etc.)?

Triability

1. If a prototype of the Big Data platform is introduced to your organization for testing would this encourage the adoption of Big Data? (Please elaborate)

Observability

1. What are the benefits that you would like to see from the use of Big Data in order to encourage adoption?

Are there any questions you would like to be clarified?

The interview has ended. Thank you for your participation.

Appendix B – Organizational Consent

University of Cape Town

Rondebosch, Cape Town, 7700
University of Cape Town, Address
Tel: +27 21 650 9111

Email: mtrlon001@myuct.ac.za

Information Sheet

Project Title: Explaining the Big Data adoption decision in Small and Medium-Sized Enterprises: Cape Town case studies

What is this study about?

This is a research project being conducted by Lonwabo Matross at the University of Cape Town. We are inviting you to participate in this research project because you have been identified as a potential adopter of Big Data. The purpose of this research project is to determine the factors that most IT teams take into consideration when making the decision to adopt or not adopt an innovation such as Big Data

What will I be asked to do if I agree to participate?

You will be asked to read and submit a consent form. Once the research has been approved by the University of Cape Town's ethics committee, the researcher (Lonwabo Matross) will commence interviews with the selected members of the IT department staff including internal stakeholders directly involved in the decision-making team for all IT systems acquisitions. This interview will be conducted during working hours at the organization's premises. The researcher may record audio and request publicly available documents such as meetingminutes. Each interview will take approximately 45 minutes to complete.

Would my participation in this study be kept confidential?

The feedback that you will provide will be stored in a password protected cloud file which is only accessible to the researcher (Lonwabo Matross) and the research supervisor (Prof Lisa Seymour). None of this information will be shared with the students at the institution,members of your organization, or any other organization without formal consent from your

organization. Furthermore, all employees who wish to remain anonymous will be provided with appropriate alias names and all documents deemed sensitive documents will not be published at any stage of the research process.

What are the risks of this research?

There is low degree of risk of the information being tempered with due to online hacking, computer viruses, and the sharing of the password to the file. Nevertheless, the researcher and research supervisor will go to great lengths to protect the information provided by the organization and its employees.

What are the benefits of this research?

The information provided by you will contribute towards the improvement of operational efficiency amongst SMEs and other Medium sized businesses within Cape Town through the use of Big Data.

Do I have to be in this research, and may I stop participating at any time?

Participation in this research is completely voluntary. You may withdraw from the research at any moment without any penalties or implications. Should the organization wish to withdraw from the research, all documents provided will be shredded and all audio transcripts permanently deleted.

What if I have questions?

The researcher Lonwabo Matross will be available if you have any questions about the research study. Please use the following contact details:

Mobile: +27 815124076
Email: mtrlon001@myuct.ac.za

Contact details of the senior research supervisor:

Prof. Lisa Seymour

University of Cape Town

Department of Information Systems

Email: lisa.seymour@uct.ac.za

Appendix C – Ethics Form

Faculty of Commerce
Private Bag X3, Rondebosch, 7701
2.26 Leslie Commerce Building, Upper Campus
Tel: +27 (0) 21 650 4375/ 5748 Fax: +27 (0) 21 650 4369
E-mail: jacques.rousseau@uct.ac.za
Internet: www.uct.ac.za
@Commerce UCT UCT Commerce Faculty Office

11/02/2020

Lonwabo Matross

Department of Information Systems

University of Cape Town

REF: REC 2020/02/014

Explaining the Big Data adoption decision in Small and Medium-Sized Enterprises:

Cape Town case studies

We are pleased to inform you that your ethics application has been approved. Unless otherwise specified this ethical clearance is valid until 28 February 2021 .

Your clearance may be renewed upon application.

Please be aware that you need to notify the Ethics Committee immediately should any aspect of your study regarding the engagement with participants as approved in this application, change. This may include aspects such as changes to the research design, questionnaires, or choice of participants.

The ongoing ethical conduct throughout the duration of the study remains the responsibility of the principal investigator.

We wish you well for your research.

2020.02.11
09:54:29 +02'00'

Jacques Rousseau
Commerce Research Ethics Chair
University of Cape Town
Commerce Faculty Office
Room 2.26 | Leslie Commerce Building

Office Telephone: +27 (0)21 650 2695 / 4375
Office Fax: +27 (0)21 650 4369
E-mail: jacques.rousseau@uct.ac.za
Website: https://www.commerce.uct.ac.za/Pages/Ethics-in-Research

Appendix D – Transcribed Interview sample

Case Study A

Definition:
Big Data - is a field that treats ways to analyze, systematically extract information from, or otherwise deal with data sets that are too large or complex to be dealt with by traditional data-processing application software

Interviewees: Senior Business Analyst

SECTION 2: Supplier Marketing Efforts
What supplier marketing factors made your organization aware of Big Data?

I would definitely say that cost savings is one of the keys pushing factor that we have discovered from the use of Big Data. Most suppliers are aware that we have a priority of increasing profit and the best way to achieve this is by reducing overhead costs.

Targeting

3. How does your organization learn about a new technological innovation such as Big Data?

The organization discovers new technological innovations from the IT seminars and conferences that the Business Analysts attend when they go for training courses overseas. The Analyst who attend these conferences not only read about the innovations, such as Big Data, but they also interact with prototype products which enhances their understanding immensely

4. Are you aware of any suppliers that send marketing information to the IT department?

We obtain marketing information via email marketing promotions from the two key vendors that they have long term contracts with. I must add that, although we have a strong firewall that blocks spam email, we have setup exceptions that allow certain vendors to send marketing information.