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Latest Trends in Big Data Utilization in Mobile and Cloud computing - Opportunities and Challenges

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Abstract

Today's digital society is characterized by an array of innovations, all aimed at solving different human problems. One of the key highlights of modern-day innovation revolves around data – its sources, management, and utilization. Accordingly, technologies such as Big Data, mobile, and cloud computing have emerged to help derive greater meanings to data. These technologies present both challenges and opportunities in different spheres. However, the central focus is to innovate creative ideas for merging such technologies to yield the greatest benefits.

The present study examined the opportunities and challenges presented by the latest trends in Big Data utilization in mobile and cloud computing among SMEs. SMEs offer a vibrant and flexible economic environment and are, thus, considered ideal for evaluating the influence of Big Data and mobile and cloud computing in practical setups. The study adopted an exploratory design, recruiting 25 venture specialists to narrate the influence of the technological tools on real-life businesses. The findings suggest that merging Big Data and cloud and mobile computing yields maximum benefits for SMEs. Similarly, employing the latest trends in Big Data utilization, such as flexible subscription models, expands the opportunities for venture development. The study was structured into different chapters as outlaid in the report.

Keywords: Big Data, mobile computing, cloud computing, SMEs

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1 Chapter One: Introduction

1.1 Background

Modern technologies have significantly increased the size and detail of data being handled by individuals and organizations. For instance, the concurrent use of social media platforms and multimedia resources by organizations generates large sets of both structured and unstructured data. The creation and handling of large volumes of data have become a common trend in today's tech world and are popularized as Big Data. El-Seoud et al. (2017) describe Big Data as a method of analyzing data, supported by complex technologies and infrastructure to collect, store and manage data. Big Data's voluminous nature calls for large storage resources. While data storage costs have significantly declined in today's tech market, small and medium-sized enterprises (SMEs) can encounter financial challenges in acquiring resources for Big Data storage and implementation (Assante et al., 2016; Hashem et al., 2015). Therefore, such enterprises are increasingly being interconnected through mobile and cloud computing to access and share large sets of data for ease of decision-making. This study explores the opportunities and challenges for SMEs by assessing the latest trends in Big Data utilization in mobile and cloud computing.

Mobile and cloud computing have simultaneously emerged as critical components of internet technology over the past few years. The two interfaces, mobile and cloud computing, are interconnected and support the transmission of on-demand services and applications via the internet (Dinh et al., 2013). Mobile and cloud computing are supported by a complex software and computing infrastructure system to store, manage, and process data requirements. The resulting benefits of mobile and cloud computing have been felt by several industries, including health, education, agriculture, and business management. These entities enjoy reduced management costs and increased flexibility in the speed and quality of the

shared data (Li et al., 2020). Accordingly, the utilization of Big data in mobile and cloud computing yields better digital solutions for ease of decision-making.

Since the advent of internet technology, information technology (IT) knowledge and resources have widely been restricted to tech companies, including giant business corporations and government institutions. However, with the emergence of mobile and cloud computing, IT knowledge and resources are rapidly being "democratized" into low and mid-level institutions (Islam & Reza, 2019). The growing accessibility to information resources implies that companies can now leverage the best use of modern technologies at affordable rates. On the one hand, the democratization of information has resulted in an open-source model for storing and managing data for related software applications. This model is termed a Hadoop, and it supports the storage of large datasets, which can be accessed ubiquitously for concurrent workflows (El-Seoud et al., 2017; Khan et al., 2014). Ultimately, Big Data is no longer viewed as a preserve of the rich corporations but as a basic knowledge resource consistent with modern technological trends.

On the other hand, the democratization of information in the modern world presents some challenges. The proliferation of IT resources to common institutions and individuals implies that more data is increasingly generated via emails and social media platforms. Accordingly, the existing data infrastructures must be continually modified to keep up with this surge in the size of data being handled. Besides, the data and information generated by basic users are largely unstructured, thus inconsistent with existing data architectures, which are optimized for structured data (Assante et al., 2016; Islam & Reza, 2019). The essence of this study is to understand such challenges and recommend the latest trends in Big Data utilization to identify growth opportunities for both tech and non-tech players. Overall, the future and sustainability of mobile and cloud computing are highly dependent on Big Data trends.

The interdependence between Big Data and mobile and cloud computing provides an innovative edge for business competition. Today's digital transformation is characterized by an increased interconnection of various devices to the internet. These devices are further interconnected and aid the sharing of vital information and data among individuals and organizations. Typically, the data shared within Big Data resources are usually analyzed for patterns and trends to infer meaningful insights for change management in organizational setups (Qi & Gani, 2012). With the rising availability and use of data in the modern world, SMEs can adopt the emerging trends in Big Data utilization in mobile and cloud computing to identify and optimize market opportunities for long-term growth and sustainability.

1.1.1 Overview of Big Data

Big data encompasses a wave of digital data sourced from digital devices and software. The data's depth, type, and complexity are diverse, depending on the source of data, which could be hardware (for example, digital scanners and sensors), the internet, and social media. The emergence and rise in Big Data are due to the development of related technologies, which have advanced the human understanding of data. Consequently, modern-day data handling is characterized by accelerated features, comprising volume, velocity, variety, veracity, and value (Vajjhala & Ramollari, 2016; Yang et al., 2016). Intuitively, these features are the fundamental building blocks of Big Data and are termed the 5V's of Big Data (As illustrated in Figure 1 below). Understanding the 5V's of Big Data is crucial in examining the latest trends in mobile and cloud computing.

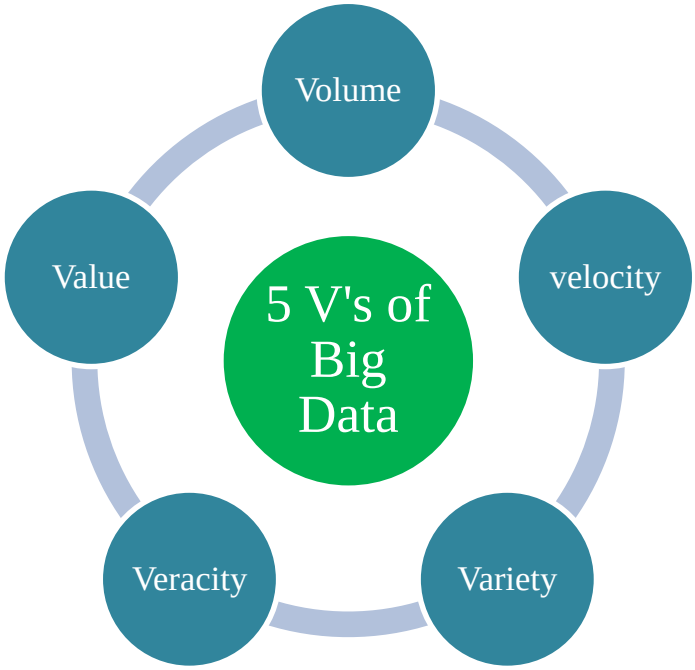

Figure 1: The 5V's of Big Data

The volume aspect of Big Data accounts for the large sets of data that are continuously being generated from diverse sources. According to Vajjhala and Ramollari (2016), Google processes up to 24 million petabytes of data daily. This example visualizes the magnitude of typical data shared by humans daily. The second component, velocity, refers to the speed at which data is generated, shared, and processed by users (Baro et al., 2015). Velocity impacts the usability of the data due to the time value of the information being shared at a point in time. Variety entails the diversity of the data sources. As mentioned, Big Data is sourced from multiple hardware and software devices such as smartphones, sensors, and social platforms (Islam & Reza, 2019). In addition, structured and unstructured data types, including audio, video, images, and textual transcripts, make up the Big Data. Veracity describes the level of reliance attributed to a given set of data (Assunção et al., 2015). Finally, the value component relates to the financial worth of adopting and implementing Big Data in a given setup. Therefore, the value aspect of Big Data assesses the benefits gained by organizations from analyzing big sets of data.

1.1.2 Overview of Mobile and Cloud Computing

Mobile and cloud computing are complementary services that rely on different infrastructures to transmit data wirelessly. Mobile computing is primarily characterized by the development of technological devices and interfaces such as tablets and smartphones. The core functions of mobile computing comprise internet access, provision of an interface for various software applications, and sharing of different data types (Dinh et al., 2013). Advancements in mobile computing have inspired innovative developments embraced in many fields. For instance, several mobile applications have been developed to support industrial operations, such as people management and resource accountability. The wave of mobile computing continues to spread with the rise in internet penetration.

Cloud computing is viewed as the current frontier for computing models and infrastructure. It is characterized by distributed networks that allow data to be shared and retrieved remotely via wireless connections (Qi & Gani, 2012). Cloud services providers have secure systems in remote locations, allowing clients to instantaneously store and retrieve their data cheaply based on an on-demand approach (Assante et al., 2016). Cloud computing is a key highlight of modern information technologies that offers many incentives for widespread deployment. Users enjoy the benefits of secure connections, scalable storage, virtualization of resources, and fast data processing (Hsieh, Li & Yang, 2013). Eventually, individuals and enterprises can operate at reduced costs while leveraging the power of data to harness insights for increased productivity. Cloud service providers, such as Microsoft Azure and Amazon AWS, offer virtualized services to optimize resource utilization and effectiveness among consumers.

The above discussions have illustrated some fundamental features of mobile and cloud computing. Mobile computing can largely be thought of as facing individual consumers, while cloud computing is a service that is more tailored to suit the needs of

corporate companies and large institutions. Over time, the two services have become interlinked due to the evolving needs of users. For instance, mobile devices tend to be limited in terms of their resource endowment and functionality. The limitations encompass aspects such as storage, security, and battery life and impede the quality of mobile computing services (Dinh et al., 2013). Therefore, cloud computing features are continually being embedded into the mobile computing environment to enhance the efficiency of mobile services and better user experiences. The product of the integration, mobile cloud computing, allows mobile devices to store and process their data remotely, thus improving the performance of inbuilt applications.

1.2 Problem Statement

Big Data is a relatively new paradigm poised to revolutionize the meaning and use of data in various human contexts. As mentioned in the preceding sections, the paradigm is characterized by voluminous datasets that offer growth opportunities in various fields. However, Big Data's continual growth, favored by ever-increasing digital data sources such as social media, presents significant challenges in data handling (Islam & Reza, 2019). In particular, the storage, sharing, and security of voluminous data is problematic. Fortunately, the use of Big Data in mobile and cloud computing infrastructure offers a lucid basis for addressing the above challenges. The interconnection of mobile and cloud computing infrastructure provides a solid platform for data visualization within secure environments (El-Seoud et al., 2017). For instance, mobile computing offers end-users the flexibility to access real-time information on their mobile devices, while cloud computing provides endless storage capacity for individual and institutional data. Therefore, understanding the trends in big data utilization in mobile and cloud computing can widen the scope for identifying opportunities and challenges for Big Data advancements.

The present study assesses the significance of the latest trends in Big Data utilization in mobile and cloud computing in advancing the application of Big Data in practical settings such as business support decisions by SMEs. Mobile and cloud computing provide a complimentary benefit to Big Data by supporting the storage of large sets of data within scalable environments. While cloud computing offers a reliable platform for data storage and sharing, the data generated from Big Data is rapidly growing (Hashem et al., 2015). Therefore, there is a need to evolve the existing cloud computing infrastructure to guarantee sustainable data storage and sharing. More importantly, there is a need to determine the impact of Big Data, mobile, and cloud computing technologies in practical environments. Notably, many businesses are already adopting Big Data as the next frontier of innovative business practices. By determining the challenges and opportunities of Big Data utilization in mobile and cloud computing, this study leverages the importance of data utilization in decision-support systems.

1.3 Research Aim, Objectives, and Questions

This subsection explains three central aspects that define the direction and interest of the current study. The research aim, objectives, and questions highlight the key areas of focus and the intended outcomes at the end of the study.

1.3.1 Research Aim

Based on the problem statement described above, the current study investigates the opportunities and challenges presented by the latest trends in Big Data utilization in mobile and cloud computing. The research aim is the overarching deliverable that the study intends to meet. Therefore, the aim is consistent with the central research question for the topic being investigated. Accordingly, the examination of challenges and opportunities in Big Data utilization in mobile and cloud computing is centered on practical applications in tech and business environments. The choice of SMEs for the current business context is due to two

reasons. First, SMEs offer a wider reflection of economic performance at the macro-business level. Secondly, SMEs are flexible towards embracing changes for increased efficiency. Therefore, introducing the component of business innovation aids in understanding the significance of Big Data, mobile, and cloud computing technologies in practical setups.

1.3.2 Research Objectives

The research objectives comprise four statements that the study intends to achieve via research work. The statements are actionable outcomes that cumulatively define the success of the study. The objectives are segmented components of the research aim and are listed as follows:

1. To understand the relationship between Big Data and its utilization in mobile and cloud computing.
2. To identify the latest trends in Big Data utilization in mobile and cloud computing.
3. To explore the opportunities and challenges for utilizing Big Data in mobile and cloud computing.
4. To determine the impact of Big Data utilization in practical setups such as SMEs.

1.3.3 Research Questions

The research questions are linearly related to the research objectives and help define the specific measures targeted in the study. The corresponding research questions are outlaid as follows:

1. What is the relationship between Big Data and its utilization in mobile and cloud computing?
2. What are thef latest trends in Big Data utilization in mobile and cloud computing?
3. What are the opportunities and challenges for utilizing Big Data in mobile and cloud computing?

4. How does Big Data utilization in mobile and cloud computing affect practical setups such as SMEs?

1.4 Significance of the Study

The realization of the above research objectives will widen existing knowledge in the field of tech innovation management (TIM), allowing business leaders to base decisions on real-time data analysis. First, this study will enhance the understanding of Big Data and its application in business setups to leverage decision-making. More importantly, the study will educate business leaders on the need to integrate Big Data into mobile and cloud computing technologies to increase productivity and market competition. For instance, companies will better refine their marketing practices based on prevailing market needs as predicted by Big Data's analytical trends. Further, examining the latest trends in Big Data utilization in mobile and cloud computing will offer creative insights to address challenges of Big Data implementation by businesses. Finally, the study will help tech players identify potential areas for improvement based on Big Data implementation challenges. Tech experts continuously develop network infrastructures to better service delivery to intended users.

Overview of Research Methodology

Meeting the desired research objectives requires the use of certain research methods. The methodology comprises theoretical assumptions, justification of the theories, and the practical procedures used to gather and analyze the research data (Mills & Birks, 2014). The present study is based on a qualitative research approach. A qualitative study identifies and uses extant literature to answer present research questions (Basias & Pollalis, 2018). By analyzing extant data, the researcher establishes a deep and complex understanding of the problem being investigated. The current research question can be answered by identifying and analyzing relevant literature to determine the opportunities and challenges presented by the latest trends in Big Data utilization in mobile and cloud computing. Further, an

exploratory research design is used as the framework for in-depth exploration of Big Data concepts and their application in mobile and cloud computing. Secondary sources provide a means for data collection before it is taken through content analysis. The secondary qualitative data is obtained from tech and business innovation databases, including OECD, EBSCO, and ProQuest databases. Overall, the methodology is designed to identify and understand the latest opportunities and challenges presented by the latest trends in Big Data utilization in mobile and cloud computing.

1.5 Scope and Limitations of the Study

This study investigates the advancement of Big Data technology and its application in the business environment. By focusing on the technology innovation management field, the research provides a basis for identifying and understanding technological innovation influences in practical environments. The technical component of this study focuses on explaining Big Data and related concepts such as mobile computing, cloud computing, wireless networking, artificial intelligence, and the Internet of Things (IoT). These technical components help explain the relationship between Big Data and technological frameworks and their eventual application in different fields. The business component of this study provides a basis for understanding the role of technology business innovation. In particular, the study explores the integration of Big Data in mobile and cloud computing services to better business outcomes. The simultaneous use of Big Data and mobile and cloud computing services can help leverage the quality of decisions made by SMEs.

The use of secondary qualitative data may limit the findings of the study. By using a secondary approach to collect data, the study may miss important research insights based on real-life experiences. In addition, the absence of quantitative data denies the study findings a statistical appeal (Basias & Pollalis, 2018). Nonetheless, the exploratory qualitative

framework adopted in the study can yield valid and reliable findings to the research questions.

1.6 Research Structure

The study comprises six chapters, divided into sections and sub-sections. The first chapter, the introduction, lays a broad background for the research context, problem, and deliverables. Next, the literature review provides a detailed account of the latest trends in Big Data utilization in mobile and cloud computing, including the opportunities and challenges in practical application. Chapter Three, the research methodology, describes the theoretical assumptions, justifications, and practical procedures used to meet the desired deliverables. The results chapter outlays the qualitative evidence gathered from the secondary sources used in the study. The fifth chapter, discussion, appraises the findings in chapter four to answer the four objectives stated at the beginning of the study. Finally, the conclusion and recommendations chapter summarizes the key insights gained from the study and measures for further utilization of Big Data in practical fields.

2 Chapter 2: Literature Review

2.1 Introduction

With the current robust growth of technology, companies in different fields have resorted to using various subsets of technology to improve their outcome. The use of Big Data has become the current and future focus of small-sized, medium-sized, and large firms with the aim of achieving premeditated competitive advantage. Big Data is a relatively new paradigm poised to revolutionize the meaning and use of data in various human contexts. As a result of growth in technology, there is a continuous increase in digital data sources resulting in difficulty in data handling. At the same time, Big Data and cloud computing offer a solution to this as they allow for data visualization within secure environments and storage of enormous amounts of data.

This chapter of the research aims to analyze different literature on the significance of Big Data utilization in mobile and cloud computing in advancing the application of Big Data in practical settings such as business support decisions by SMEs. By understanding the trends in big data utilization in mobile and cloud computing, the scope for identifying opportunities and challenges for Big Data advancements can be achieved. Also, by pointing out the opportunities of Big Data utilization in mobile and cloud computing, this study will leverage the essence of data used in decision-making systems. The critical analysis of past research in this section entails the use of relevant sources on Big Data and its trends, challenges, and benefits in SMEs. Small and medium-sized businesses often fall short of the capacity to invest as required on the needed technology in order to leverage Big Data. Nevertheless, they can adopt computing techniques that will minimize their spending on human resources and technology, thus enabling benefit from Big Data.

Further, this chapter presents the general principles of Big Data, its definition, and associated components. The section also looks at cloud computing and illustrates Big Data

Analytics and MapReduce and Hadoop as Big Data Systems. This is followed by the definition of institutional theory and its correlation to Information Research systems and adoption of cloud computing in relation to normative, coercive, and mimetic pressures. There is also an analysis of the advantages of big data and its various characteristics. In addition to these, the section also examines the different opportunities, risks, and challenges associated with using Big Data and cloud computing in small and medium-sized enterprises.

2.2 Definition of Big Data and Related Concepts

2.2.1 Big Data

The definition of Big Data varies according to different literature. Balachandran and Prasad (2017) define it as a collection of data sets that is enormous and complex, leading to difficulty in its processing when the standard techniques and tools are utilized. Vajjhala and Ramollari (2016) further support this by including the multi-V model with four V's in the depiction of Big Data. The four V's include Volume, Veracity, Variety, and Velocity. Baro et al. (2015) include a fifth V for value in the definition of Big Data. Big Data is intrinsically characterized and defined by large volumes of data sets. Studies have attempted to visualize the nature of data volumes processed by current technologies. According to El-Seoud et al. (2017), leading tech companies, such as Facebook, Amazon and Google, typically process enormous volumes of data daily. For instance, Facebook subscribers typically upload more than 10 million images on their platforms per hour. Bella-Orgaz et al. (2016) estimates that the current stream of technological use leads to the processing of up to 2.5 Exabytes of data daily. The above statistics depict a robust trend of data sharing through contemporary computing systems.

The second known feature of Big Data is Variety. Scholars have attributed this characteristic to multiple sources of data. For instance, Vajjhala and Ramollari (2016) note that the data processed as Big Data is inherently sourced from a wide range of places, which

include social media and static image sources. Besides, the data exists in various forms, which could be structured or unstructured (Baro et al., 2015). As a result of this data variation, there is difficulty with the integration process to achieve a common representation. Similarly, the indifference of data sources causes the challenge of data incompatibility during cleaning and processing.

Big Data characteristcs are also exmplored in terms of frequency and speed. Baro et al. (2015) states that data frequency affects its sourcing and usage, ultimately impacting velocity. The frequency and speed of data influences the practical usage of data due to user demands and experiences such as the need for instantaneous updates (Vajjhala & Ramollari, 2016). The frequency and velocity characterictics of Big Data are often challenging to execute when dealing with traditional data sourced from different places. Therefore, data should be veracious to enhance its trust and dependability during usage. Bello-Orgaz et al. (2016) emphasize that for this fourth characteristic to be met, data has to be trustworthy, authentic, accountable, and available.

2.2.2 Big Data Analytics

Big Data analytics is characterized by the identification and extraction of key information and insights from large volumes of data. The data sets are usually processed using standard procedures to realize crucial insights for usability. Balachandran and Prasad (2017) note that the main processes that involve big data include capture, curation, storing, and search. Subsequently, this can be followed by other processes such as sharing the data, transferring, analyzing, and visualization. The business sector has particularly seen a dynamic rise in the generation and use of data for valuable insights. Businesses have embraced contemporary technologies such as website marketing to obtain useful intuitions for progressive growth. As a result of this, the decision-making process has been better and informed. In different businesses, big data analytics enables the determination of hidden

patterns, making relevant correlations, establishing market trends, and depiction of consumer preferences, among other crucial business information (Sathya & Avinash, 2015). The current advancement of technology has made it possible for firms to come up with effective data analytics algorithms allowing firms to make good use of big data analytics. Nevertheless, there is the challenge of making use of the analytics due to poor data quality, improper storage, analysis, and visualization.

2.2.3 Sources of Big Data

Despite the different features of big data, the feature-based challenges are usually based on digital earth-relevant domains. The source of big data influences the domain and, resultantly, the challenges and associated consequences resulting from geospatial principles. Overall, this section entails an analysis of the potential domain-specific problems associated with Big Data, the relevance of spatiotemporal thinking in solving these challenges, and the associated geospatial principles.

2.2.3.1 Earth Sciences

As technology advances, there have been improved processes in computer simulation and sensing. This allows for easy collection and production of massive data within seconds. The resultant data sets vary in spatiotemporal scales for monitoring, and in some cases, the scales used in their presentation and understanding are also different due to the complex earth systems (Yang et al., 2017). For instance, the data collected by EO usually consists of TB images, and these data usually have to heighten spatial, sequential, and spectral resolutions. At the same time, data gathered through geospatial models tend to be enormous in terms of their spatiotemporal aspects as numerical simulations are utilized (Yang et al., 2017). An example of the use of big data in earth sciences is the field of climate science which depicts the fact that big data is shifting across digital earth domains. An example of the use of big data on climate science is the IPCC AR5 utilizing information technology to generate 10,000 TB of climate data.

The use of big spatiotemporal data is crucial in this scenario as it allows for analysis and interpretation of the resultant multifaceted climate system. With 10,000 TB of data produced, it is crucial to analyze the information and point out any temperature anomalies. The analysis is also necessary to know geographical regions which share or have different climate patterns and also identify areas at increased risk of extreme weather events. Li (2015) points out that despite the efficiency and relevance of climate data, the mining process for the information tends to be challenging. With the simultaneous application of the use of big data, the relevant data can be collected efficiently, and analysis carried out more efficiently.

2.2.3.2 Internet of Things (IoT)

The advancement of technology has contributed to the development of sophisticated devices such as mobile phones, health monitors, and computers which can utilize advanced sensors and identify multiple information from the users of the devices (Yang et al., 2017). These devices have a connection through the cyber-physical system, and this contributes to their ability to measure time, identify the location of an individual, and track the movement of vehicles. This connection system also gives the devices the ability to identify climate temperature, precipitation, and other changes within the atmosphere. Overall, the concept of the Internet of Things refers to this process of constant production of data throughout the earth by making use of data generated from mobile devices among other computers and devices that tend to be interconnected (Alam et al., 2015). Big Data produced from the various sensors that contribute to the Internet of Things has significant amounts of spatiotemporal information (Yang et al., 2017). In light of this, with the advancement of technology, the correlation between the internet of things and big data results in easy processes of product line management. There have also been improved processes of criminal investigation and enhanced agricultural activities. In the long term, the internet of things contributes to fastened development of small towns and the introduction of new architecture, which improves the globe as a whole.

2.2.3.3 Social Sciences

Social sciences have significantly been impacted with the introduction of multiple social platforms such as Twitter, WhatsApp, Facebook, and Instagram. The use of these social media platforms continues to grow as users get to millions daily. Consequently, since there is significant use of the platforms, there is a significant amount of data to be mined from these areas (Yang et al., 2017). Therefore, political scientists, economists, and other individuals make use of Big Data mining methods to gather information on human interactions and gain access to health records and records kept by authorities. Grimmer (2015) notes that these data mining methods are crucial to social studies and governments. Nevertheless, the use of these mining processes is still problematic since the use of spatiotemporal patterns in relation to big data is demanding. Proper application of big data ad appropriate data mining processes allows for efficient prediction of emerging public health issues and identification and investigation of criminal activities, after which appropriate solutions can be established.

2.2.3.4 Astronomy

The field of astronomy has not been left behind in terms of technology since the production of the spatiotemporal maps has been enabled by introducing sky survey technologies that allow for observation of activities in the sky. The use of these sky survey technologies enables the study of the universe, and this allows for the production of enormous spatiotemporal data. An example of survey technologies used includes the Sloan Digital Sky Survey (Alam et al., 2015), which produces as much as 120 TB of data. More research is still underway to ensure new tools such as the Large Synoptic Survey Telescope have an enabled functioning. The introduction of such a new survey tool will enable the production of almost 15 TB of data every night. This information will be crucial in providing answers to the structure and evolution of the earth and the universe as a whole (Yang et al., 2017). The use of technology in the field of astronomy is not only limited to observation as

the use of tools such as the Large Hadron Collider, which functions at the atomic level, gathers its data through experimental processes, and this enables the production of 60 terabytes of data daily, and this culminates to 16 PB every year.

Despite the ease of data collection, the real challenge arrives in the management of big data after the use of these new astronomical data collection devices. Transforming the data into meaningful information and identifying correlations and interesting celestial objects in an efficient manner is also difficult. Jagadish et al. (2014) note that the field of astronomy tends to be enormous, and the data collected also tends to be large. Big data entails information on the evolution process of the universe and enables an appropriate understanding of the process of earth evolution. With the collection of such data, astronomists can determine any outer space impact on the earth and put-up planetary defense systems to deal with any issues (Yang et al., 2017). Overall, the use of big data in Astronomy tends to be significant, and the subsequent transformation of the big data into relevant information also remains crucial. Therefore, concomitant use of cloud computing and big data can be crucial in managing challenges associated with the utilization of big data in Astronomy.

2.2.3.5 Business

Technology is crucial in business as the utilization of analytics and intelligence allows business owners to make predictions in markets and thus, make appropriate decisions. Business intelligence and analytics enable the incorporation of big data in making corporate decisions and enable management optimization and making appropriate decisions to deal with competition (Yang et al., 2017). The various activities associated with business actions such as the making online purchases or using credit cards to carry out purchases contribute to the production of vast amounts of data, leading to big data of high velocity and volume. At the same time, the data gathered through this process tends to be highly unstructured in terms of variety and veracity (Brunswicker et al., 2015). Despite the lack of organization, the data

gathered contains a large amount of geospatial information, including the area where the transaction was carried out and the time. Since these data are essential, applying appropriate data processing and management methods is crucial to generate relevant information.

Business corporations have been able to utilize a full spectrum of processing technologies to establish relevant output from the data and make use of scalable storage environments. On the downside, producing spatiotemporal statistical models from the big data gathered remains a difficult process for businesses. Appropriate spatiotemporal models can be crucial in enhancing product placement and ensuring the clients' transactions are analyzed to frame the market structure. In addition, the gathering appropriate data from these processes is relevant in establishing personalized product recommendation systems and dealing with risks while making appropriate business decisions (Yang et al., 2017). In light of this, ensuring the data is processed accordingly will enable businesses and corporations to grow through the making appropriate decisions and to alienate associated risks within the business.

2.2.3.6 Industry

With the current fourth phase of the industrial revolution, firms utilize the Internet of Things and big data to enhance production and activities within industries and establish ad-hoc networks. As illustrated by O'Donovan et al. (2015), these networks are crucial in the processes of self-control and boost the efficiency of industries. Interestingly, the application of big data in the fourth industrial revolution culminates in a variety of challenges, including the continuous entanglement between energy and production. At the same time, big data requires the centralization of data that is gathered from all the different production levels. It also demands scheduling of algorithms in order to heighten the performance of the industry.

In order to store the data appropriately and ease access of the data from industries, the big data has to be stored in a semi-structured data model, which allows for processes such as random access and accessing data immediately without delays or having to compensate for

time-consuming operations (Yang et al., 2017). Another downfall of big data is that it requires the realization of on-the-fly analysis to enable corporations and businesses to react fast to events that were not predicted and identify hidden patterns that have the capacity to diminish production efficiency. Nevertheless, to deal with these challenges, cloud computing can be utilized in this fourth phase of the industrial revolution, and this can improve the processes of networking, integration, and analysis of data (Golzer et al., 2015). The utilization of cloud computing also allows for the integration of cyber-physical systems, and this improves self-optimization and self-control.

2.2.4 Mobile and Cloud Computing

Through cloud computing, computing services can be made use of as services instead of a product (Vajjhala & Ramollari, 2016). Firms that use cloud computing can share resources with ease and achieve completion of tasks at a cheaper cost with higher scalability. At the same time, cloud computing supports network use by external entities interested in on-demand services. It also enables the virtualization of resources and fosters processing and storage within the Web through the internet. Depeige and Doyencourt (2015) note that the integration of mobile and cloud computing in businesses has led to improvements in business solutions, including the customization of products to meet specific customer needs. The benefits of mobile and cloud computing are flexible, increasing reliability, improving cost-cutting and creating knowledge resources for sustainable growth.

Cloud computing, in its most recent nature, is dependent on three types of service models Software-as-a-Service (SaaS, Infrastructure- (Iaas), and Platform-as-a-Service (PaaS) (Vajjhala & Ramollari, 2016). The three services have varying benefits to their end users. For instance, SaaS is characterized by vendor-managed services, which are then availed to end users. PaaS offers users a flexible platform for development, but with minimal control. IaaS

avails resource infrastructures to organizations, allowing them to reduce their operation costs, while enjoying on-demand services. In Infrastructure as a service, the users can be given the capacity to manage the cloud infrastructure. The choice of a given service model depends on the unique needs and requirements of an organization intending to solve a data problem. Sharma (2016) also analyzes the different service models of cloud computing. Given that they all have limitations, Sharma (2016) recommends the inclusion of Database-as-a-Service (DaaS) to be among the service models. This type is already in use by Microsoft Azure and Amazon RDS. The advantage of the DaaS service model is that it offers a solid platform shared among different parties, and the database is flexible and makes use of a pay-as-per-use mechanism.

2.3 Data Processing and Resource Management

In managing Big Data systems and applications, various processing methods such as Hadoop and MapReduce are adopted. Hadoop is a free Java-based programming framework that enables the analysis of enormous quantities of data present within a computing environment. Samir et al. note that Hadoop is an Apache project as a result of the Apache Software Foundation. It uses a Master/Slave structure to execute the set instructions (Dhabhai & Gupta, 2016). The use of Hadoop allows large data to be processed at the same time within different clusters. In addition, applications can also be made to function on systems that have multiple nodes with thousands of terabytes. Hadoop also possesses a distributed file system that allows data to be transferred faster and accommodates normal functioning and processing even in cases where the nodes fail (Sathya & Avinash, 2015). Consequently, there is a reduced risk of data loss and processing capacity in case of system failure or malfunctioning of a given number of nodes. Hadoop is also scalable, flexible, and cost-effective. Its use is common among popular firms such as Google, Amazon, and even Yahoo, as it is used to support a significant amount of data.

The Hadoop feature is highly efficient and comprises two subfearures – MapReduce and Hadoop Distributed File System. The MapReduce framework is of the essence in writing applications used in the analysis of large data in parallel clusters (Ogbuokiri et al., 2015). The job of the framework is to divide data into different piles, which are then processed in parallel by Map jobs. The output of the processed data is then organized by MapReduce and then sent to the reduced tasks. MapReduce also carries out scheduling. Re-execution of failed tasks and monitoring of the processing. Overall, his framework carries out its functions in a reliable and fault-tolerant manner (Kalra et al., 2016). The other subproject, the Hadoop Distributed File System, is a file system that encompasses the nodes present in a Hadoop cluster. It establishes a link between the various file systems, which tend to be present in different local notes. As a result, the clusters of data with the storage resemble one large file system, which heightens reliability as data is available from multiple sources even in cases where nodes fail.

2.4 Current Trends in Big Data Using Cloud Computing

With the current technological advancement, the use of Big Data provides room for different firms to achieve competitive advantage as long as appropriate big data analytics is used. According to Vajjhala, Strang and Sun (2015), the evolving data dynamics, such as volume, limit the efficiency of data processing through traditional techniques. At the same time, investing in appropriate technology that caters to both the financial and human resources of Big Data is costly. Therefore, cloud computing application offers an effective alternative and reduce the burden of costly computer resources on institutions as the expense of availing and maintaining computer resources relies on the services providers in cloud computing.

Tian and Zhao (2015) emphasize that cloud computing and Big Data tend to complement each other. The Big Data issues can be alleviated through the use of various cloud computing techniques. Cloud computing provides a scalable, effective, and robust

Infrastructure with the necessary processing power achieved through analogous and scattered processing models. Cloud computing avails the necessary tools for managing big data and plays a crucial role in big data analytics. At the same time, cloud computing is open scalability due to its characteristic of boundless processing power and memory.

Fazio et al. (2015), Hashem et al. (2015), and Sharma (2016) all agree that cloud computing can be effective when used in big data storage and processing. According to Fazio et al. (2015), the use of Infrastructure-as-a-Service in Big Data management is advantageous since it enables leveraging cloud storage capabilities and accommodates processing within the virtual machine. At the same time, Hashem et al. (2015) back this claim, believing that cloud computing and Big Data are adjoined since Big Data offers the users the capacity to carry out commodity computing, execute distributed queries while cloud computing avails the foundation for the engine whereby the environment for the performance of distributed data processing is provided. Latest advancements have seen the models for Big Data processing evolve to incorporate a new framework known as Hadoop. Hashem et al. (2015) states that such novel interventions have been used on various occasions to improve data analytics. Notably, the technology, coupled with cloud infrastructure, has been used in genome research. The example illustrates the significance of cloud infrastructure in optimizing the benefits of Big Data analytics. fThe infrastructure-as-a-Service service model has established various platforms, including OpenNebula, within which open-source solutions for data processing can be carried out. OpenStack is another example of IaaS within which analysis and processing of Big Data Analytics through cloud computing has been carried out.

2.5 Overview of Institutional Theory

Institutional theory borders on the social and governance aspects of any organization. According to Miller and Paradis (2020), an institution is a social structure that constitutes a

group of individuals or organizations who carry out a collective exercise action within a given environment. Furthermore, collective action or collectivism focuses on togetherness among the people and putting the group's interest first before personal interests. According to Reay et al. (2019), institutions tend to be taken for granted, yet they define how people or organizations think or carry out different actions. Raza et al. (2020) point out that institutions arise from different rule-setting centers such as governments and communities in most cases. In relation to this, the institutional theory focuses on the deep characteristics of the communal structure.

The theory explains the processes behind the integration of certain rules or norms as authoritative references in organizational practice. Overall, the institutional theory speculates that the various changes in structure and behavior within firms are significantly impacted by the desire for organizational legitimacy and are less likely due to competition or firms to be more efficient. Schneiberg and Lounsbury (2017) further support this by observing that institutions are composed of ordinary, consistent, and cultural cognitive elements which combine with activities and possessions to give sense to social life.

2.5.1 Institutional Theory in Information Systems Research

The Institutional theory provides a framework for technology adoption. Adjei et al. (2021) note that institutional theory gives room for technology to be explored beyond its complexity in design and its financial aspects, including wider concepts that entail dogmatic, societal, and cultural aspects. The regulatory forces present within institutions often have an inevitable presence in relation to understanding information systems research among different firms. This posits that although the methods by which institutions influence rarely change, these structures are influential and tend to be more stable than the innovations they bring about. Currie and Swanson (2009) note that there are few studies in the information research field that encompass the process method.

Nevertheless, when the process method is used in this field, institutions are considered entities with effects and prioritized as independent variables. In relation to reviewing past literature on Institutional theory, research carried out by Wiesche et al. (2017) found that those who research on information systems are aware of the different units of research when it comes to institutional studies, yet most studies carried out in this field focuses on the organizational levels while neglecting crucial areas such as the organizational field. Currie and Swanson (2009) highlight similar concerns in their research as they emphasize the need to put information research within its appropriate societal, political, and cultural aspects. The neglect of depiction of the broader environment and individual units has been criticized as a whole. Overall, the adoption of cloud computing tends to be a dependent variable reliant on institutional stimuli that include technology.

The institutional theory offers multiple strengths, including accounting for irrational influencers present within the structural levels of the firm and the organizational field as a whole. Multiple external forces act on organizations culminating in the development of homogeneous cultures and structures. These cultures and structures can be attributed to the organizational field, and the process by which it contributes to homogeneous structures is an isomorphism. The different external forces strong enough to result in organizational changes were identified by Adjei et al. (2021) as competition, profession, and states. Within the organizations, the various stakeholders make decisions depending on what they think is rational. However, isomorphic forces that act through the field determine which options are available for the stakeholders. Three types of isomorphism have been shown to result in organizational changes, namely, normative, coercive, and mimetic isomorphism.

2.5.2 Mimetic Isomorphism

An organization can always mirror its competitors' strategies in an attempt to better its performance. This is particularly true in the technological context, where massive benefits

can be enjoyed from using technology-based resources. Adjei et al. (2021) note that mimetic isomorphism causes organizational change with time to become similar to other surrounding firms within its environment. In light of this, mimetic pressures arise when organizations attempt to compete with their counterparts to become more superior. In some cases, the environments within which firms function are full of uncertainties, and there is a poor understanding of emerging technologies.

To ensure growth, firms will therefore simulate their structurally equivalent competitors that are successful or assume will be successful. Even though the adoption of cloud computing was predicted to increase in rising in developing countries such as Ghana, its adoption has been low as a result of a lack of understanding and expertise on the technology. Adjei et al. (2021) argue that such a poor understanding of technology contributes to the adoption of mimetic behavior. In another study carried out in Australia by Yigitbasioglu (2015) on the function and role of management teams on implementation of cloud computing across 1160 organizations, it was found that mimetic played a big role in the beliefs of organizations on the essence of cloud computing. The resultant beliefs from the management teams influence the organizations' intent towards the accommodation of cloud computing. Conclusively, Adjei et al. (2015) argue that mimetic pressure significantly contributes to cloud computing implementation.

2.5.3 Coercive Isomorphism

Trust tends to be among the values determined by cultural norms, and according to Hassan et al. (2017), it determines the process of organizations making decisions on information resources based on other firms. The collectivist worldview of the society results in firms having common values and goals, and this contributes to being oriented towards a given group ideology. Unlike mimetic isomorphism, coercive pressure results in firms experiencing coercive pressure from the other firms they rely on. DiMaggio & Powell note

that these pressures can either be formal and informal or, in some cases, they are influenced by the cultural context within which an organization lies. The coercive pressures can arise from the government and parent organizations.

In developing countries such as Nigeria, coercive pressure arises from the enforcement of restrictive legal and regulatory conditions. The individuals who imposition these conditions include foreign investors, international suppliers, and non-governmental institutions such as World Bank. Oredo et al. (2019) utilized a partial least square structural equation modeling to determine the impact of imposition from institutions on 93 Kenyan firms. These organizations were mostly within the financing, manufacturing, and ICT sector. It was found that coercive and normative pressures contribute significantly to the adoption of cloud computing, although mimetic pressure played no role in the adoption. Similarly, Hsia et al. (2019) researched the determinants of e-health adoption and found that only mimetic and coercive pressure has a significant impact. Ronaghi (2021) finds out that coercive pressure from governments can either lead o adoption or avoidance of technology. Cloud service suppliers also rely on the distribution of their services in order to get final clients.

2.5.4 Normative Isomorphism

The final pressure that impacts the adoption of cloud computing includes normative pressure. This pressure arises from universities and professional networks. To adopt trends, the involved vendors, consultants, and academics determine how new technology is interpreted in the society within which it is to be adopted (Currie & Swanson, 2009). Lin et al. (2020) research the effect of firm innovation and institutional pressure on e-business involving four hundred and thirty-seven agricultural firms in China. The study findings demonstrated negative impacts from normative pressure as opposed to coercive and mimetic isomorphism. Martínez-Ferrero and García-S'anchez (2017) examined pressures on six hundred and ninety-six non-financial firms from sixteen different countries from 2007 to

2014 and found that the assurance demand is the most significantly determined by normative pressure followed by a coercive factor, and mimetic pressure had the least impact. Therefore, the study outlays the effects of the discussed pressures in real-life organizations.

2.6 Small and Medium-Sized Enterprises (SMEs)

Small and medium-sized enterprises constitute a significant number of firms globally, with over 99% of firms in Europe constituting SMEs. Consequently, SMEs are a major player in spiraling economic growth, supporting innovation and creating employment opportunities. There are multiple definitions to categorize firms into small and middle-sized categories. The European Union recommends that firms that are to be considered medium-sized enterprises are those that have less than 250 workers and a balance sheet totaling less than 43 million Euros (European Commission, 2016). Meanwhile, enterprises that record less than 10 million euros in their balance sheets and have staff members not more than fifty are taken as small-sized enterprises.

Often, the growth of firms relies on the level of innovation. In light of this, Love and Roper (2015) note that SMEs that are centered on innovation are likely to gain more economic benefits than those that are less interested in innovation. Due to the small sizes of the firms, small and medium-sized firms tend to benefit from rapid decision-making and their readiness to make mistakes in order to grasp market opportunities. At the same time, as aforementioned, their decisions in relation to technology are influenced by normative, coercive, and mimetic pressure. In order for SMEs to gain a competitive advantage and heighten their capacity to be innovative, they need to be unique in terms of their products and flexible towards the acquisition of new technology. In addition, their successes also rely on the firms' capability to efficiently use scarce resources and utilize their external relationships with other small and medium-sized enterprises to improve each other.

2.7 Advantages of Big Data Applications

Big Data applications are large-scale applications that are utilized in processing large amounts of data. The process of data exploration and processing became an issue within different sectors as a result of the use of large amounts of data (El-Seoud et al., 2017). This feature, along with that of the vast amounts of data being complex, made it difficult for management, more so for those utilizing the traditional data processing applications. These, therefore, contributed to the development of big data applications to aid in eradicating the barriers. As a result, applications such as Google's map and Apache Hadoop were introduced. Google map minimizes framework, and Hadoop allows for management of large amounts of intermediate data. Big Data applications are therefore used comfortably in different areas such as manufacturing and Bioinformatics.

The use of big data applications leaves room for transparency within the manufacturing industry. As a result, there are uncertainties present in the industry that can be unraveled and inconsistencies eradicated. Within the large data applications, conceptual frameworks are utilized, and the manufacturing process can be made more predictive (Kalra, 2016). The manufacturing process starts with accumulating data from sensory data, including vibration, voltage, and pressure. Furthermore, sensory data can also entail current flow and acoustics within the firm. The collected sensory data can then be put together with the historical data, and these together form Big Data. Consequently, the Big Data generated can be input into predictive tools and preventive tactics such as prognostications.

In Bioinformatics, Hadoop is used to carry out sequencing and determine the biological makeup of an organism. In order to achieve sequencing and carry out bioinformatics efficiently, large amounts of data are involved (El-Seoud et al., 2017). Therefore, to analyze these enormous amounts of data, there is a need to use Hadoop, which accommodates Big Data processing. Big Data applications avail software packages with

multiple tools that allow users to map the whole data landscape across the firm. This gives room for the users to identify potential threats that are possible to arise internally and come up with appropriate solutions. This remains an outstanding advantage since it entails the use of Big Data to keep data safe. In light of this, this advantage gives an individual the power to determine potentially positive information which is not protected accordingly and change its storage to ensure it is stored according to recommendations.

Among the different characteristics of Big Data is that it constitutes both structured and unstructured data. In light of this, Big Data also addresses scalability, flexibility, and stability. It enables quick data extraction from various sources, including mobile phones, automated sensory technologies, and the internet. Therefore, the application of Big Data within enterprises offers organizations the advantage of speed, capacity, and scalability in relation to cloud computing (Kalra, 2016). At the same time, the use of big data allows for the usage of analytics, which can be personalized to suit the customers as they access the website (Sharma, 2016). Nevertheless, the concurrent use of Big Data and predictive analytics would contribute to multiple challenges with different companies. The blend would lead to exploration in areas such as determining risks associated with huge portfolios, upgrading delinquent collections, and achieving high-standard publicizing campaigns.

2.8 Big Data Technology Challenges

The utilization of traditional data is associated with multiple challenges when it comes to big data. The resulting technological challenges associated with big data are due to the 4V features of the technology, with the challenges varying according to different sectors such as industry, sciences, and governance.

2.8.1 Data Storage

As aforementioned, big data is associated with enormous amounts of data. Therefore, storage poses a challenge due to the features of volume, velocity, and variety. Traditionally, big data is stored in physical storage devices such as hard disk drives, which offers a

challenge since such storage systems sometimes fail and make use of traditional data protection mechanisms that are more vulnerable to cyber-attacks (Yang et al., 2017). Furthermore, the velocity of Big Data necessitates storage systems that have the capacity to scale up quickly. Nevertheless, this is difficult to achieve since the traditional storage systems have limited capacity. Comparatively, the utilization of cloud storage services provides unlimited storage space for data and this enormously spaced vault which are quicker to scale up (Alam et al., 2015). The use of cloud computing can therefore provide a solution to the issues associated with the traditional storage methods. However, the use of cloud computing can be expensive as a result of the size of data volume (Yang et al., 2017). To counter this, there needs to be appropriately developed algorithms and principles so that the spatiotemporal patterns are properly applied, and the value of data preserved, and the associated cost of data minimized by ensuring the transfer process is fast.

2.8.2 Data Transmission

There are different stages involved in the data transmission process. The process begins with collecting data through the use of sensors and then transfer to storage. Subsequently, the stored data can then be integrated through the use of multiple data centers. The integrated data is then managed and transferred to processing areas such as the cloud. Finally, the fourth step involves data analysis, where data is transferred from the storage units to analyzing platforms. Li et al. (2015) argue that within all these stages of data transmission, different challenges can arise. Such challenges can be prevented by putting in place smart preprocessing techniques and ensuring data is compressed so that the size is reduced before their transmission. Li et al. (2015) propose that to carry out data transmission efficiently, there is a need to ensure a set of compression techniques are put in place to ensure geospatial data is easily transferred within the environment. With the emergence of cloud computing technology, big data can be transferred to the cloud, and the process is made easier (Brunswicker et al., 2015). Nonetheless, there is a lack of algorithms that oversee the

automatic transfer of data to appropriate cloud service locations which will ensure there is reduced cost while the speed of transmission is enhanced.

2.8.3 Data Management

Initially, when big data is collected, the data tend to be unstructured, voluminous, and heterogeneous. Management of such data sets by computers remains difficult and, if carried out, will lead to consumption of too much energy, which translates into higher costs. With the different features of big data such as variety and veracity, utilizing new technologies such as Hadoop to smoothen different processes such as organizing and managing unstructured data can be crucial (Brunswicker et al., 2015). The utilization of metadata can be useful as it will ensure the integrity of data. However, the usability and effectiveness of metadata remains as data cannot be produced automatically for use in Big Data interfaces. Moreover, such data is much more difficult in geospatial data settings as a result of the complexity and high dimensionality associated with the data.

Apart from the difficulty in the generation of the metadata systems associated with big data, there is also the challenge of lack of scalability associated with the management of big unstructured data as a result of the lack of reliability of the traditional data systems (Yang et al., 2017). A number of non-relational databases have been developed to enable easy management of big data and ease information processing. This includes systems such as MongoDB and HBase. Even though these systems effectively manage big data, there is still a challenge on how to tailor them towards appropriate management of geospatial Big Data through the use of algorithms.

2.8.4 Data Processing

Efficient data processing requires powerful CPUs and dedicated computing resources. When it comes to big data, the computing resources required are more than those of traditional paradigms. The utilization of cloud computing ensures that required processing is carried out on-demand and the processing is unlimited. However, there is a challenge of

shifting to cloud computing, especially when there is the use of large data volumes since the network's bandwidth is significantly increased (Yang et al., 2017). Also, after using these clouding systems, it is difficult to track and ensure data locality, which minutes the exchange process and communication required by the data.

Since big data often has a feature of veracity, preprocessing is needed before carrying out the data analysis process. LaValle et al. (2013) note that preprocessing allows for machine learning and classification, and this ensures excellent quality of information during the data mining process. García, Luengo, and Herrera (2015) and Aghabozorgi et al. (2015) both agree that in cases of high dimensional spatiotemporal data, which are voluminous, utilization of prevailing data compression algorithms tend to be ineffective as the resultant output of data will be unwanted quality and will not be produced within the acceptable time frame. The traditional algorithms available are not able to carry out preprocessing (Brunswicker et al., 2015). Therefore, there is a need to update these systems to allow for effective and scalable compression algorithms which are efficient enough to eliminate irrelevant and redundant data, making the whole process of analysis and processing easier.

2.8.5 Data visualization

Through this process, the hidden patterns present in big data are identified, and therefore, correlations can be drawn and appropriate decisions made (Nasser & Tariq, 2015). In most cases, big data tends to be heterogeneous, and therefore, through visualizations, it is easier to make sense of the information. Data visualization is crucial since it enables the use of user interactive graphics, which allow for best practices.

2.8.6 Data integration

Data integration is necessary for establishing the feature of value of big data. This is achieved through integrative analysis processes and, in some cases, application of cross-domain collaborations (Yang et al., 2017). There are a variety of challenges associated with data integration processes, such as record linkage and schema mapping. The utilization of

metadata smoothens the process of tracking mappings, and this enables the integration of data sources.

2.9 Opportunities and Challenges for SMEs in Big Data and Cloud Computing

2.9.1 Opportunities

The use of Big Data and efficient processing methods in drawing correlations aids in firms being more innovative and encourages heightened levels of productivity and increased profits of the involved organizations. Bhat and Quadri (2015) note that for a firm to acquire big data, they need expensive Infrastructure, costly software expenses, and even higher experienced and well-trained workers who can use the technology accordingly. Nevertheless, according to Frizzo-Barker et al. (2016), multiple technology-savvy organizations are using Big Data in multiple strategic ways despite the high costs associated with implementing it.

At the same time, there are multiple medium and small-sized enterprises that struggle to put up Big Data and integrate it into their organizational culture. The implementation of Big Data into enterprises through the use of cloud computing offers many advantages, such as lowering the overall cost of hardware and processing and having the capacity to test the value in relation to the available data. In relation to achieving this, small and medium-sized businesses are likely to lack adequate resources to adopt Big Data technology. Nevertheless, Vajjhala and Ramollari (2016) argue that this can be countered through cloud computing, which would give the firms the room to adopt Big Data at much lower costs and attain a reliable cloud computing infrastructure.

Cloud computing supports network access to external entities for on-demand services. Moreover, the type of analytical processes and the quantity of data predict the capability of the computing process. Therefore, the use of Big Data accommodates the pay-as-you-go cloud computing in which the applications can be increased or reduced according to demand.

It also gives room for firms to restructure their virtual resources either horizontally or vertically to strike their goals within a short period without having to purchase additional hardware (AWS, 2016). If the organization requires change, the use of Big Data would easily accommodate the change in a quick and less costly process. There are also cloud providers such as Amazon, who give their users the whole package when it comes to Big Data services, including accumulation, storage, and processing of data.

The use of cloud computing and Big Data applications gives room for fast data processing as the involved provisioning servers in the cloud are feasible and easy to access. In relation to this, the processing requirements involved in Big Data and cloud computing can easily be scaled according to the requirements. In addition, fast provisioning is of the essence since the value of big data often depreciates with time. The concomitant use of Big Data and cloud computing is convenient and gives room for on-demand access to the computing atmosphere with little effort (El-Seoud et al., 2017). The dynamic environment tends to also be strong and mechanized, with room for multi-tenancy. The use of cloud computing with Big Data allows Big Data to be easily controlled and monitored. Also, the combination reduces the complexity of data and enhances overall productivity. As a result of all these advantages, cloud-based approaches remain key in the management of Big Data.

Vajjhala and Ramollari (2016) analyzed the contemporary trends in using Big Data through cloud computing and the various ways small and medium-sized organizations can use opportunities provided by these technology trends. The study aimed to identify current trends in big data and cloud computing, identify how firms can benefit from these technologies, and analyze the various challenges and risks of the technologies. A significant factor of the research process was extensive literature that elaborated how enterprises stood to gain from taking part in Big Data technology and cloud computing. Vajjhala and Ramollari found that even though Big Data analytics is complex and requires a significant amount of

investing, SMEs can adopt concurrent cloud computing to smoothen the process and make it less costly. Cloud computing provides SMEs with the chance of being able to make use of Big Data even if they are resource-constrained. During the study, some identified challenges include security issues and the sophistication in the use of the two technologies.

2.9.2 Risks and Challenges

Cloud computing plays a crucial role in reducing the costs and required resources for companies to process data efficiently. It also gives room for scalability and flexibility. However, Depeige and Doyencourt (2015) note that challenges relating to user privacy and system performance derail the acceptance of cloud computing infrastructures. Additional research also reveals that some users complain that cloud computing tends to be unreliable and has poor data security. Recently, there have been multiple reports that cloud computing violates the privacy of its users. Privacy concerns arise from the fact that firms that offer data services have advanced infrastructures that can potentially allow them to access people's private data. Consequently, users like SMEs are always advised to weigh the potential risks of leaking their sensitive data through cloud computing services.

As noted, privacy and security concerns can be major deterrents to the adoption and implementation of cloud computing services by SMEs. Consumers, in some case scenarios, have developed a lack of trust in their service providers. Apart from trust challenges, Big Data faces potential risks in service level agreements due to existing knowledge gaps (Botta et al., 2016). Cheraghlou (2016) notes that cloud computing also tends to have fault tolerance. The technology can detect damage and initiate automatic recovery, preventing any damages to the final output. The technology also has issues when it comes to its portability and interoperability. Interoperability remains an issue in the field of communication since there is difficulty in establishing connections among multiple clouds. On the other hand, Vajjhala and Ramollari (2016) conclude that the challenge in cloud data does not involve big

data deployments. Rather, the challenges identified in on-premise deployments are considered to be the major cause of challenges. This includes lack of cooperation from clients, lack of big-data skills, and poor perception of the technology.

2.10 Chapter Summary

With the advancement of technology, the utilization of Big Data has become a common trend among organizations. However, the inherent features of Big Data (the 4Vs) complicate the processing and use of targeted data sets. This is particularly true when traditional data processing applications are used to manage the current enormous amounts of data. Despite these challenges, the use of cloud computing establishes a smooth vehicle for the management of Big Data. On the other hand, the use of Big Data enacts a challenge of reconciling two incorporable plan principles. The use of Big Data concomitantly with cloud computing gives room for businesses and other institutions to make use of their large amounts of data easily.

Mobile and cloud computing leverage the capacity of data storage in different forms and also quicken the processing of very large data, and this will enable fast development of the enterprises and businesses which make use of it. Cloud computing and Big Data offer the advantage of allowing data storage and processing of data. There is the availability of adequate space for Big Data needs, and thus, the complexity of the data is reduced, and productivity increases. Notably, as different research points out that the use of cloud computing is associated with reduced security and privacy, there is no association between the users' impact on these flaws. Therefore, further studies need to be carried out to determine if the resultant flaws result from poor skills in Big Data and cloud computing or the cloud service providers themselves.

3 Chapter 3: Methodology

3.1 Introduction

The current chapter describes the core research tools and processes deployed to examine the challenges and opportunities of using Big Data in mobile and cloud computing by SMEs. Accordingly, the examination of challenges and opportunities in Big Data utilization in mobile and cloud computing is centered on practical applications in tech and business environments. This approach allows for a proper understanding of the relationship between Big Data and its utilization in mobile and cloud computing and provides a way to develop theory and come up with conclusions from the data to explore the opportunities and challenges for utilizing Big Data in mobile and cloud computing and determine the effect of Big Data on SMEs. Consequently, the applicability of grounded theory and a constructivist approach in this research is analyzed. At the same time, this chapter also entails other crucial sections such as the used research methods and design, sampling design for the target. The chapter also details the processes followed and the techniques used to acquire and process the research data, thereby meeting the intended deliverables. The ethical factors observed during the actual research process are also discussed.

3.2 Research Questions

As mentioned earlier, the focus of this study is to establish a theory that answers these research questions:

RQ1: What is the relationship between Big Data and its utilization in mobile and cloud computing?

RQ2: What are the latest trends in Big Data utilization in mobile and cloud computing?

RQ3: What are the opportunities and challenges for utilizing Big Data in mobile and cloud computing?

RQ4: How does Big Data utilization in mobile and cloud computing affect practical setups such as SMEs?

3.3 Research Design

The research design of every study plays a key role in allowing for proper planning of the research process and eases the implementation of these tactics. It serves the purpose of a blueprint, indicating a clear pathway as to the means by which data collection will occur, then processes and analyses data as the study demands. The current work employed the exploratory research approach, where the researcher had the opportunity to familiarize with past data and discover crucial insights about the research problem (Schoonenboom & Johnson, 2017). Besides, the exploratory research model is ideal for exploring viewpoints that are yet to be exhausted by extant research. Therefore, the researcher could develop novel insights about the progression of Big Data trends on mobile and cloud computing and their impact on SMEs. Finally, the exploratory model was crucial in directing the scope of potential future research regarding the feasibility and sustainability of novel data computing technologies.

3.4 Research Method

In this particular study, both primary and secondary data collection methods are utilized. With the aim of collecting required data and giving feedback to the research objectives, the researchers implemented qualitative and quantitative approaches. Qualitative study is necessary when the goal of research entails the exploration of the phenomenon by making use of people's knowledge, perception, or experience in a given situation (Browne et al., 2019). On the other hand, the quantitative research method is appropriate when the research focuses on determining the association between variables. A qualitative approach is employed to cater to the necessity of analyzing trends, benefits and risks of using cloud computing and big data.

During the process of primary research, emphasis is placed squarely upon the data collection via the survey and interviewing techniques. Moreover, rather than obtaining a quantitative result as a consequence of our implementation of a quantitative data collection

strategy, that is, questionnaires, we have a result that depicts a qualitative orientation. In light of this, the research entails interpreting respondents' feedback on the research problem. Key emphasis has to be placed on understanding the opinions and perspectives on the adoption of big data and cloud computing and potential challenges that have arisen with the use of these technologies. Consequently, in-depth insight on the use of Big Data on small and middle-sized enterprises can be generated.

The objective of the study is to determine the relationship between Big Data and its utilization in mobile and cloud computing, identify the latest trends and the opportunities and challenges associated with the use of Big Data mobile and cloud computing. The use of secondary research in this study entails accessing past literature related to the problem of research. Therefore, the proposed research methods allowed for the development of strong theoretical viewpoints about the research problem. In light of these, a comprehensive analysis of the study assumptions can be made by use of the research methods, both primary and secondary. At the same time, the researchers are more equipped to deal with the implications of the study since they are able to examine multiple perspectives associated with the research topic.

3.5 Grounded Theory Methodology

Grounded theory is a crucial way of research since it provides a qualitative approach of shifting from an individual point of view to collective knowledge. First discovered in the 1960s, grounded theory was mostly used in research communities and is considered the process of discovering theory from data (Belgrave & Seide, 2019). Since the study involves a qualitative study, grounded theory methodology is used. This methodology allows for the establishment of theories from methodological coding interviews and using terms that concisely and abstractly recapitulate the words and phrases.

Interestingly, the use of grounded theory has been shown to have a combination of constructivist and rationalist inclinations. The positivist (rationalist) philosophical position is

a concept that entails utilizing human experience while keeping in mind that human perception is prone to error and maintaining complete objectivity (Belgrave & Seide, 2019). On the other hand, the constructivist philosophical position also focuses on the use of human experience, but in this case, the experience is considered to be prone to be influenced by external forces, culture, and society.

In this piece of work, a grounded theory with a constructivist approach was utilized. As a result, interpretive grounded theory, which forms part of the constructivist tradition, is utilized to draw the concepts of the studied phenomenon and foster clear articulation of theoretical claims. The interpretive grounded theory also gives room for an imaginative interpretation and recognizes the probability of subjectivity in theorizing. In this study, the focus is placed on conceptualizing the phenomenon of every respondents' opinions and knowledge, comprehending in abstract terms the coded data gathered from interviews, and creating a theory grounded on an understanding of these participants' knowledge.

In order to achieve this and use the constructive grounded theory accordingly, emphasis is put on the phenomenon and the reflective nature of this study. Reflecting on the evolving theory from the beginning to the end of this research is crucial in guiding changes in interview questions while carrying out the study, and this gives room for the collection of more data on arising theories. The researcher focuses keenly on subtleties of data to determine the various challenges and advantages. Cumulatively, the resultant conclusion is based on the researcher's interpretation of data while using the constructivist grounded theory. The key tenets of the grounded theory methodology relevant in this study include coding, the establishment of memos, data analysis to create theory, identification of key categories from coding, and theory development (Belgrave & Seide, 2019). When utilized in grounded theory, these procedural steps enable the researcher to view data from different perspectives and draw appropriate conclusions from the data.

3.6 The Researcher

The researcher in this study has a background in business technology innovation, including a Master's degree in related fields. The researcher was keen during the study, and no participant had a direct relationship with them, constituting a conflict of interest. There was no conflict of interest such as contracts or any relationships with the subjects that resulted in bias during the research. The researcher has undergone training on the skills necessary to carry out the design of this study. The researcher is experienced in interviewing as they have interviewed people on different occasions with intent to hire. The various skills the researcher has include listening skills as part of corporate necessities and qualitative research capability. For the last ten years, the researcher has been actively involved in corporate communications and fostering internal engagement and external activities.

3.7 Sampling Design

The data collection methods used in this research include a combination of primary and secondary research approaches. It was vital to propose or formulate a sampling method that aligns with the technological deliverables outlined at the beginning of this study. The purposive sampling technique was adopted since it allows a researcher to assess and select a sample size based on the factors, or parameters they deem to be crucial to a given study (Etikan et al., 2016). The primary data collection method required the selection of interviewees based on their extensive ICT knowledge. The target population includes ICT experts who have worked for firms that have successfully incorporated the use of Big Data and cloud computing. The idea is to come up with a sample that can represent ICT teams in cloud computing and Big Data. At the same time, the researcher aimed to pick individuals with expert knowledge compared to the remaining population, and respondents depicted significant knowledge on the challenges and benefits of using Big Data and cloud computing (Lohr, 2019). In light of this, 25 ICT experts, as determined by saturation, were chosen to participate in the survey and provide relevant feedback on Big Data and cloud computing. It

is assumed that these individuals can provide crucial insight on opportunities and challenges for utilizing Big Data in mobile and cloud computing and how Big Data utilization in mobile and cloud computing affects practical setups such as SMEs.

The sample size was carefully selected, recruiting participants with knowledge of Big Data and mobile and cloud computing, and how they affect business operatons. This sample comprises 25 individuals who work as top managers for the various firms that have successfully implemented big data and cloud computing use. These individuals are expected to have in-depth knowledge on the research topic and discuss the latest opportunities and challenges presented by the latest trends in Big Data utilization in mobile and cloud computing. Consequently, the gathered information from the study can be used to effectively improve implementation processes of big data and cloud computing use in technology and enable different firms to anticipate what is expected from the use of these services. The utilization of the two research samples depicts the need for a comprehensive exploration of the use of these technologies and the potential challenges and benefits that firms gather from using them. Respondents picked in these samples are determined to participate in the study and provide their views on big data and cloud computing use trends in small and medium-sized businesses.

3.8 Data Collection

Through data collection, the crucial data that forms the foundation of research is gathered, which provides room for acquiring a substantial amount of information on the research objectives. In some cases, data collection is the most important process in research as it entails the utilization of validated methods to acquire information that will undergo analysis and processing to come up with conclusions in relation to the set research questions (Maxwell, 2018). In addition, the overall information is crucial for the research process as the researcher is able to gauge their hypotheses basing on what was found. Conclusively, it is the researchers' responsibility to ensure that the results obtained during the collection of data for

a study are in-depth and reliable, thus alleviating them enough to be used in making evidence-based conclusions.

In this piece of work, the data gathered is based on multiple aspects and variables to ascertain the legitimacy and correctness of the discussed data. In light of this, before carrying out research, appropriate measures have to be implemented to ensure the data collected from the research meets the desired level of reliability and validity. Every research remains useful since the gathered information from the study can be utilized to draw appropriate conclusions, influence management practices across firms, and introduce new systems. Based on the information gathered in this study, different stakeholders from different industries and organizations can draw crucial conclusions in relation to the use of big data and cloud computing, the current trends, the advantages and risks, and its use among different small and medium-sized organizations. This can be beneficial as it can lead to increased input from the organizations and ensure increased productivity in relation to technology. Therefore, while carrying out this research, a properly structured data collection process is utilized to heighten the validation of the collected data and ease its integration into the associated field of study. Once this is achieved since the data gathered will be valid and accurate, useful insight can be drawn from it and the information utilized to determine the impact of the use of data and cloud computing in small and medium-sized organizations.

3.8.1 Primary Data Collection

3.8.1.1 Qualitative data: Semi-structured interviews

Semi-structured interviews were one of the techniques employed in this study as a data-gathering method. This method remains a key process in attaining information in qualitative research and can be applied across multiple fields such as social sciences, health sciences, and technological sciences (Browne et al., 2019). Semi-structured interviews can be defined as a series of queries that offer participants a chance to give their feedback, perspectives and insight into the research due to their open-ended nature. Essentially, for the

researcher to establish an appropriate background for the study using this research method, a properly structured framework or guide must exist. As a result, multiple themes can be thoroughly analyzed.

In this study, a semi-structured interviewing method was used, and the instrumentation was applied to the interviewer and interview questions. To ensure information was captured during the research, interviews were recorded electronically through the use of a voice recorder. At the same time, memos were utilized to note down ant new research thoughts that arose during and after the various interview sessions. The semi-structured interviews began with open-ended questions on the respondents' profession and area of expertise and their interests in big data and cloud computing. More intensive questions followed to gather more information on perception and opinion on the use of big data and cloud computing, the risks and benefits, and their applicability in enterprises. The interviews ended with more open-ended questions giving room for the participants to provide their view on potential solutions associated with the risks and the advice that should be provided to small and medium-sized businesses in relation to adopting the two technologies.

The interviews were carried out over the telephone. The participants were informed in advance, and a session was scheduled according to their availability. The researcher focused on the set questions during the sessions, and the session was recorded using a voice recorder. The researcher ensured the personal information of the respondents is not disclosed. At the same time, no session was carried out before acquiring written and verbal informed consent from the respondents. To ensure efficiency and prevent confusion, each session entailed interviewing a single participant.

Overall, there are 16 interview questions developed for top managers on cloud computing and technology. The structure of the questions is put in such a way that an in-depth analysis of challenges, trends, and opportunities associated with the use of these

technologies is gathered. The use of semi-structured interviews was an essential part of the data collection process as it allowed the researcher to ask follow-up questions. Conversely, the interviewee could ask the interviewer to rephrase their statements in case there was a need for clarification,. To ensure that there is flexibility in the data collected and a wholesome discussion on the associated topic, the researcher is expected to put emphasis on varying questions.

The interviewer has not only specific questions but also open-ended questions that afford the respondents the capacity to pose queries on the discussion topic. This two-way communication facilitates an environment where trust can thrive, and the participants are hence enabled to discuss even sensitive issues. Consequently, important qualitative data is collected and utilized to draw conclusions that can be utilized for comparisons and can also be used to influence future research.

The grounded theory used in this research gives room for discovering different phenomena while carrying out research, thus allowing flexibility. Since the overall theory of the study arises from data gathered, it is possible that new questions can be established during the interview, and even the already proposed questions changed during the study. Nevertheless, the interviews that are already conducted are not re-conducted using the new or remodified questions. Through this flexibility, the researcher is able to address gaps that emerge and discuss the research topic extensively.

3.8.1.2 Quantitative data: Questionnaires

Apart from the use of semi-structured interviews, this research process also includes the use of survey techniques. This research method is important since it allows researchers to get neutral and objective responses to their set questions. Unlike the semi-structured interviews, the questionnaires give participants the freedom to choose from a group of close-ended questions with various options. In relation to this, the initial section of the questionnaires enquires about the basic information of the respondents, including their age

and gender. In addition, this section also asks about the amount of experience the individual possesses, their current occupation, and the firm within which they work. There is also an inquiry about their area of expertise and job title.

The initial section of this questionnaire introduces the context of the research, while the subsequent part gathers information that tells of how the respondents' organizations use big data and cloud computing. It does this by asking the participants if their business or organization utilizes IT services and cloud computing daily. The subsequent section then analyzes the benefits and risks associated with big data and cloud computing. Therefore, the respondents are asked to provide a reason why they do not use cloud computing and big data in their organizations. On the other hand, those who agree to use the service can then provide a response on the computing services they utilize, the benefits of the service to their organization, the necessary skills required for successful implementation of cloud computing, and the need potential concerns associated with the use of cloud computing.

Apart from the use of close-ended questions, which ensure neutral and objective responses, there is a need to include open-ended questions in the study. The use of these types of questions in the study provides the respondents with a chance to provide their insights on the research topic. Open-ended questions allow these experts to provide their opinion and valued responses. In relation to this, the open-ended section will include questions that enquire on other potential issues that are associated with cloud computing and potential solutions that can be put in place to alleviate the challenges associated with cloud computing and big data application among small and medium-sized enterprises.

3.8.2 Secondary Data Collection

In this study, it is critical to utilize already existing literature to find data related to the topic in question. There are multiple existing pieces of literature that focus on the topic of research, the risks and benefits of big data, and cloud computing use in small and medium-sized organizations. Therefore, obtaining these sources of information can aid in responding

to the research question. In order to acquire data through the secondary collection method, the is a need to review these sets of literature and find their contributions to the research problem and thus, draw conclusions. The current research question can be answered by identifying and analyzing relevant literature to determine the opportunities and challenges presented by the latest trends in Big Data utilization in mobile and cloud computing. Secondary sources are used to collect data which is then examined using content analysis. In order to achieve this, the secondary qualitative data is obtained from tech and business innovation databases, including OECD, EBSCO, and ProQuest databases. After identifying these databases, one has to develop specific keywords related to the research problem. The different keywords significant in this study include big data, cloud computing, SME's utilizing big data, and big data using cloud computing. After identifying these keywords, they can be run through the databases such as Science Direct and ProQuest.

To effectively answer the different research questions, there is a need to come up with keywords for every research question. These keywords can then be run through the databases and the relevant articles gathered from the databases. Overall, when carrying out secondary data collection, the initial step involves pointing out the precise research topic, which is to identify and understand the latest opportunities and challenges presented by the latest trends in Big Data utilization in mobile and cloud computing. Furthermore, the topic of the literature review s extended to include the current trends in using these two technologies. How Big Data utilization in mobile and cloud computing affects practical setups such as SMEs.

The data gathered through secondary research is focused on the challenges that organizations face when it comes to using cloud computing and big data. It also analyzes the different constraints towards achieving effective implementation of the technologies in different organizations. In this context, it is crucial to analyze the appropriate changes that organizations need to put into place before adopting the two systems. Once the data is

effectively collected for the research topic, one has to compare and combine the variety of findings. The researcher must possess an extensive level of critical thinking skills since utilizing only one descriptive perspective diminishes the quality of the outcomes and thus, strains with the research process.

While using secondary data collection, the researchers stand to benefit significantly since there is expensive data available. In light of this, data acquisition remains a cheap and easy process compared to primary data collection (Maxwell, 2018). It conveniently enables the researcher to obtain data from various authentic sources in a quick and relatively efficient method. Nonetheless, based on the most recent reports, other secondary data sources tend to give information that is inconsistent with and irrelevant to the research topic. This can be combated by using primary and secondary research approaches that give room for an optimal and wide-ranging study on the topic of study while availing the latest statistics and availing different insights on the research problem (Pal, 2017).

3.9 Triangular Confirmation

This is an efficient procedure that serves the purpose of ensuring the results from a study are associated with enhanced levels of reliability and validity. Therefore, since this study is important and the gathered information will be useful in impacting decisions made by firms and will also influence future research, it is important to ensure the reliability and validity of the results. In this research, it is crucial not to that a survey in one of the organizations that use cloud computing and big data is carried out. While ensuring a spacing of six months, the survey is administered twice to the firm. This method of study is taken as a means of detailed observation, and it is considered to be among the processes of validating the research findings. As a result of using the triangular formation, there is heightened validation of data since the cross-verification process ensures the study involves the use of relevant information.

3.10 Analysis of Data

Since the data collected in this research is majorly qualitative, it is essential to use an interpretive approach to analyze the data. Taking the point of view of this research paradigm, one can conclude that society, due to the limitation of perspectives and various insights that could be obtained from the research, is often not viewed from a singular or objective angle. With putting into consideration that the reality is multiple, it is easier to make use of different insights and perspectives (Terry et al., 2017). The interpretive research paradigm was preferred as ideal for examining practical human contexts. Determination of the meaning of the collected data is further made easier through social interactions, which gives multiple points of view on the risks and benefits of the use of big data and cloud computing.

A crucial process of analyzing data in this research is the use of thematic analysis. This method is effective as it enables a thorough analysis of the different responses given by the participants to the different questions. The analysis process is carried out through coding, which allows for the identification of multiple crucial patterns related to the topic of study, and those patterns identified as similar grouped into the same codes. Therefore, one is enabled to generate initial codes, which subsequently offer the researcher a chance to have relevant themes capable of responding to the research inquiries. After this is complete, the researcher can then isolate the themes which they consider most important.

Throughout the research process and while carrying out thematic analysis, the integrity of data has to be maintained, so that trustworthiness of the research is preserved. The information gathered in this research can be crucial in influencing the use of big data and computer clouding among different small and medium-sized organizations. With this in mind, the thematic analysis must be achieved via rigorous to give the researcher an opportunity to yield meaningful results. In this research process, the researcher was able to remain keen and provide sufficient attention to details, and consequently, individuals who interact with this research afterward have the room to criticize it and review its credibility.

Coding of data by researchers allows understanding the opinion and perspectives of the subjects, and this allows for easy analysis of the provided responses. In the context of this research, codes are established as the research progresses, and this is carried out based on data gathered to achieve data analysis. Achieving coding of data can be carried out through a manual process or the use of qualitative data analysis software. The critical process of data analysis in this research entails coding the transactions or dividing them into different meaningful and controllable data groups. As a result of this process, it is easier to focus on the feedback given by the respondents in a structured way and avoid overemphasis on one aspect of the research instead of the whole interview.

Constant comparison entails analyzing, reanalyzing, and associating the newly gathered data with already existing information. This is a crucial process in the analysis of this research. During the different faces of coding, the newly coded information is compared to those of the previous phases and connections established, and this is carried out until saturation is achieved. The three main coding phases are described in the next paragraph.

Open coding entails coding of the transcribed interview text one line after the other. This comprehensive line-by-line coding is essential, especially in grounded theory. As described by the name, open coding entails using a few words to code each line of the interview text. It is essential since it allows for in-depth analysis and instills the discipline of grounded theory. Subsequently, selective coding arises when there are no more open codes, and the already existing core categories emerge. The grounded theory allows for categories and constructs to remain interchangeable in a study. While using selective coding, some data tend to emerge compared to others.

In some cases, a single selective code can mature into a prominent theme and become the theoretical code. The final process, theoretical coding, begins after categories emerge, or in some cases, it can begin during open coding when the gathered data starts to unveil

potential theories. This coding process arises when the categories or codes derived from the open and selective coding are compared, and associations are found to be existent between them.

3.11 Validity, Reliability, and Trustworthiness of the Collected Data

The validity, reliability and trustworthines of research findings influence the effectiveness and usability of a given study. Cumulatively, the three aspects of data impact the degree of confidence drawn by the end readers (Mohajan, 2017). In improving the confidence of readers and usability of research findings, researchers usually model different factors that may affect the reliability, accuracy and trust of the collected data.

Often, in qualitative research, the trustworthiness and validity of a study rely on what the researcher observes or hears. Enhancing the trust and credibility of research findings encompass factors such as the tools of data collection and methods of data verification. In this study, the researcher ensured credibility by ensuring that all the respondents who provided feedback were ICT experts with in-depth knowledge on cloud computing and big data or top managers in firms with a history of implementation of these two technologies. It is crucial to ensure that the respondents have in-depth knowledge of the phenomenon the researcher seeks to explore. The use of vignettes during interviews allows for the depiction of the research themes in the study and provides support to the gathered results. To ensure the confirmability of data, there is a need to eliminate all sources of bias in the research. In this research context, the respondents had no relationship with the researcher, and this prevented bias. At the same time, the data gathered is interpreted in an unbiased way.

Constant comparative analysis is used during the data analysis process to allow for systemic comparisons of data and enable the research to show the association between the analysis and the theories that arise. Through constant analysis and comparison of the data gathered, the research achieves credibility on the conclusions and derived theories. Depicting

saturation is also necessary for ensuring that the gathered data is adequate to provide credibility to the conclusions arrived at.

There are different criteria used in this research to ensure the validity of the data collected is achieved. First, one has to ensure that the credibility of the research is preserved, and this entails ensuring that the feedback provided by the respondents is truthful and correct. After this, it is imperative to ensure that the level of authenticity of data is preserved. This entails ensuring different perspectives are put into consideration while carrying out analysis of data, and thus, bias associated with data presentation is reduced.

In spite of the variation of the periods of collecting data, the focus is directed towards ensuring consistent research information is produced to ensure that the data is reliable. To ensure the reliability of the collected data, emphasis is placed on ensuring consistent research information is produced despite different periods. This entails achieving the same results while using the same approaches, same measurements, and circumstances but over different time periods. Providing consistent and stable results boosts the confidence associated with research findings and increases its reliability and applicability (Carrier et al., 2020). Ensuring the reliability of data is achieved is important since it ensures the research meets the predicted objectives.

In order to ensure the trustworthiness of research, it is also important to ensure the research remains accessible. Even though this research will be available for over five years, all the related transcripts and recordings will be disposed of after that. This limits the availability of the associated data and thus, reduces the trustworthiness and credibility of the use of this research in the future.

Another potential limitation of this study is that the interviews are carried out on the phone instead of in person. Nevertheless, to compensate for this, it is important to heighten the attention to verbal communication to compensate for the missing non-verbal cues. To

ensure consistency across the different interviews, they were all carried out the same way, through the phone, even in cases where the interviewee was close enough to allow for an in-person interview.

To lower the various bias that arises in this study, the researcher puts across various measures. Clear rules are set, and they are followed throughout the study. At the same time, several controls ensure the set rules are followed. The thematic coding of the interviews while relying on the grounded theory methodology allows for objective data interpretation and lowers bias.

3.12 Ethical Considerations

Throughout the research, ethical consideration remains a top priority. Specifically, these ethical attentions focus mostly on the primary research methods utilized in the study. Before beginning the process of distributing questionnaires and interviewing the respondents, it is essential to acquire informed consent through the informed consent form. Acquisition of informed consent entails providing the respondents with the study's specific information, its aims, and the associated benefits and risks. With the information they receive, the participants are awarded the capacity to informed decisions, which determine if they will be part of the research or if they will decline. Throughout this research, the participants have the independence of withdrawing from the research at any point.

In addition, another crucial consideration in terms of ethics is making sure the confidentiality of the respondents is maintained. This entails the researcher ascertaining that the personal information provided by the respondents are not accessed by any other individuals. Meeting the objective boosts the safety of the participants and also improves trust towards the researcher. Ethics also applies to analyzing and reporting data, and the researcher has a role of ensuring no misrepresentation of research information occurs throughout the research process. This is crucial since the data gathered and the general information is necessary for providing solutions and influencing corporate decisions.

3.13 Chapter Summary

The main focus for this research chapter was to discuss the significance of the outlined research methodology that has been used to respond to the research question, which was defined as an approach that takes up both the primary and secondary research strategies. A discussion on the research design and methods, data collection, including interviews and questionnaires, is carried. A constructivist grounded theory is utilized to conclude the risks and benefits of using cloud computing and big data. The data that confounded this research was acquired through the use of secondary sources through using keywords to search databases. Study participants also contributed to answering the research questions by sharing their expert knowledge and experiences. The subsequent chapter provides this research's study results and depicts that the methodology in this third chapter was followed.

4 Chapter 4: Presentation of Findings and Analysis

4.1 Introduction

The previous chapter enlisted the research tools and methods to answer the four research questions. In examining the latest trends in Big Data utilization in mobile and cloud computing, this research sought to gather practical primary data from the target respondents. The evaluation of both primary and secondary data was critical for the confirmation of research findings. The current chapter presents the research data in its raw form, illustrating the data through tables, schematics and charts. The data sets are accompanied by shallow commentaries to provide context for the data and set the stage for an in-depth discussion in chapter 5. Data is presented in two stages – quantitative and qualitative. Quantitative data sets were derived from the respondents' questionnaire responses. Accordingly, the quantitative data were subjected to in-depth statistical analysis using the SPSS software. On the other hand, qualitative data sets were retrieved from the respondents' interview responses. The present study's qualitative data was analyzed using a thematic analysis approach, where vital viewpoints were isolated and described. The analytical processes are described under each sub-section.

4.2 Quantitative Data – Questionnaire Responses

Remarkably, primary data was utilized for this current research to provide a solid platform to portray the real-time challenges, opportunities, and the latest trends in Big Data utilization in mobile and cloud computing. Therefore, the participants selected for this study specifically characterize a population of ICT teams in cloud computing and Big Data, including experts who have worked for firms that have successfully incorporated the use of Big Data and cloud computing. This section is thus in sync with the quantitative research guidelines and methods used during the actual collection procedure of data. It also displays the study findings focusing on the full survey report retrieved from the sample of 25

respondents' questionnaires. These findings are therefore expected to provide critical comprehension on opportunities and challenges for utilizing Big Data in mobile and cloud computing and how Big Data utilization in mobile and cloud computing affects practical setups such as SMEs.

4.2.1 Sample Description

Survey data applied for the analysis of this research was generated from distributed questionnaires amongst 25 top managers from various firms that have successfully implemented big data and cloud computing. The raw data extracted from these survey questionnaires were then recorded in MS Excel files awaiting further analysis and then interpreted as presented below in specific sub-sections. Additionally, descriptive measures were used to characterize and visualize the research data focusing on the study's general objective. Data visualization for Big Data has proven operational in motivating complex analyses and presenting vital information in massive data amounts (Keim et al., 2013). Resultantly, it offers novel research opportunities and mirroring for real data characteristics and better understanding. This will facilitate decision-making processes in line with visual forms of analytics and make it easier for the data to make sense. Moreover, it helps in comprehending information, discovering patterns, and forming opinions.

Responses by Gender

Table 1: Distribution of respondents by gender

Gender

		Frequency	Percent	Valid Percent
Valid	Female	7	28.0	28.0
	Male	18	72.0	72.0
	Total	25	100.0	100.0

Out of the total responses obtained (25 respondents), the gender distribution was 28% females and 72% males. The respondent distribution is pictorially presented (figure 1) to

enhance easy and quick interpretation. This large gap in the gender data depicts that there are very few women in direct contact with big data analytics. Although workforce gender imbalance has been alarmingly highlighted recently, these current study data highlights the minimum number of women hired as data scientists. This unbalanced gender distribution thus does not display the ideal recruitment case of participants as this might influence the data findings, thus biasing the research findings. This calls for a diversified workforce in the population of ICT teams in cloud computing and Big Data, something relevant owing to the gender inequality upsurge in many sectors of society and industries, particularly science and technology.

Although Big Data has been integrated with several companies in recent years, the recruitment of gender-balanced and qualified employees is still a challenge. Data-driven companies and departments need to make sure that all genders are equally represented in the employment field. This facilitates diverse and balanced growth and development of the workforce and companies rather than the classic male-dominated workforce causing major challenges for traditional industries. The stereotypical gender-based roles depicted in the research findings should be addressed with major priorities pegged on it since there are no major differences in the analytical performances of women and men in analytics. In particular, the unequal gender distribution in this current research might bias the study findings concerning the comprehension of opportunities and challenges for utilizing Big Data in mobile and cloud computing.

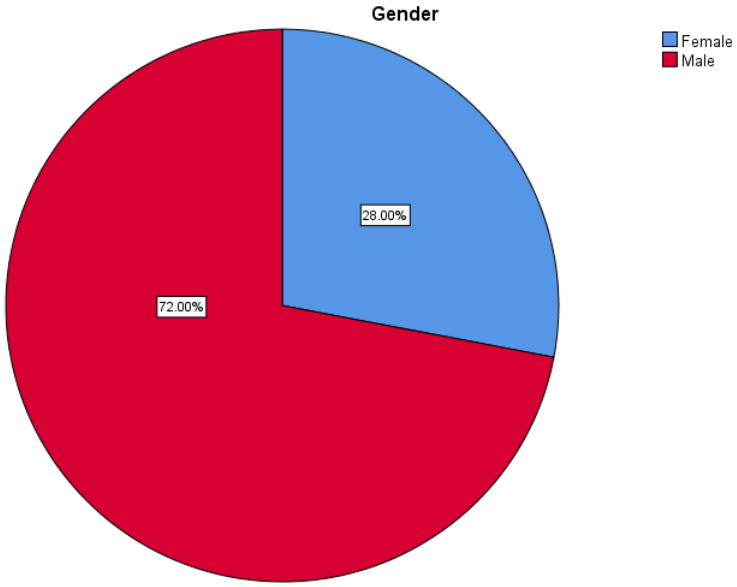

Figure 1: Distribution of respondents by gender

4.2.2 Data Utilization Fields in Mobile and Cloud Computing

Table 2: Distribution of Data utilization Fields in mobile and cloud computing.

		Frequency	Percent	Valid Percent
Valid	Finance	9	36.0	36.0
	ICT	2	8.0	8.0
	IT Services	10	40.0	40.0
	Retail	1	4.0	4.0
	Retail (Fashion)	1	4.0	4.0
	Retail (Women's Clothes)	1	4.0	4.0
	Retail/Fashion	1	4.0	4.0
	Total	25	100.0	100.0

In minimizing the study bias, respondents were sampled from different industries to portray the utilization of Big Data in different employment fields in improving their productivity. Based on the respondents from the table above, the highest number of respondents stemmed from IT services, with 40% of the total respondents translating into 10 individuals. This was followed by the respondents in the finance field with 36% of the total sample size, accounting for 9 respondents from the sample. The third-largest group was from the ICT field, with 8%

(2 individuals) of the total respondents. Those from the retail, retail (fashion), retail (women's clothes), and retail/ fashion were of the same proportion (one person each), 4% of the total respondents. These other industries registered a very low number for the research.

Big data in recent years has proven to be of significant use to many modern companies. Therefore, any company can handle large amounts of data conveniently with efficient analytic decisions. Thus many companies are objectively integrating their daily structures with Big Data Analytics to improve their efficiency and decision making. Moreover, now companies can easily communicate within themselves and engage customers due to mobile and cloud computing. Many organizational processes have been influenced and improved by these processes in the IT services; thus, the largest number of respondents displayed. Big Data is applied in monitoring activities in the financial market, including fraud mitigation, risk management, high trading analytics, and predictive analysis. Other companies apply Big Data analytics in customer retention, handling supply chains like the retail industry, and product creation. Thus the distribution of the study respondents across different industries is expected to exhibit the real-time usage of Big Data across different employment sectors.

It is important to highlight the utilization of Big Data Analytics in different employment fields. Notably, the current research focuses on understanding challenges and the latest trends to identify growth opportunities for both tech and non-tech players. Therefore, addressing the implication of Big Data trends on the future and sustainability of mobile and cloud computing can help advance existing technological infrastructure. As such, it is important to understand how utilization of Big Data analytics is distributed across industries to understand mobile and cloud computing in different fields. Thus information from the different fields could be applied in understanding and mitigating challenges and opportunities associated with efficient uptake of Big Data analytics. Although it is obvious

that most participants originate from the IT field, other non-tech companies like retail portray the positive continuous uptake of Big Data in varied companies.

4.2.3 Age Distribution

Table 3: Age distribution

		Frequency	Percent	Valid Percent
Valid	20-29	9	36.0	36.0
	30-39	13	52.0	52.0
	40-49	3	12.0	12.0
	Total	25	100.0	100.0

The age distribution of respondents for this research ranged from 20 years to 49 years, being the highest age. The highest number of respondents (13 respondents), translating to 52%, were from the age group of 30 to 39 years. This was followed by those of 20 to 29 years, with 9 individuals from the total respondents. The least number of respondents were those from 40 to 49 years, with 3 individuals from the total sample size. The labor force has increased significantly in Africa in recent years, and unemployment numbers also have risen. The current research findings indicate that averagely experts of ICT teams in cloud computing and Big Data do not consist mostly of the young and old age groups but with the highest number of experts falling within an average age of 30 to 39 years. This might imply that it takes time and experience to be an expert amongst those who have experienced the active introduction of Big Data into industries.

4.2.4 Years of Firm's Operation

Table 4: How long has your firm been operating?

		Frequency	Percent	Valid Percent
Valid	1-2 years	15	60.0	60.0
	3-6 years	7	28.0	28.0
	Less than 1 year	1	4.0	4.0
	More than 6 years	2	8.0	8.0
	Total	25	100.0	100.0

The table above depicts the distribution of the years the research's respondents' firms have been operational. A larger proportion of respondents interviewed indicated that their firms have been operational for an average of 1 to 2 years, with 15 respondents translating to 60% of the total respondents. Seven companies have been operational for three to six years, with an average of 28% of the total respondents. This is followed by those companies in operation for more than 6 years with 2 individuals that translates to 8% of the total respondents. Lastly, there was only one individual in a company that has been operational for less than 1 year deciphering a 4%. The fact that most of the respondents were in companies that have been operational for three to six years postulates that the data collected represented well the objective of the current research. This, therefore, implies that the information collected on the utilization of Big Data is varied and stems from experienced companies.

The inclusion of most respondents from companies that have been relatively operational for longer periods improves the study's reliability. Therefore, the larger number of respondents from comparatively well-established companies is suggested to provide crucial insight on opportunities and challenges for utilizing Big Data in mobile and cloud computing. They are also insightful on how Big Data utilization in mobile and cloud computing affects practical setups such as SMEs due to their varied interaction with Big Data for longer periods. The expert knowledge acquired from these respondents compared to the remaining population and respondents is expected to depict significant knowledge on the challenges and benefits of using Big Data and cloud computing. This data, therefore, builds on the confidence that the current study's findings come from experienced employees with insightful information on the study topic.

4.2.5 Utilization of Big Data in Mobile and Cloud Computing

Table 5: Cross-tabulation of Big Data utilization and cloud computing

			Do you utilize Big Data in your firm?	
			No	Yes
Do you use cloud computing?	Yes	Row N %	8.0%	92.0%
		Count	2	23

The results presented above seek to understand the relationship between Big Data utilization in mobile and cloud computing. The research findings indicate a positive integration of Big Data analytics in various industries, evident in the 92% of the respondents who agreed to utilize Big Data in cloud computing. With the increasing uptake of mobile and cloud computing systems in the modern operating systems, these research findings depict the true picture of SMEs' application of Big Data analytics. Moreover, the ability of mobile and cloud computing to improve the whole digital lifestyle continuously encourages SMEs to utilize them in their daily business routine. Additionally, mobile and cloud computing systems guarantee the provision of highly virtualized and on-demand computing resources. It provides improved levels of elasticity, improved storage services, and improved networking to meet the demands of customers. With the ability of mobile and cloud computing to reduce computational resources needed for on-premise management, this study implies a positive pattern in the utilization of Big Data in mobile and cloud computing.

4.2.6 Latest Trends in Big Data Analytics

Predictive analytics

How do you utilize Big Data in your firm?

		Frequency	Percent	Valid Percent
Valid	Artificial Intelligence	1	4.0	4.0
	Data mining	9	36.0	36.0

	Data mining, predictive analytics	1	4.0	4.0
	Machine learning	6	24.0	24.0
	Predictive analytics	8	32.0	32.0
	Total	25	100.0	100.0

Big data utilization is varied in many industries. The current study results indicate that the greatest use of Big Data in different industries using a predictive analysis is data mining, with 9 respondents translating to 36% of the total responses. Data mining implicates analyzing and exploring huge amounts of data to decipher patterns for Big Data. Here, data is used for classification or prediction, where classification involves sorting out data into groups and prediction involves the prediction of continuous variables. This is followed by predictive analytics, with 32% of the total respondents with 8 individuals. Big Data is applicable in leveraging acquired information, having healthy communication, and gaining significant tangible novel insights. These SMEs use predictive analytics in optimizing business processes and in discovering present statistical patterns.

The third utilization of Big Data analytics is machine learning, with 24% of total respondents and 6 individuals. Machine learning is decision-making algorithms and processes that are designed to evolve by learning. Therefore Big Data facilitates the continuous improvising of machines with the ever-changing and growing data streams to produce valuable and continuously evolving insights. For these purposes, some SMEs are applying Big Data analytics to continuously perform machine learning. Lastly, Artificial intelligence and the combination of data mining and predictive analytics registered a 4% each translating to an individual respondent each. Big data is indissolubly connected to artificial intelligence. Even though the development of big data technology depends on artificial intelligence, the response rate for this current research was still very low. In conclusion, the data are shown

above clearly highlights the trends of big data applications, with the most preferred being data mining.

Opportunities and challenges for utilizing Big Data in Mobile and Cloud Computing.

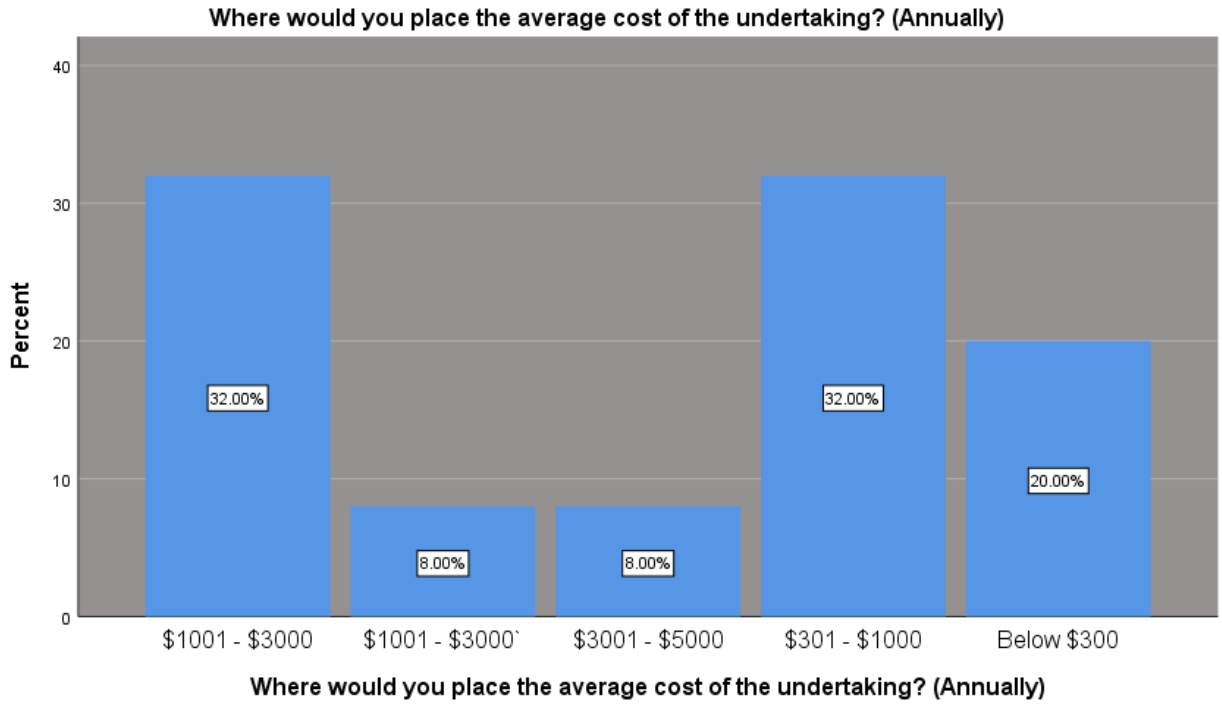

Figure 2: Annual average cost for undertaking Big Data

The cost of undertaking Big Data is too much, as evident in figure 2. From the current study findings, most industries (32%) use up to approximately $1001 to $3000, which could be challenging for SMEs to obtain. Similarly, 32% of respondents hinted that the annual average cost ranges from $301 to $1000, which could be fairly applicable to SMEs. However, 8% of each of the two groups suggest that the annual cost applied in undertaking Big Data is $1001 to $3000 and $3001 to $5000, respectively. The remaining 20% of respondents highlighted that their annual undertaking ranged from $300 and below. Although Big Data analytics has improved the sources of clientele information with the availability of structured and semi-structured data, the opportunity cost pegged on it is yet to be completely appreciated. The reality in the continuous utilization of Big Data in mobile and cloud computing is the need to constantly upscale hardware for voluminous growth in data.

Therefore, the real cost of overall integration and management of Big Data within SME systems needs to be exploited explicitly before taking these processes up.

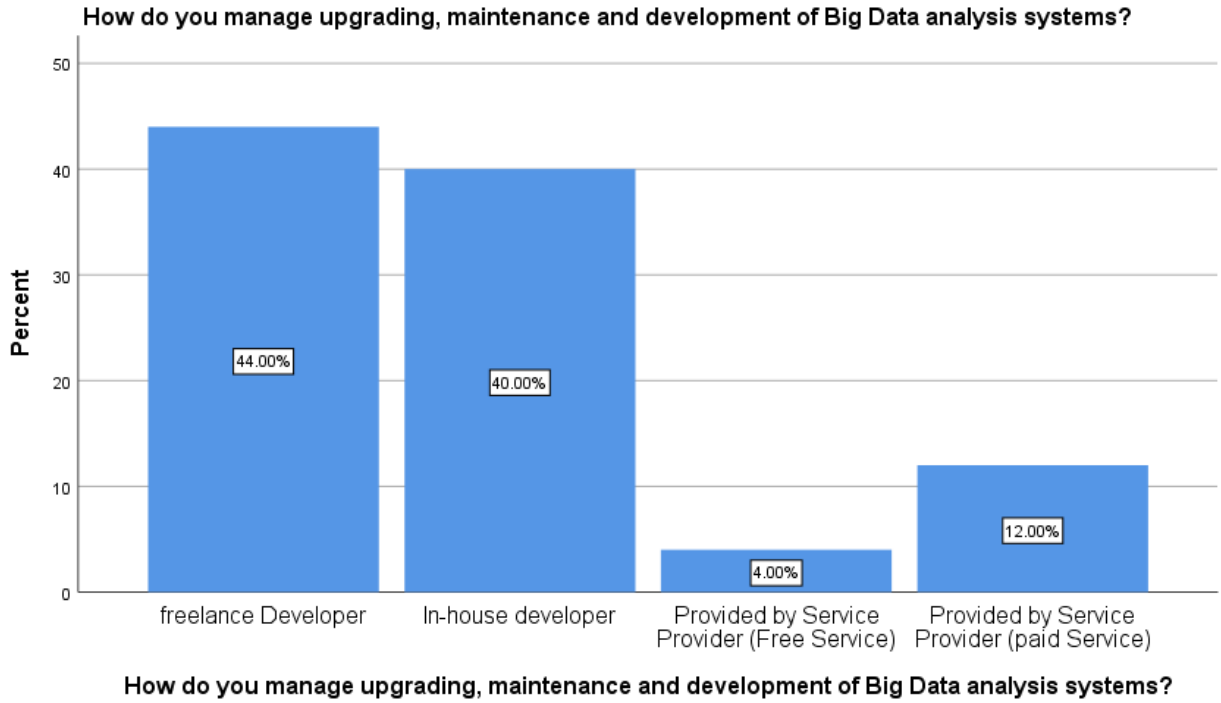

Figure 3: Managing upgrade, maintenance, and development of Big Data analysis system

The technical opportunities and problems created by Big Data analytics warrant skilled personnel thus job opportunities. With an increasing number of industries utilizing Big Data analytics, new challenges are presented, including risks to consumers and businesses alike. Therefore, from the current research's findings, 44% of freelance developers are continuously engaged to help in the management, upgrading, maintaining, and developing of Big Data analytic systems. Better modeling driven by Big Data analytics is required for continuous decision making, improved automation, continuous productivity, and optimization of services, underpinning the need for upgrade and maintenance. The second group involved in the upgrade and maintenance is the in-house developers, with 40% of the total respondents. Finally, service providers with paid services have 12% opportunities created for them, and service providers providing free services have a 4% chance of managing upgrades, maintenance, and development of Big Data analytics. Therefore, from figure 3, it is evident

that the utilization of Big Data analytics in mobile and cloud computing can create job opportunities.

4.2.7 Data Sourcing

Table 7: Where data is sourced

		Frequency	Percent	Valid Percent
Valid	Online (Social Media)	12	48.0	48.0
	Online (User activity on owned assets)	13	52.0	52.0
	Total	25	100.0	100.0

Over the recent years, there has been an improving comprehension of the role of Big Data in transforming the operations of an organization. Big Data has the possibility of being generated in varied sources with an important need of defining external and internally generated data. Therefore both structured and unstructured data should be defined concerning their data sources. The study findings, therefore, indicate that online sourced data from user activity on owned assets (with 52% of respondents) were preferred compared to online sourced data from social media (with 48% of respondents). These data sets are made available by small groups or firms, making it possible for small businesses to acquire business opportunities through data mining Big Data.

4.2.8 Impact of Big Data Utilization

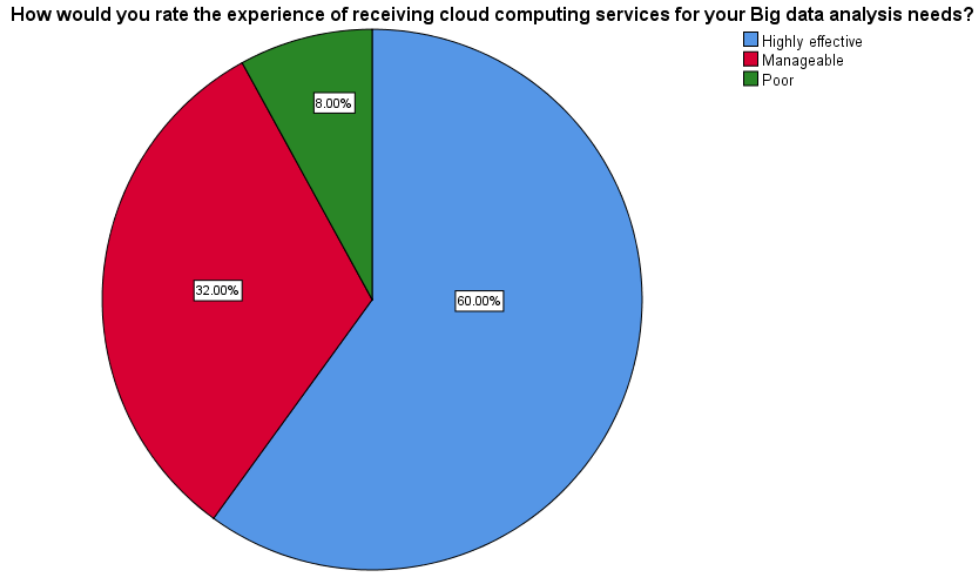

Figure 4: Ratings of experiences received from cloud computing services for Big Data analysis needs

Several SMEs are adopting Big Data analytics that enables large amounts of data collection, exploitation, and analysis. Therefore understanding the practical impacts of Big Data utilization in SME setup is important in improving the performances of companies. Analyzing user experience from the research findings thus illuminates the impacts of Big Data analytics. From figure 4, 60% of the total respondents indicated that the experiences obtained are highly effective. This could translate into high satisfaction with the impacts of Big Data analytics. Additionally, 32% of the total respondents indicated that the experiences are largely manageable. However, 8% of the total respondents rated the experiences received as of poor quality. Generally, the majority of the respondents recorded a positive impact from Big Data analytics.

4.3 Qualitative Data – Interview Responses

The current research utilized both the quantitative and qualitative data analysis methods to achieve the set goals. The previous sub-section focused on quantitative data analysis using SPSS. Contrarily, the current sub-section reviews qualitative themes drawn

from the research interview data set. The thematic analysis approach utilized in evaluating the theoretical insights is flexible, offering an accurate account of the actual data (Castleberry & Nolen, 2018). The method allowed the researcher to draw meanings from the data set from the independent observations made by each respondent. This approach allows for identifying unique cues from the interview data and facilitates the comparison between different data sets. Therefore, the qualitative data analysis approach emphasizes core theoretical insights, highlighting the study's contextual understanding. Additionally, it illuminates the beliefs, values, and contextual behaviors on which the study is conducted.

The current study applies an inductive approach. According to Azungah (2018) qualitative analysis techniques often involve participants' unique experiences gathered during a study. The process is generally inductive, requiring the researcher to review large theoretical datasets to draw expected outcomes. Further, the process is task-intensive as the researcher must embark on a line-by-line interperation of the data set. Therefore, it is a recursive procedure involving a back and forth movement from the literature and data analysis segments to make meaning from developing concepts. Additionally, it is beneficial in capturing the most theoretically interesting and empirically grounded factors in research. The over-indulgment of a researcher in reviewing theoretical outcomes can always lead to biased viewpoints. However, the findings are always regarded as valid if a researcher follows an evidence-based methodological framework.

Consequently, the highlighted thematic themes were derived from the following research objectives; to understand the relationship between Big Data and its utilization in mobile and cloud computing and to identify the latest trends in Big Data utilization in mobile and cloud computing. Furthermore, the themes were based on the need to explore the opportunities and challenges for utilizing Big Data in mobile and cloud computing, thereby determining the impact of Big Data utilization in practical setups such as SMEs. A six-step

thematic process was then applied to analyze the highlighted core themes from the information collected from interviews. The applied thematic process, as described by Kiger and Varpio (2020), was employed in the study as shown in table 1 below.

Table 8: Procedural description of the thematic analysis process deployed in the study

Stage of Thematic Analysis		Description
1.	Familiarization	The researcher in this stage familiarizes himself with the entire data set through repeated reading of the collected information. This is a foundational step for successive segments and offers a valuable orientation. The recorded interviews were transcribed and recorded in a Microsoft Word document with an emphasis on preserving the intended meaning. Active reading of the general data was then conducted to obtain the overall structure and comprehension of the data.
2.	Coding	This step helps in the organization of data and research ideas. Here, the researcher notes important connections, questions, and interests within the collected information, including preliminary ideas. The codes should be sufficiently demarcated and defined to explicitly explain one idea at a time (Castleberry & Nolen, 2018). Similarly, highlighted codes could be pegged on latent or semantic meanings, and the process could be deductive, inductive, or reflective of the issues raised. The current qualitative analysis segment applies an inductive coding approach relative to the interview transcripts' research objectives and relevant points. Shorthand labels and codes were then used to label recurring ideas.
3.	Generating Themes	Themes are generated from the highlighted codes to inform on the broader significance. These themes are developed from graphically mapping, comparing, combining, and analyzing related codes.

		The current research segment linked and combined related codes to obtain the general key thematic themes.
5.	Reviewing Themes	Here, the researcher counterchecks if all the related codes are placed within relevant themes. The researcher then confirms if codes in each theme are coherent and support the common meaning of the broader theme. Therefore, the final analysis should include all the relevant highlighted codes. The highlighted themes were counterchecked against the coded texts from the interview transcripts to ensure that the extracted data reflected the critical research objectives.
6.	Defining and Naming Themes	The researcher then creates a narrative description or definition of all the highlighted themes, including their contributing importance to the broader study objective. The themes are then reviewed to ensure that they adequately describe the study objectives and there is no overlap. An extensive analysis was applied to identify the relevance of each highlighted theme relative to their contribution to the current study objectives.
7.	Write up	This step comprises the description of the findings and the final analysis write-up. The report should be logical, concise, and clear, accurately interpret important data. This segment includes symbolic data extracts and narrative descriptions to explain the research questions. The final findings of the current study were linked to the research objective to explicitly conclude. Some direct quotations from participants were also contextually included in the report of each theme. A discussion of the highlighted main themes is then conducted.

The above qualitative analysis model was applied to the interview data to generate three broad themes, defined as Big Data, Cloud Computing and Subscription. These themes

are showcased in the schematic shown below. The themes were further classified into sub-themes to explore the different facets of the relationship between Big Data, mobile and cloud computing and SMEs. The theoretical analysis of the sub-themes is presented in the next section.

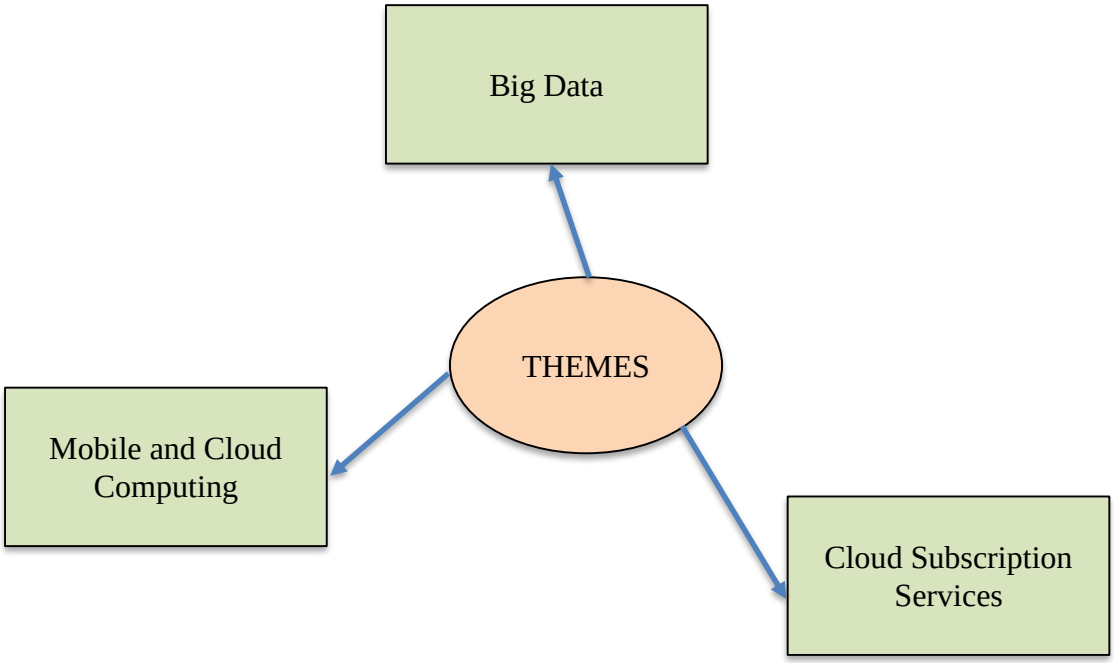

Figure 5: Core themes identified from the qualitative analysis

4.3.1 Analysis and Evaluation of Core Theoretical Themes

4.3.1.1 Big Data

The increased detail and size of data has been the current trend in the tech world for individuals and organizations. While this move has significantly improved the storage costs in today's tech market, SMEs are still encountering challenges in acquiring resources for Big Data storage and implementation. Typically, the data shared within Big Data resources infer meaningful patterns and trends for change in management, organizational setups, and organizational development. Big Data analytics, therefore, enhances organizational development by strengthening organizational relationships and strategies related to Big Data analytics, influencing sustainable innovations (Figure 6). The success of Big Data analytics in organizational success is thus linked to how well an organization utilizes it and how well the

barriers are addressed. Therefore the recorded interviews aimed at unearthing the latest trends in the utilization of Big Data analytics with its opportunities and challenges.

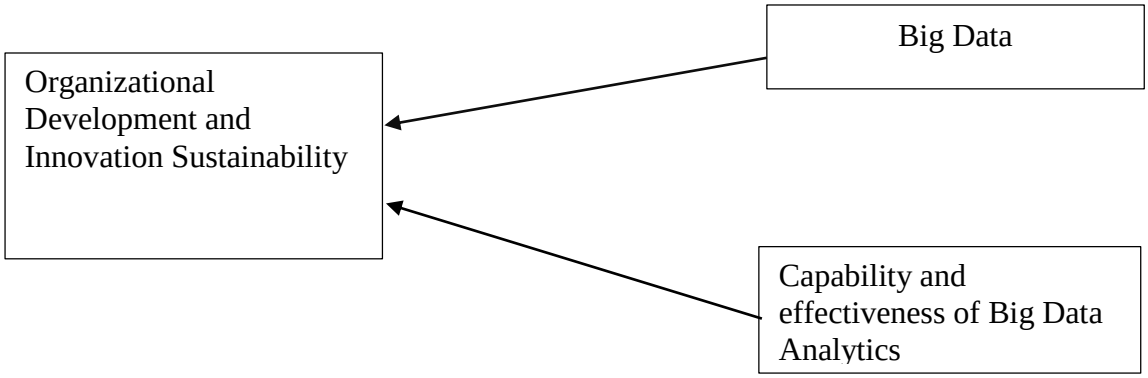

Figure 6: Theoretical framework illustration of how Big Data Analytics influences organizational developments and sustainable innovations

Big Data for Data Mining, Artificial Intelligence, Machine Learning, and Predictive Analysis

Although some participants failed to reveal how their systems work, participant 1 (A) hinted that services were used to host open-source software. Collection and analytics were conducted from the clients' website to offer predictive analysis for potential customers and to purchase trends currently being experienced in the country. Additionally, they offered social media sentiment analysis for their clients with feedback on consumers' uptake of their services. Similarly, participant 3 (A.A.S) indicated that they used Big Data as a predictive tool for their trade. This was performed by monitoring trends from popular sources and giving predictions on how market prices fluctuate. Generally, the participants highlighted that they employed Big Data in data mining and predictive analysis by determining and assessing current trends from social media trends, assessing product demands, thus predicting future trading trends.

Moreover, other participants, such as participant 6 (D.G.), indicated that they used Big Data for artificial intelligence. System data development automation facilitated analysis, stopped losses, and calculated profits individually; however, the processes were monitored to minimize losses. Other participants specified that they used Big Data for machine learning such that personalized financial advisors' data is analyzed then reliable predictions of financial markets are made. Additionally, machine learning employs the current firm's data, data on purchase trends, and customer feedback from social media, then analyses it to expedite future planning. Therefore, Big Data analytics is essential in modifying products, predicting future business trends and demand markets.

Implementation of Big Data

Most of the participants recorded an improved revenue from the successful implementation of Big Data analytics due to indicators of implementation success such as reduced expenditure. Furthermore, others indicated an improved projection of income, accessibility of latest market trends, increased sales, and the ability to project future business trends. Despite the positives registered from other participants, Participant 23 (S.Y.) suggests that accuracy and effort must be applied to get the right analytics from computing systems. These participants also recorded that they are currently not making any income from the system due lack of accuracy in portraying the current market state. Although Big Data analytics improves business dynamics, some businesses might register losses when the system is not efficiently cross-checked with the current market state.

Clients' Awareness of Data Collected

The interview responses for this segment were highly varied. Some participants indicated that their clients were aware, while others blinded their customers, backing it up for several reasons. Some of the reasons for letting the customers know how data was collected included Participant 1's (A) response that encourages transparency between the customers

and service providers. Other reasons for the awareness included permission granting, curiosity from some customers, to aid in service improvement, and effective feedback. However, some participants did not see the need to make their customers aware of the data collected. Others based the lack of awareness on the use of public data and company-based strategies to blind this information from clients. Generally, the participants determined their clients' knowledge of data collected and its utilization.

Barriers of Big Data Analysis

Overall, some participants specified that employing Big Data analysis through cloud computing was difficult, while others felt it was an easy process with a few challenges. Participant 22 (O.N.) cited that the process was difficult since it took a long to get it right. They employed three different developers to work on the system. Most participants also implied that the greatest challenge was finding a good developer because most individuals do not know how to build efficient algorithms that can be applied in data analysis. Other barriers included validation of results from the conducted analysis, requirement of expertise for its development and maintenance, optimization to reduce running cost, the process being time-consuming and inadequate knowledge on Big Data and cloud computing.

However, other participants felt that the process was less difficult when one had the required knowledge and skills. Participant 13 (J) highlights that although he has little technical knowledge being an IT diploma holder with no experience dealing with big data and cloud services, the services were easy to use and set up due to the provided tutorials and procedures. Additionally, the process is improved since the servers are dedicated to helping users. Other reasons include the availability of developers since most of them have entered the business field, especially the wholesale and retail business. Thus, the availability of expertise and a developer influence the implementation process of Big Data analysis through cloud computing.

Benefits of Big Data

As indicated by the respondents, the main benefit of Big Data analytics is improved revenue. Big Data analytics has improved productivity due to the continuous analysis conducted to increase trading profits. Therefore, due to the guarantee granted to the customers, clients have made more investments, thus increasing returns. Additionally, Big Data in the google cloud facilitates healthy competition among businesses, helps maintain clients, and ensures business continuity by offering a continuous flow of revenue. Other respondents imply that although there are still challenges in implementing the system, time used to analyze signals has been significantly reduced with improved decision-making processes. Other benefits of Big Data implementation include effective resource management, projection of income and market trends, improved market size. This is significant from Participant 19's (K.Y.) response; "there has been productivity and revenue increase compared to when I started the business. The information I get had enabled my productivity to grow because when I started, I used 50,000 but now I have doubled that."

4.3.1.2 Mobile and Cloud Computing

SMEs are increasingly being interconnected through mobile and cloud computing to access and share large data sets for ease of decision-making and improved investment returns. Apart from participant 23's (S.Y) response indicating minimal investment returns on utilizing Big Data through cloud computing, other respondents link their improved returns to Big Data analytics. This response directs that the system still needs work to produce accurate data capable of penetrating the market. Other respondents highlight that they can attribute their improved investment returns to Big Data through cloud computing due to several organizational developments. Although some participants suggest that the system can be modified to include human suggestions and cover larger markets for effective productivity, it has contributed to improved customer services, improved revenue stream, business significance, and improved prices of newer designs. Big Data provides clear insights

regarding a product's general response and acceptance, infers on return and business investments.

Furthermore, respondents and customers benefit from services derived from Big Data analytics. Participant 2 (A.A) suggests that cloud computing for big data has effectively increased his profits and reduced the risks associated with forex investments. However, Participant 3 (A.A.S) highlights that cloud computing for big data may sometimes be misleading due to wrong interpretations of data. Some of the responses also indicated that the Google cloud platform was challenging to set up with others registering losses from the system. Overall, most participants rate their experiences using cloud computing for big data as efficient due to improved productivity, improved capability to handle large data, increased customer size, and the ability to host various websites. Other participants also hinted that the Amazon sourced cloud computing model has facilitated effective analysis due to its reliability and efficiency. Despite the challenges faced by some participants in their experiences, most responses indicated an improved general organization's productivity from cloud computing for Big Data.

Management of Cloud Services

With only four participants recording otherwise, most respondents indicated that their choice of type of management approach to Big Data analysis depended on the expertise needed. However, Participant 11 (G.F) indicated that their drive for opting for a self-managed approach was inadequate capital. Moreover, some of the participants who recorded a no implied that they opted for this approach since they needed to invest in the new sector. They also needed to invest in a system that could be easily modified and changed relative to the customer's needs. These factors, therefore, influenced the decision on cloud services management, with other participants preferring a self-managed approach to an in-house developer.

Apart from participants 22, 23, and 24 who integrated the self-managed approach and the in-house manager, other participants applied a single management approach. This was supported by the need to authenticate their companies by either creating new job opportunities or targeting the local market. Other participants who used the self-managed approach indicated that they did not have an in-house developer hence the outsourcing with preferences on developers with expertise in customizing services. Some of the participants, including participant 14 (J.A), opted for an auto-managed provider due to inadequate capital to hire a dedicated employee or freelance manager. Moreover, some of the reasons for opting for a self-managed approach include the need for an IT expert who could individually handle all the tasks, inadequate capital at the start, lack of good full-time developers, and the need to uptake a secure program stored in Amazon servers. Therefore, many organizational strategies play an important role in choosing methods of cloud services management.

The efficiency of Cloud Services

With Participant 12 (H.K) having the only different opinion on the efficiency of cloud services, other participants emphasized that they were satisfied with the options they picked. Participant 12 (H.K) indicated that they would have received a better system if they had paid a more experienced developer, which they could not afford due to inadequate capital. Other participants indicated that they had tried using other options in the past, which were ineffective, hence the satisfaction levels with the current option. Additionally, the current option was reliable, effective, easy to modify depending on current needs, and easy to manage without the additional expense of algorithm experts to manage emerging issues. Other factors include being self-sufficient, having a good server administrator, and significantly reducing expenses. Similarly, participant 22 (O.N) underscore that the current option is efficient since they can maintain and update the software without much trouble with the possibility of modifying the code as social media websites upgrade and change their

appearance since the expert is part of their team. Generally, most participants would not change their current cloud service option since they consider it efficient.

4.3.1.3 Cloud Subscription Services

Apart from Participant 1 (A), who employs the IaaS cloud computing model, other participants apply either SaaS or PaaS. Therefore, Participant 1 (A) suggests that IaaS is more flexible with any infrastructure deployed and virtualized environments based on needs instead of purchasing prepaid subscriptions. Other participants employing SaaS argued that it was a better option allowing for little technical requirements, with Participant 18 (K.S) indicating that it is flexible in delivering services to customers with the ability to reach them over the internet. Conversely, Participant 4 (A.H) had diversified services to minimize costs while maximizing gains. Therefore, they largely used Amazon and Google for most projects, depending on their complexity. Other factors influencing the software as a service (SaaS) model include its set up and deploying speed since the application is already installed and configured, thus saving time.

Other participants indicated a preference of a platform as a software (PaaS) over other cloud computing models. Participant 2 (A.A) indicated that PaaS does not require server setup and security other than application security due to the need to deploy services quickly. In addition, some participants bought a VPS from Data Ocean to host their systems, while others emphasized that PaaS is better for inaccessibility, development and offers more flexible approaches. Other participants indicated that PaaS could host many users, and it is efficient in terms of skill ability and performance. This is due to the ability to increase the server's specifications based on the user's needs, unlike other platforms. Finally, PaaS supports collaboration, including collaborations in planning management of financial skills and record keeping. Generally, PaaS is a flexible and efficient cloud computing model.

Monthly Prepaid model and Pay-as-you-go Subscription Model

Many participants indicated that they had minimal or no regrets for opting into the monthly prepaid model and the pay-as-you-go subscription pricing plan. However, Participants 1 (A) and 22(O.N) felt that this plan was insufficient. Participant 22(O.N) indicated that their system outgrew the initial purchased plan, and it was not able to align with the requirements, so an upgrade of a more equipped system was needed. Some participants attributed the type of subscription model to a lack of other options, such as IBM only offering monthly and annual subscription plans. In contrast, others opted for cheaper subscription options. In comparison, Participant 12 (H.K) indicated that the pay-as-you-go subscription model was more expensive compared to the monthly prepared subscription model. Therefore the monthly option offered a space server configuration that was easy to develop and manage resources. Other factors supporting the monthly prepaid subscription included maximizing the SaaS cloud computing model output and the need to restrain programs to a specific service relative to an affordable budget. Participants who opted for the pay-as-you-go model indicated that it involves fast decision making, thus improving a company's revenue, and it also had better flexible payment terms. In conclusion, participants opted to choose different subscription plans generally depending on their urgency, company needs, and cost-efficiency.

5 Chapter 5: Discussion of Findings

5.1 Introduction

The current chapter deliberates on the research findings presented in the previous chapter, comparing the data with extant literature to infer new viewpoints. This way, the current research data is interpreted to achieve the main aim of the study, which was to investigate the opportunities and challenges presented by the latest trends in Big Data utilization in mobile and cloud computing. More centrally, the research data are discussed with a focus on SMEs for the reasons highlighted at the beginning of the study – SMEs offer a wider reflection of economic performance at the macro-business level and are flexible towards embracing changes for increased efficiency. Therefore, the discussions on Big Data utilization in mobile and cloud computing are centered on their application to practical business environments. Finally, the discussion chapter is aligned with the four core objectives mentioned at the beginning of the study.

5.2 Relationship Between Big Data and its Utilization in Mobile and Cloud Computing

The first study objective aimed at determining the relationship between Big Data and its utilization in mobile and cloud computing. The study findings indicate that most SMEs use Big Data and cloud computing in their daily business routine. In addition, most participants indicated that utilizing Big Data and the interconnection through mobile and cloud computing was beneficial to most SMEs. Although the system could have improved productivity with modification, there are several attributed benefits to utilizing Big Data in mobile and cloud computing. The study findings also indicated that cloud computing facilitated the reliability and efficiency of Big Data analytics despite some of the challenges registered. Therefore, Big Data offers a bridge between technological competencies and evolving market needs.

The above findings suggest that the relationship between Big Data and its utilization in mobile and cloud computing has overarching benefits to SMEs. These findings are supported by Tian and Zhao (2015), where their study findings state that cloud computing and Big Data complement each other. This was evident from the larger percentage of respondents using Big Data and cloud computing. Similarly, as Sathya and Avinash (2015) depicted, the current technological advancement has made it possible for several firms to use Big Data analytics to create effective data analytics algorithms. This has therefore improved the handling of both structured and unstructured data with the ability to gather useful information, share data, transfer and visualize useful information and cues. Consequently, firms using Big Data and cloud computing can easily share resources and improve on task completion at affordable prices (Depeige & Doyencourt, 2015). The growth of SMEs is pegged on their utilization levels of innovation. More rapid decision-making processes and implementation of technological advancements significantly translate to the growth of SMEs.

In addition, the findings indicated that the mobile and cloud computing systems concerning Big Data provide highly virtualized and on-demand computing resources with improved storage services. Kalra (2016) supports these findings emphasizing that concerning cloud computing, the successful application of Big Data analytics offers organizations an advantaged speed, scalability, and reduced storage capacity. The improved data processing due to mobile and cloud computing improves the flexibility and stability of information in enterprises, improving services offered. Although most SMEs require improved computing resources to handle Big Data, integrating cloud computing and Big Data ensures that the unlimited prerequisite processes are carried out on-demand and at an improved speed. Therefore, despite the challenges presented by the implementation process of Big Data analytics, most SMEs largely embrace the utilization of Big Data in mobile and cloud computing.

5.3 Latest Trends in Big Data Utilization in Mobile and Cloud Computing

The second study objective was to identify the latest trends in Big Data utilization in mobile and cloud computing. With various uses of Big Data in SMEs, the current study findings indicated that most respondents used Big Data for data mining. Therefore, SMEs use Big Data analytics for prediction purposes, optimizing their business proceeds. Other usages of Big Data analytics include artificial intelligence and machine learning. Subscription plans used by the participants also varied depending on the customer's needs and the available infrastructure. Some of the subscription plans highlighted by the participants include; IaaS, SaaS, and PaaS. Other diversified participants used Google and Amazon services depending on the complexity of tasks. In conclusion, the subscription model used by the participants, as exhibited by the study findings, was either the monthly prepaid model or the pay-as-you-go model. This decision was generally based on the urgency of the company's needs and the costs' efficiency.

Apart from data mining that is indicated as the largest use of Big Data in firms, the current research findings highlighted artificial intelligence, predictive analytics, and machine learning as other big data analytics uses. These current trends have successfully faced out traditional data processing methods due to the nature, variety, and volume of Big Data, as Sun (2015) confirmed. Subsequently, Yang et al. (2017) state that social media platforms such as Twitter, Facebook, WhatsApp, and Instagram have facilitated the data mining processes to gather information on human processes and interactions. The study findings indicate that most participants used Big Data analytics for predictive and data mining purposes with the need to assess current trends to predict the future. Likewise, Big Data analytics was used for artificial intelligence and machine learning. Firms are capable of facilitating automated processes with minimized observations and using current and past information to predict future planning.

The study findings also indicated varied subscription plans utilized by the respondents, including IaaS, SaaS, and PaaS. Some of the information collected from the respondents indicated that IaaS is a more flexible plan based on the current firm's needs. Relative to these findings, Fazio et al. (2015) emphasizes that the utilization of IaaS in Big Data management is advantageous due to its ability to leverage cloud storage capabilities with accommodation of processes within virtual machines. This subscription model has led to the establishment of various platforms, including OpenStack and OpenNebula, through which Big Data analytics through cloud computing has been carried out. Moreover, the study highlighted the monthly prepaid model or the pay-as-you-go subscription model. AWA (2016) explains that the pay-as-you-go model is accommodated by the utilization of Big Data, where the applications are flexible according to demand. This subscription model type also enables firms to attain their goals in a less costly process without having to purchase additional hardware. With other participants opting for other diverse options like Google and Amazon, the subscription plan and model were settled upon based on the firm's specific needs.

5.4 Opportunities and Challenges for Utilizing Big Data in Mobile and Cloud Computing

The study also explored the opportunities and challenges for utilizing Big Data in mobile and cloud computing. Regarding the continuous uptake of Big Data analytics in SMEs, several technical opportunities arise with the study findings indicating that several participants engage the expertise of freelance developers in the management, upgrading, maintaining, and developing of Big Data analytic systems. Other service providers include in-house developers, paid and unpaid service providers. Other opportunities created include; healthy business competition and the ability to project income and market trends to improve market size. Conversely, most participants experienced technical challenges in the implementation of Big Data and cloud computing. Most participants also hinted that

validating results and finding a good developer was challenging. Similarly, optimization of proceeds, inadequate knowledge of Big Data and cloud computing, and expensive implementation processes were some of the highlighted barriers to successful implementation.

Technology is crucial in the growth of SMEs and the implementation of Big Data analytics. The increasing number of firms implementing Big Data analytics has consequently increased the number of experts and developers required for the implementation processes. Therefore, this has translated to technical job opportunities for these developers, with the study findings indicating that most firms highly engaged freelance developers in their management, upgrading, maintenance, and development processes of Big Data analytics. Services provided by free service providers were the least engaged. In addition to job opportunities, the implementation of Big Data analytics has successfully created a healthy business competition environment. According to Roper (2015), for SMEs to gain a competitive advantage and increase their innovative capacity, they need to maintain unique standards concerning their products and acquire new technology. Generally, SMEs grow by gaining a competitive advantage and by the level of innovation acquisition. Implementation of Big Data analytics in mobile and cloud computing has created the required environment for the growth of competitive SMEs.

Contrariwise, the utilization of Big Data in Mobile and cloud computing has posed challenges to SMEs. The study findings indicated that validation of results, optimization of proceeds, inadequate knowledge on Big Data and cloud computing, expensive implementation processes, and finding a good developer were challenging. Brunswicker et al. (2015) underscore that organizational and management processes of unstructured data can translate to higher costs. Although Big Data has proven benefits, sometimes, the management of such large data could be expensive. The verification of the integrity of the collected data

could be tasking as well. Inadequate knowledge of these processes could as well hinder its successful implementation. Even though there are systems effectively managing Big Data, there is still scarce knowledge on how best to appropriately manage geospatial Big Data through the use of algorithms (Yang et al., 2017). Similarly, the implementation of Big Data in mobile and cloud computing sometimes leads to a lack of trust in service providers (Botta et al., 2016). Various challenges and opportunities have been largely experienced due to the implementation process of Big Data analytics.

5.5 Impacts of Big Data Utilization in Practical Setups such as SMEs

The final research objective aimed at determining the impacts of Big Data utilization in practical setups such as SMEs. The study's findings indicated that several SMEs were adopting Big Data analytics to improve their companies' performances. This was exhibited by the larger number of participants indicating that the services and experiences obtained from Big Data analytics were effective. The findings also exhibited that most participants recorded an improved revenue after the successful implementation of Big Data analytics. Other impacts include easy accessibility of the latest market trends, improved sales, and future projections. Correspondingly, the implementation of Big Data analytics has improved investments amongst SMEs with improved management of resources and decision-making processes. Although these impacts were evident from the findings, other participants highlighted that Big Data analytics required a lot of effort for its success.

Most of the study respondents highlighted that several SMEs that were adopting Big Data analytics had improved performances on their companies. In addition, some of the impacts of Big Data utilization include easy accessibility of the latest market trends, improved sales, enabled future projections, and improved investments amongst SMEs with improved management of resources and decision-making processes. In support of these findings, Sathya and Avinash (2015) stated that Big Data utilization could improve decision-

making processes, unearthing hidden patterns, making relevant correlations, establishing market trends, and delineating consumer preferences. Moreover, accessibility of the latest market trends has also been made possible by developing sophisticated devices such as health monitors, mobile phones, and computers capable of identifying users' information for improved services (Yang et al., 2017). Advancements in technology have seen major imrpovements in the factors favoring the practical utilization of Big Data by SMEs.

5.6 Future of Big Data Utilization in Mobile and Cloud Computing

The objectives of the study, discussed above, have highlighted the core tenets of technological integration in today's digital spaces. The research data, coupled with the literature review, have also presented a practical view of the interactions between mobile and cloud computing and big data in the context of SMEs. Accordingly, the exploration of opportunities and challenges presented by the latest trends in Big Data utilization in mobile and cloud computing can be used to predict the future of technological innovation and influences on the business culture and human interactions. This subsection relies on the insights gathered from the present study to highlight the potential outcomes of continued integration of Big Data technology in mobile and cloud computing modules by SMEs.

The integration of Big Data in mobile and cloud computing has enabled firms to draw the benefits of efficient operations and routine processes. This finding was affirmed by the research data, where all respondents indicated that Big Data had allowed their firms to enjoy various degrees of success. Notably, the respondents mentioned that Big Data had streamlined productivity through the consistent use of data analytics to evaluate processes and appraise performance. Participants went further to quantify the impact of Big Data in their operations. For instance, the 19th respondent mentioned that the consistent use of Big Data and cloud computing in their premises had allowed their firm to increase their profit two-fold. Big Data and cloud computing also managed to improve other areas of business,

including resource management, decision-making, and data mining to project income and market trends. It is important to note that the benefits of Big Data are not limited to the facts gathered in this study. Instead, the benefits are defined by the bounds of innovation, which is a continuous area of focus for most businesses. This is especially true in modern times where the bounds of data availability have been extended by novel data sources such as social media, web applications, and sensor devices. Markedly, all the respondents interviewed in the present study source their data from online sources through automated means. The scenario depicts the changing phase of digitization amid a constant push for business innovation.

In the same way, firms are adopting mobile and cloud computing services to bolster their vibrancy, market positioning, and competitive advantage. Evidence of mobile and cloud computing services was present in the current study, where participants listed various cloud subscription services and their service providers. Cloud service subscriptions were offered in three main variants, IaaS, SaaS, and PaaS, by different service providers, including AWS, Google, and Ocean Data. The careful deployment of these mobile and cloud computing services by the SMEs allowed them to improve their operations by developing faster and more reliant software for business intelligence and decision-making. Conveniently, combining Big Data and mobile and cloud computing has the significant potential of transforming enterprises for greater sustainability. Consequently, the future of modern businesses will see an increase in the integration of Big Data in mobile and cloud computing interfaces.

The resulting research evidence point to the benefits of merging Big Data and mobile and cloud computing. SMEs have continually encountered challenges in their quest to integrate more technological tools and interfaces in their operations. Notably, issues in data handling, including storage, sharing, and security, pose imminent problems to the long-term use of data insights in business processes (Islam & Reza, 2019). Similarly, data from the

study respondents highlighted challenges of technological integration in SMEs, with the threat of security and technological know-how being the biggest concerns for most participants. Fortunately, merging Big Data resources with mobile and cloud computing resources limits the challenges of standalone technologies applied in business setups. For instance, the respondents credited the merging of Big Data and mobile and cloud computing infrastructures with increased flexibility and access to real-time information crucial for business intelligence and decision-making. 60% (15 out of 25) of the respondents rated their experiences of receiving cloud computing services for their Big Data analysis needs as 'Highly Effective,' with only 8% (2 out of 25) rating such experiences as poor. Therefore, the future of big data utilization in mobile and cloud computing must focus on widening the scope for identifying opportunities for sustainable business developments.

By evaluating the role of Big Data in mobile and cloud computing, this study has identified areas and strategies for growth within SMEs. Typically, SMEs begin to implement Big Data projects by acquiring data storage facilities and system analytics modules. As businesses expand, the need for bigger storage spaces becomes inevitable. However, the systematic upgrade of storage resources is never sustainable. This is the point when businesses begin to appreciate the role of mobile and cloud computing. The cloud environment provides SMEs with a scalable interface, which supports intensive data handling and manipulations to generate viable business insights (Yigitbasioglu, 2015; Zhao, 2015). Besides, the cloud environment promotes data sharing and collaboration among employees, giving them adequate time for decision-making. However, realizing the above advantages will require a dedicated effort by SMEs to bridge existing knowledge gaps in the business innovation segment. The sustainable adoption and deployment of mobile and cloud computing platforms in Big Data infrastructures require a solid background and understanding of business needs and technological leverages.

From the survey data, most respondents cited technical incapability as the biggest barrier to the successful deployment of mobile and cloud computing interfaces in Big Data analytics. For example, participant 3 (A.A.S.) mentioned that they had to seek the services of an off-shore developer in Ukraine as they are the only ones that understood their business requirements. Further, the self-management of cloud computing servers of the ventures interviewed by dedicated employees depicts a case of specialized knowledge and competencies. While the knowledge of Big Data and mobile and cloud computing is inherently a preserve of IT professionals, such competencies must be regularized for normal employees. Upscaling the knowledge and understanding of employees across the board can improve the speed and quality of decisions made in an enterprise. Ultimately, SMEs must prioritize knowledge acquisition and training of staff to link business needs with evolving technologies.

6 Chapter 6: Conclusion, Recommendations and Future Work

6.1 Summary of the Study

The current study investigated the opportunities and challenges presented by the latest trends in Big Data utilization in mobile and cloud computing. Advancements in technology, coupled with a growing trend in globalization, have transformed the scope of business operations globally. Accordingly, SMEs are adopting and implementing various technological tools and strategies to sustain competition and maximize their profits. The vibrancy and flexibility of SMEs on economic performance at the macro-business level thus offered an ideal backdrop for evaluating the challenges and opportunities for utilizing Big Data in mobile and cloud computing platforms. The research paper was guided by four research questions, listed as follows: What is the relationship between Big Data and its utilization in mobile and cloud computing? What are the latest trends in Big Data utilization in mobile and cloud computing? What are the opportunities and challenges for utilizing Big Data in mobile and cloud computing? How does Big Data utilization in mobile and cloud computing affect practical setups such as SMEs?

A methodological framework was conceptualized and developed to help explore the research themes. First, an exploratory research design was designed to help illuminate the crucial trends and scenarios on Big Data utilization in mobile and cloud computing with limited past literature. The study population was picked based on the purposive sampling technique, where participants were selected based on their skills and relevance to the research problem. Ultimately, the study incorporated 25 ICT experts with a history of working for ventures that have successfully assimilated Big Data analytics and mobile and cloud computing architectures in their operations. This sample size was carefully selected to represent ICT teams using Big Data and mobile and cloud computing modules in their day-

to-day operations. The study also comprised a sample size of 25 top managers of various firms that have successfully implemented big data and cloud computing. Data collection of qualitative data was conducted using semi-structured interviews, allowing the researcher to make follow-up questions for clarity. A set of 16 interview questions were virtually posed to the respondents through phone interviews. The results were recorded electronically and later transcribed for valuable insights.

Further, quantitative data was collected using questionnaires with a focus on open-ended and close-ended questions to complement the exploratory nature of the study. Finally, secondary data was obtained from past literature that contributes to the research problem. These data were hinged on addressing the challenges that organizations face when implementing cloud computing and Big Data. Data analysis was conducted using an interpretive research approach since the collected data was majorly qualitative. Similarly, the different responses provided by the participants to different questions were analyzed using a thematic analysis approach. Related codes are extracted from the questions, building on the relevant research themes required for analysis. Finally, quantitative data insights were gathered using the IBM SPSS 24.0 with the presentation of statistical outputs using tables and figures.

According to the research findings, the study sample comprised 72% males and 28% females, with the age of 36% of these participants ranging between 20 and 29 years. Likewise, the age of 52% of the participants ranges from 30 to 39, and the age of 12% of the participants ranges from 40 to 49. Different fields utilizing mobile and cloud computing were also included in the study consisting of finance (36%), ICT (8%), IT Services (40%), retail (4%), fashion (4%), and women's clothes (4%). Based on the feedback from the questionnaires, most firms have been operational for between one and 2 years, with 60% of the total respondents confirming this. The least number of operational years was less than one

year, 4% followed by more than six years, 8%, and 3-6 operational years having 28% of the total respondents.

From qualitative analysis, some participants failed to reveal how their systems work, while others indicated that they utilized Big Data analytics for predictive analysis through assessments of current and popular trends. Other participants hinted that collection and analytics were performed from clients' websites while others used popular sources. Apart from using Big Data for artificial intelligence, other participants used it for machine learning to enhance prediction analytics of financial markets. Moreover, some participants exhibited discontent with the cloud services options they picked, with others highlighting room for improvement with the right implementation process. Some of the positive feedback on the current option recorded included; effectiveness, ease of management, efficient server administrator, manageable expenses, and ease of modification. Generally, most participants were satisfied with their cloud services options, with most of the participants indicating that their clients were blinded to the data collection and utilization process.

6.2 Key Findings of the Study

The study's key findings are summarized and presented in terms of the key deliverables posed at the beginning of the research work. This approach promotes the fluidity and coherence of the findings with the research objectives.

Relationship between Big Data and its utilization in mobile and cloud computing. The current technological advancement exhibits a relationship between Big Data analytics and its utilization in mobile and cloud computing. The improved handling processes of both structured and unstructured data has therefore fueled this relationship, with many SMEs opting to use Big Data in creating data analytics algorithms. Consequently, the various advantages stemming from the implementation of Big Data and its utilization in mobile and cloud computing could confirm the large number of experts considering Big Data analytics.

Latest trends in Big Data utilization in mobile and cloud computing. Data utilization in mobile and cloud computing has various usages with many latest trends in its processes. These trends are generally picked depending on the firm or precise expert specifications. However, most experts prefer using Big Data for data mining. With companies aiming at improving and embracing the latest market trends, most experts rely on these processes to collect individual information and predict future trends. In addition, settling on subscription plans and models is majorly dependent on the subscription's flexibility, the current firm's demand, and the availability of capital.

Opportunities and challenges for utilizing Big Data in mobile and cloud computing. The implementation process of Big Data in mobile and cloud computing has significant challenges and opportunities linked to it. Apart from job creation opportunities through the expertise needed from developers, firms are also able to thrive in a healthy competitive environment created by firms that are successfully implementing Big Data analytics. However, there are many challenges experienced during the implementation of these processes, with recorded challenges including limited knowledge on Big Data, expensive processes, and the challenge of finding a good developer, among others.

Impacts of Big Data utilization in practical setups such as SMEs. Several SMEs have recorded very many impacts of the utilization of Big Data in mobile and cloud computing. These include; improved decision-making processes, future predictions and understanding of hidden patterns, improved accessibility of current market trends, and improved SME sales. The many impacts highlighted are as a result of the improvement and the effective handling of the implementation processes of Big Data analytics.

6.3 Recommendations for SMEs

Merging Big Data and mobile and cloud computing infrastructures presents business enterprises with infinite opportunities for growth. Therefore, SMEs must continually

find ways to harness and utilize the power of tech to champion development. SMEs can implement the following ideas to foster growth and sustainability.

1. SMEs should nurture an innovative culture to transform the role and influence of Big Data and cloud computing in routine operations.
2. SMEs should continually evaluate their business environments, identifying potential threats and the role of Big Data and cloud computing in solving such challenges.
3. SMEs should appraise the benefits of Big Data and its integration in mobile and cloud computing to support business intelligence and productivity.
4. SMEs should upscale tech knowledge and train towards Big Data and its utilization in mobile and cloud computing platforms.

6.4 Suggestions for Future Work

The present study was limited to the influence of Big Data and cloud computing on SMEs. There is a need for future studies to explore the broader context of Big Data and cloud computing in macro businesses, including global corporate giants. Such studies would minimize the potential bias of examining the limiting trends of technology in SMEs. More importantly, there is a need to predict the future state of SMEs with regards to adopting and implementing the latest in Big Data utilization in mobile and cloud computing. Such studies should utilize available data in predictive technological models to help current businesses prepare for future business environments.

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Latest Trends in Big Data Utilization in Mobile and Cloud computing - Opportunities and Challenges

Transcription of Interview Audio

Participant 1 (A)

1. **You mention you employ IaaS cloud computing model. Why did you opt for that?**

IaaS offers us more flexibility with any infrastructure we can easily deploy, virtualized environments based on our needs as opposed to purchasing prepaid subscription.

2. **Why did you go for a monthly payment subscription model?**

IBM offers payment in either a monthly or annual subscription for their bare metal service. It was the only option since the other options are costly.

3. **Do you have any regrets for opting into the monthly prepaid subscription pricing plan over the others offered by the cloud computing platform?**

Yes

4. **You mentioned you use big data for data mining and predictive analysis. Would you mind explaining how you do this?**

We use the service to host open-source software. We do the collection and analytics from our clients' websites to offer them predictive analysis for potential customers and purchase trends currently being experienced in the country. We also offer social media sentiment analysis for our clients, where they can get information about how their services are being taken up by consumers.

5. **You mentioned that your venture into the big data was successful. Why and how did you come about this?**

Our business model is based on the services we provide. We don't only offer development services. We offer after-sale services in terms of add-ons, enabling our customers to make the most of the system we developed.

6. **Have you experienced a higher return on your investment in Big Data through Cloud computing? Could you explain how this is and how you think the situation can be improved further.**

Yes. We have a higher rating among businesses, which us built our name

7. **Please explain why you found it difficult to employ Big Data analysis?**

It requires expertise to develop, set up and maintain. Even with expertise, getting insights from data takes a lot of time.

8. **Do your customers know about the data you collect and how you use it?**

Yes. Our customers know which data we collect and where we collect it from because they depend on our services to give them information about their business. They have allowed us to tap into their system to get the relevant data.

9. **Please explain why you rated the experience for cloud computing for Big Data as highly effective.**

The benefits are evident. Our customers' businesses really benefit from our services since it's the key selling point of our services.

10. **Please explain why you opted for an in-house developer to manage your cloud services.**

It is easier and more efficient for us because we can optimize the systems and change it according to the demands we witness. If a product doesn't offer the right insight, we can always sit down and fix it.

11. **Has the option proven to be efficient, or would you rather have another option?**

I can argue that our choice has proven to be efficient and I would not change it. Basically, we have control over the infrastructure. So, unless something catastrophic happens to IBM, we can guarantee the same option.

12. **You mentioned that Big Data requires expertise. Is that the reason you opted for a self-managed approach to the Big Data analysis?**

Yes

13. **Please elaborate on how Big Data has aided your firm in terms of productivity.**

Big data analysis, has over the years, proven to be effective in our line of business because it helps us maintain clients that otherwise would have been one-off clients. So, I can say it has aided our company's productivity by ensuring business continuity and offering a continuous revenue stream since we charge our clients on subscription terms.

Participant 2 (A.A)

1. **You mention PaaS cloud computing model. Why did you opt for that?**

PaaS worked best for us because we could deploy our services quickly; not worrying about server setup and security other than our application security. We try really hard so that it is not hackable because we depend on it for our business.

2. **Why did you opt for a pay-as-you-go pricing model over the other pricing models?**

Pay-as-you-go pricing model is better for us because it is cheaper in the long-run. We only pay for the resources we consume and since the majority of our analysis is real-time, we save some money because resources usage is low.

3. **Do you have any regrets for opting into the pay-as-you-go subscription pricing plan over the others offered by the cloud computing platform?**

No. I think the pay-as-you-go plan works best for our needs given the resources we use when the analysis is real-time.

4. **You mentioned you use big data for predictive analysis. Would you mind explaining how you do this?**

I will not reveal too much about the working of the system because it is generally a forex trading robot to predict, to a relatively high degree, the trend of current major currencies. It analyzes Twitter and major forex sites to predict whether the dollar will fall or rise.

5. **You mentioned that your venture into the big data was successful. Why and how did you come about this?**

Although we lost a lot of money before mastering the system, I can say it has been successful because covered our loss and gained considerable profits.

6. **Have you experienced a higher return on your investment in Big Data through Cloud computing? Could you explain how this is and how you think the situation can be improved further.**

Yes. Based on the robot prediction, mostly forex, has contributed to our success by a great margin. However, I think the system can be improved to include human suggestions because there are things only an experienced trader can identify without having an effect on the price of market.

7. **Please explain why you found it moderately difficult to employ Big Data analysis through cloud computing platform?**

It is hard getting a developer that can incorporate guidelines and analysis of data from various sources to deliver insights that were useful to predict possible trends. But once the software is developed, maintenance is easy. That's why I rated it as moderately hard. The hard part is getting someone who knows what to do.

8. **Do your customers know about the data you collect and how you use it?**

No. They do not know because we only use public data so it does not concern them. All our customers need to know is that their investment is safe.

9. **Please explain why you rated the experience for cloud computing for Big Data as highly effective.**

Because it has highly increased our profits and minimized the risk associated with forex investments.

10. **Please explain why you opted for self-managed cloud services.**

We needed a system that would work better than most off-the-shelf system based on our own experiences.

11. **Has the option proven to be efficient, or would you rather have another option?**

Yes. We had tried off-the-shelf software and it was not effective.

12. **You mentioned that Big Data requires expertise. Is that the reason you opted Big Data analysis from the selected provider?**

Yes

13. **Please elaborate on how Big Data has aided your firm in terms of productivity.**

The information we get from the analysis software currently benefit our business. Before we place a trade, we have to refer to the predictions offered by the system to counter check our moves. In most cases the system is right. But in some areas we ignore it because we can observe something that it might have missed. But generally, I can say that big data has helped our company generate more revenue.

Participant 3 (A.A.S)

1. **You mention you employ PaaS cloud computing model. Why did you opt for that?**

I think by using a platform provided by a company that has had years of experience in managing service is better compared to starting a new one.

2. **Why did you go for a pay-as-you-go payment subscription model?**

I prefer this option because we only pay for what we use. So, when we don't use much resources we pay less.

3. **Do you have any regrets for opting into the pay-as-you-go subscription pricing plan over the others offered by the cloud computing platform?**

No

4. **You mentioned you use big data for predictive analysis. Would you mind explaining how you do this?**

We use it in a bot to monitor currency trends from popular sources and gives a prediction of how the market prices fluctuate. We use it as a predictive tool for our trade.

5. **You mentioned that your venture into the big data was successful. Why and how did you come about this?**

I think the profit we have gained over the years are proof of that success. We generally make more money since we started using the trading bots.

6. **Have you experienced a higher return on your investment in Big Data through Cloud computing? Could you explain how this is and how you think the situation can be improved further.**

Yes. The general effectiveness of big data can be improved if a person is able to find a developer who understands big data.

7. **Please explain why you found it moderately difficult to employ Big Data analysis?**

The biggest challenge was finding a developer who understood our requirement. Since we use an off-the-shelf software, to find a developer who knew how to code in a specific language was hard. We found one in Ukraine and even if he charged highly, we have experienced growth.

8. **Do your customers know about the data you collect and how you use it?**

No. We don't share we trade with our customers. So, we don't tell them how we do our analysis.

9. **Please explain why you rated the experience for cloud computing for Big Data as moderately effective.**

Sometimes the system interprets data wrongly. So, it's not perfect.

10. **Please explain why you opted for self-managed developer to manage your cloud services.**

As I explained before, we needed someone who understood training and had experience in developing such systems. We couldn't find a person locally. So, we looked online and hired one from Ukraine.

11. **Has the option proven to be efficient, or would you rather have another option?**

Yes. The software works as intended and it was delivered on time.

12. **You mentioned that Big Data requires expertise. Is that the reason you opted to manage Big Data analysis from the selected provider?**

Yes

13. **Please elaborate on how Big Data has aided your firm in terms of productivity.**

Big Data analysis has helped us generate more revenue since our trade has placed fastest. It has revolutionized the way we currently trade.

Participant 4 (A.H)

1. **You chose some cloud computing models. Are these cloud computing models from the same provider?**

Actually, I would say no. We have diversified our services to minimize cost, while maximizing our gains. However, we largely use Amazon and Google for most of our projects. Other projects are offset depending on the complexity.

2. **Why did you go for a pay-as-you-go subscription model over the conventional pricing models?**

The model seemed better in terms of cost and scalability compared to the standard fee paid monthly regardless of resources utilized. This model allows us to buy credit and only pay for the time and the resources used by our algorithms. This is important because of the maintenance and other unexpected difficulties. About a year ago, a previous developer made an error in the code which took us about a month to rectify. So, the algorithm was not running at the time. We only paid for the resources used in that minimal time. A monthly subscription would have cost us more (About $300/month).

3. **Do you have any regrets for opting into the pay-as-you-go subscription pricing plan over the others offered by your service providers?**

Actually, No. I don't think we have any regrets. As I previously explained cost fluctuates based on our load. So, we only pay based on what we use. And mostly, we use more when we have more work and less when there are few projects. I believe this was, and still the best approach.

4. **You mentioned you use big data for data mining. Would you mind explaining how you do this?**

I am not sure I can explain how we conduct our data mining without revealing what we do in detail. But I can generalize by saying we collect it from our website and interactions. We only use the data to target our customers and offer them better services.

5. **You mentioned that your venture into the big data was successful. Why and how did you come about this?**

The sales and revenue trends over the years show the success clearly. Sales have improved since we started targeting specific customers for our services.

6. **Is it safe to say you have had higher returns on your investment by using Big Data? Why have you attributed higher returns on the use of big data compared to other factors such as aggressive markets and higher demand for products and services?**

Yes. Currently, we rely on feedback from the analysis to provide better services to our customers. So, I think that it is the baseline. Analysis is conducted based on the customer we are targeting. So, I believe it is the main factor.

7. **Please explain why you found it moderately difficult to employ Big Data analysis system through cloud computing?**

Well, first, I am a system developer. So, I had a little difficulties setting up the environment for the system. Another challenge was doing optimization to reduce the running cost. I found the task relatively easy as we worked as a team of three.

8. **Do your customers know about the data you collect and how you use it?**

No. We don't collect personal information. We only collect user activity.

9. **Please explain why you rated the experience for cloud computing for Big Data as highly effective.**

It is because we get the data we intended to get and it has been profitable for us.

10. **Please explain why you opted for a dedicated employee to manage your cloud services.**

As a technology-based business, we need somebody to be on call in case something is not working right, or something needs upgrading. And since I handle several duties, I might not be able to attend to it in time.

11. **Has the option proven to be efficient, or would you rather outsource the service?**

As I said, we need someone to correct the issues as they rise. Therefore, I can say it has been effective.

12. **You mentioned that Big Data requires expertise. Is that the reason you opted to manage Big Data analysis through an in-house developer?**

Yes

13. **Please elaborate on how Big Data has aided your firm in terms of productivity.**

Generally, I believe it has helped us greatly in targeting services to provide to our customers. Before we used big data in our business, we could select a random service to offer to our clients without knowing their interests. Right now we can get user interests and offer suggestions and discounts for the services they need. Our overall productivity has increased since we can make more sales.

Participant 5 (D.A)

1. **You mention you employ PaaS cloud computing model. Why did you opt for that?**

We just needed a place where we could host our systems. So, we just bought a VPS from Data Ocean.

2. **Why did you go for a prepaid monthly payment subscription model?**

We find the prices to be favorable and since we intend to use the VPS for a lot of our services, we found the cost to benefit ratio was appropriate.

3. **Do you have any regrets for opting into the monthly prepaid subscription pricing plan over the others offered by the cloud computing platform?**

No

4. **You mentioned you use big data for predictive analysis. Would you mind explaining how you do this?**

We use the VPS to host our website and the services we offer. Currently, we offer retail analytics for our customers. For example, if someone has opened a shop selling electronics, we can offer them information about which devices to stock and how the product should be priced.

5. **You mentioned that your venture into the big data was successful. Why and how did you come about this?**

The products we have developed are very effective. Like, there was one client who opened a phone accessories shop. We helped him price his products so they could sell better.

6. **Have you experienced a higher return on your investment in Big Data through Cloud computing? Could you explain how this is and how you think the situation can be improved further.**

Yes. We sell the services to our customers. So, it adds as an additional revenue stream.

7. **Please explain why you found it moderately difficult to employ Big Data analysis?**

It is not difficult as long as you know what you are doing.

8. **Do your customers know about the data you collect and how you use it?**

No. We keep it secret.

9. **Please explain why you rated the experience for cloud computing for Big Data as highly effective.**

Because the information we get has helped our customers understand their businesses.

10. **Please explain why you opted for self-managed system to manage your cloud services.**

It is easier for us because the system requires adjustments according to customers' needs.

11. **Has the option proven to be efficient, or would you rather have another option?**

Yes. It is dependable.

12. **You mentioned that Big Data requires expertise. Is that the reason you opted for a in-house developer?**

Yes

13. **Please elaborate on how Big Data has aided your firm in terms of productivity.**

We make more revenue and spend less.

Participant 6 (D.G.)

1. **You mention you employ PaaS cloud computing model. Why did you opt for that?**

PaaS opinion seemed better in terms of accessibility and development because the developer we found to set up our program did not know how to set up a server from scratch.

2. **Why did you go for a pay-as-you-go pricing model over the other services?**

Amazon was suggested to us by the developer as the most viable option for the program because they are a trusted company. So, we went with the payment plan they suggested while……

3. **Do you have any regrets for opting into the pay-as-you-go pricing plan over the others offered by the cloud computing platform?**

   No. The program helps us make money so we come the server expenses as a business expense.

4. **You mentioned you use big data for artificial intelligence. Would you mind explaining how you do this?**

   Sure. The system data development is automated. It does its own analysis and places straits by its self-clauses, stops loses and calculates perfect lose by its self. However, we view the traits pleased and monitor them to minimize loses.

5. **You mentioned that your venture into the big data was successful. Why and how did you come about this?**

The program we developed helps wits and all we have to do is just to run it. It does everything on itself, so we can see it is successful.

6. **Have you experienced a higher return on your investment in Big Data through Cloud computing? Could you explain how this is and how you think the situation can be improved further.**

   Yes. We make big profits from the programs which has a higher return on investment.

7. **Please explain why you found it difficult to employ Big Data analysis?**

   It's because we took over a year before the program started functioning like it was supposed to and the person given the work would charge us very high because, so it's not easy to start analyzing data, we have to invest on time and……

8. **Do your customers know about the data you collect and how you use it?**

   No.

9. **Please explain why you rated the experience for cloud computing for Big Data as highly effective.**

   It is because of the money we get from it. I find now it's been running since Monday helps us……..

10. **Please explain why you opted for a self-manage your cloud services.**

    It was easier for us to start for that kind of system and can also make sure that we are safe from hackers because the program is stored by secure server from Amazon.

11. **Has the option proven to be efficient, or would you rather have another option?**

    Yes. I think the guy we go with to…… the program is reliable and so I don't think another option.

12. **You mentioned that Big Data requires expertise. Is that the reason you opted for a free last developer?**

    Yes.

13. **Please elaborate on how Big Data has aided your firm in terms of productivity.**

    Yes. Currently the only people we hire are for markets because they are able to handle all the trading with the help of the system and hence has increased our productivity……..

Participant 7 (E.A.)

1. **You mention you employ PaaS cloud computing model. Why did you opt for that?**

   We prefer this approach because it did not require to configure networks and other hard way issues. We can get an environment where we can rapidly deploy an application.

2. **Why did you go for a pay-as-you-go pricing model?**

   It was a better approach. Given a financial obligation required by other plants was too much for us when we started needed a high-end environment and this was the cheapest option we could find. Overtime, I have come to appreciate our decision because a few weeks ago we compared what we pay currently to what we could be paying for the average resources we use up and the difference was……..

3. **Do you have any regrets for opting into the pay-as-you-go pricing plan over the others offered by the cloud computing platform?**

   No. It is more sustainable in the long run.
4. **You mentioned you use big data for data mining and predictive analysis. Would you mind explaining how you do this?**

   The business started mining data, that's why the operation was success. We collect that from social media trends and other trendy websites so we can analyze their viability as form of business which we later compile and sell to our prospective buyers. We also collect matters related to product demands from some online markets which we sell to merchandises as a curated list of top products.
5. **You mentioned that your venture into the big data was successful. Why and how did you come about this?**

   The business started mining data, that's why the operation was success.
6. **Have you experienced a higher return on your investment in Big Data through Cloud computing? Could you explain how this is and how you think the situation can be improved further.**

   Our business model is based on big data analysis. So we wouldn't be operational if we did not make some sorts of significance……..
7. **Please explain why you found it difficult to employ Big Data analysis?**

   It took us a long time to understand the complexities of big data analysis and by the time we had figured out how to approach the issue, no one in our group knew how, which was the programming language that was centered on big data analysis. So, we had to…….
8. **Do your customers know about the data you collect and how you use it?**

   Yes. They didn't know the data was valid so had to explain to the source.
9. **Please explain why you rated the experience for cloud computing for Big Data as man guide.**

   We haven't really had the big builder we thought we would and its largely because of the complexities of data collection and analysis
10. **Please explain why you opted for an in-house developer to manage your cloud services.**

    It's because when we started we were all employed and it was relatively cheaper the hiring someone……..
11. **Has the option proven to be efficient, or would you rather have another option?**

    Yes, it has been very efficient because we are able to modify and update program based on our current needs and since it's a joint operation, it's even more efficient.
12. **You mentioned that Big Data requires expertise. Is that the reason you opted for an in-house developer a self-managed approach to the Big Data analysis?**

13. **Please elaborate on how Big Data has aided your firm in terms of productivity.**

It has helped our company to be productive by offering us a way to make a living by doing something we are passionate about and also to generate revenues that we would otherwise not gotten.

Participant 8 (E.C.)

1. **You mention you employ PaaS cloud computing model. Why did you opt for that?**

   It offers us a more flexible approach in terms of what we can do with the platform compared to the others.
2. **Why did you go for a PaaS pricing model?**

   It seemed appropriate because the price changes according to usage, and so the more we use the higher the price and the less we use the platform the lower the price hence better than the others which charge a fixed price.
3. **Do you have any regrets for opting into the PaaS pricing plan over the others offered by the cloud computing platform?**

   No. The others seemed too costly and so appeared to be expensive to us because we normally have down times when we are configuring and updating our competitors.
4. **You mentioned you use big data for data for machine……. Would you mind explaining how you do this?**

   We use machine …….to process data personalize product of where we hope our customers target specific customers based on their social media activities on our customer's website mostly, we deal with betting websites to offer them incites about user activities and in which areas their websites and product they need to work on.
5. **You mentioned that your venture into the big data was successful. Why and how did you come about this?**

   We make a considerable profit from what we do hence I see it successful.
6. **Have you experienced a higher return on your investment in Big Data through Cloud computing? Could you explain how this is and how you think the situation can be improved further.**

   Yes. Our business depends on machine ……...and its reliant on big data hence it's been very profitable to us. I think the best way we can improve on our system is by getting better raw data.
7. **Please explain why you found it difficult to employ Big Data analysis?**

   Its because it took us a considerably long time before we got a good developer to work on the system.
8. **Do your customers know about the data you collect and how you use it?**

   Yes. They need to give us permission to tap into their website to get user activity data.
9. **Please explain why you rated the experience for cloud computing for Big Data as highly effective.**

   I think it falls back to the developer. We opted to go for a dedicated the meter saver since we thought it would be a better option, but when we got a developer for the system, he requested us to change it which ended up costing us more. However, I think it was the right choice and manageable.

10. **Please explain why you opted for a self-managed free-lance manager for your cloud services.**

    We could not get a good developer to higher full time, so we opted to go with a more experienced developer in the field of machine ……..who we found in India , so the decision was largely based on the option of best reference.
11. **Has the option proven to be efficient, or would you rather have another option?**

    Yes. Because we are able to modify the program based on our current needs and since it's a joint operation it has even been more efficient.
12. **You mentioned that Big Data requires expertise. Is that the reason you opted for a free last developer to the Big Data analysis?**

    Yes.
13. **Please elaborate on how Big Data has aided your firm in terms of productivity.**

    It has increased productivity because initially when we started, we were making little sales but when we developed the system and marketed it to some businesses, we are now able to increase our overall sales and revenue hence minimizing cost since the process is largely automated.

Participant 9 (E.G.)

1. **You mention you employ PaaS cloud computing model. Why did you opt for that?**

   Because of providing intensive service for our customers. We opted for a platform that could host a number of users.

2. **Why did you opt for a pay as you go pricing model over the others?**

   Pay as you go option was much more professional, even that sometimes we have small tasks so instead of paying a standard price. We opted it based on our usage.
3. **Do you have any regrets for opting into the Pay as you go pricing plan over the others offered by the cloud computing platform?**

   This approval was favorable because in two being analyzed invariable for example when it comes to which something which can access the price of a dollar, majority of the websites and data sources we utilize use are usually flooded by suggestions and predictions thus are regard them hard to analyze.
4. **You mentioned you use big data for data mining and for machine learning. Would you mind explaining how you do this?**

   We use machine……..to provide a good analysis of how the forex market might change…….American dollars.
5. **You mentioned that your venture into the big data was successful. Why and how did you come about this?**

   Over the years, we have been able to establish a name for ourselves, the forex trading sector, because of the consistent returns we give to our clients.
6. **Have you experienced a higher return on your investment in Big Data through Cloud computing? Could you explain how this is and how you think the situation can be improved further.**

Yes. I think this is because we developed a very powerful system. I also think we can improve it and we are working on a second algorithm that we think will work better than what we currently have.

7. **Please explain why you found it difficult to employ Big Data analysis?**

   Yes, because we had a hard time finding the right developer when we started thinking about the program. We looked at other systems and how they are being developed but then it did not provide what we were looking for. So, we started planning out on how the system might work. We had developed a strategy but we did not know how to program it

8. **Do your customers know about the data you collect and how you use it?**

   Yes. They know we analyze data so they can invest their money wisely.

9. **Please explain why you rated the experience for cloud computing for Big Data as highly effective.**

   Because our company has greatly benefited from it.

10. **Please explain why you opted for a self-managed freelanced manager for your cloud services.**

    It was easier to have one main developer maintaining the program and we could control who can access them.

11. **Has the option proven to be efficient, or would you rather have another option?**

    Yes. It has been efficient because the developer we found…….

12. **You mentioned that Big Data requires expertise. Is that the reason you opted for a free-lance developer?**

    Yes.

13. **Please elaborate on how Big Data has aided your firm in terms of productivity.**

    Productivity has definitely improved since we started using this technology with constant returns on our investment and its largely because of the technology we use.

Participant 10 (E.H.)

1. **You mention you employ PaaS cloud computing model. Why did you opt for that?**

   It offers us a better deal in terms of resources flexibility compared to other services.

2. **Why did you go for a pay as you go pricing model over the others?**

   It was more affordable for us.

3. **Do you have any regrets for opting into the pay as you go pricing plan over the others offered by the cloud computing platform?**

   No. I still find it more affordable compared to other……

4. **You mentioned you use big data for machine learning and artificial intelligence. Would you mind explaining how you do this?**

We developed a statement that reads and interprets statements made by major financial advisors and then we use that data to offer a more reliable prediction of how the financial markets might flow board long term issues.

5. **You mentioned that your venture into the big data was successful. Why and how did you come about this?**

   We have been making better profits since we started using the program we developed. The information we get from the program when predicting wrong trends.

6. **Have you experienced a higher return on your investment in Big Data through Cloud computing? Could you explain how this is and how you think the situation can be improved further.**

   Yes. I think it's because we developed a very powerful system but I also think we can improve it, I'll not say how. We are working on second algorithm that we think will work better than what we currently use.

7. **Please explain why you found it difficult to employ Big Data analysis?**

   It took us a long time to come up with a working system. We had to revise engineer programs so that we could get some ……..working but in the long run ……..

8. **Do your customers know about the data you collect and how you use it?**

   No. I don't see the need to inform them because it's part of our company's strategy to offer them better services.

9. **Please explain why you rated the experience for cloud computing for Big Data as highly effective.**

   It's because our company has greatly benefited from this technology, so I can confidently attribute part of our large success to it.

10. **Please explain why you opted for self-managed free-lance manager for your cloud services.**

    We preferred to pay someone a one whole fee for the work instead of hiring someone permanently.

11. **Has the option proven to be efficient, or would you rather have another option?**

    It has been very efficient because we are able to keep the system running without additional expenses by paying an algorithm expert on emerging issues.

12. **You mentioned that Big Data requires expertise. Is that the reason you opted for a free-lance developer?**

    Yes.

13. **Please elaborate on how Big Data has aided your firm in terms of productivity.**

    Productivity has grown so much because of the analysis we have been doing to increase our trading profits. We have had more investments from our clients because we have been offering them guarantees and keeping our promises to increase the returns.

Participant 11 (G.F.)

1. **You mention you employ PaaS cloud computing model. Why did you opt for that?**

The platform was more economical and flexible compared to other models. The system as a service choice has answered to our problem.

2. **Why did you go for a pay as you go pricing model over the others?**

   It was more ……for us because we needed a platform for initial model. We saw that the pricing model was cheaper since we did not know how long the…….

3. **Do you have any regrets for opting into the pay as you go pricing plan over the others offered by the cloud computing platform?**

   No. It has proven to be relatively cheaper compared to ……..

4. **You mentioned you use big data for predictive analysis. Would you mind explaining how you do this?**

5. **You mentioned that your venture into the big data was successful. Why and how did you come about this?**

   Yes, it has been very successful. We have been able to increase our overall revenue by at least 50% since we started using the new program.

6. **Have you experienced a higher return on your investment in Big Data through Cloud computing? Could you explain how this is and how you think the situation can be improved further.**

   Yes. Before we started using the program there were relatively small number of customers and revenue but after we started using it, our customers have increased since we offer the with products and services they need.

7. **Please explain why you found it difficult to employ Big Data analysis?**

   It took us a long time to develop the system since analyzing and implementing at the same time.

8. **Do your customers know about the data you collect and how you use it?**

   Yes. It is included in our time condition so they know that we collect data and use them to offer them better services.

9. **Please explain why you rated the experience for cloud computing for Big Data as highly effective.**

   They have been able to increase our overall productivity because our customers get better services. So I think it is largely because we use the data we collect to predict what they might need.

10. **Please explain why you opted for a self-managed approach easier than an in-house developer to manage your cloud services.**

    When we were starting up, we didn't have a lot of capital to invest in big data analysis and since we were……. we decided to follow through with our ideas while working traditionally to develop a program that could do more……

11. **Has the option proven to be efficient, or would you rather have another option?**

    Yes. Because we learn how to properly manage the program and can easily modify it.

12. **You mentioned that Big Data requires expertise. Is that the reason you opted for an in-house developer?**

    Largely it was because we were in short of capital so we decided to do it yourself.

13. **Please elaborate on how Big Data has aided your firm in terms of productivity.**

Using big data through google cloud as a google competing platform has increased our productivity as sure case by the number of clients we save and increase of our revenue we have experienced.

Participant 12 (H.K.)

1. **You mention you employ PaaS cloud computing model. Why did you opt for that?**

The PaaS appeared more economical and efficient in terms of skill ability and performance, because we are able to increase the server's specifications based on our needs unlike the other platforms.

2. **Why did you opt for a monthly prepared subscription model over the other models?**

We prepared to pay on a monthly basis because when we weighed our needs, we saw that the pay as you go model would be expensive in the long run as we would bypass our current service setting. The monthly option gives us a space server configuration that we can develop on and manage the resources as we receive it.

3. **Do you have any regrets for opting into the monthly prepaid subscription pricing plan over the others offered by the cloud computing platform?**

No. This plan has proven to be effective in limiting the resources we use since we don't need high server specification.

4. **You mentioned you use big data for data for data mining. Would you mind explaining how you do this?**

We use big data for data mining in terms of getting the latest free signals from the free signal provider that we then compare those to our own analysis and if they match with assessing degree, we proceed with opening……..

5. **You mentioned that your venture into the big data was successful. Why and how did you come about this?**

Yes. We have increased our profits by large margins since we started verifying our analysis with other publicly available signals.

6. **Have you experienced a higher return on your investment in Big Data through Cloud computing? Could you explain how this is and how you think the situation can be improved further.**

Yes. We have integrated a system report out of our business strategy, and so I can argue that we have had a substantially high return on investment.

7. **Please explain why you found it difficult to employ Big Data analysis?**

Before, we used to gather the data and compare it manually which would cost us a lot of time because we would end up opening entries one hour later but now, we use it automatically and before getting here, we had to encounter numerous challenges like google recapture.

8. **Do your customers know about the data you collect and how you use it?**

No. They don't need to know how we do our analysis. They just need just to get a consistent return.

9. **Please explain why you rated the experience for cloud computing for Big Data as highly effective.**

   we still need to do a manual comparison even though we have a program that does that automatically.it is essential in the verification of data collected. However, we are working on getting a fully automated system. May be then, the experience might be more favorable rating.

10. **Please explain why you opted for a self-managed approach using an in-house developer to manage your cloud services.**

    Since we had a person with an IT background who was confident in the technology, we decided to let him handle the task as he was the one who proposed it in the first place.

11. **Has the option proven to be efficient, or would you rather have another option?**

    No. I think we could have gotten a more system if we had paid a more experienced developer but since we were in short of capital, it was the only option.

12. **You mentioned that Big Data requires expertise. Is that the reason you opted for a self-managed approach to the Big Data analysis?**

    No. It was because it was a new system and we needed to make little investment in the sector as we had just started in first reading and most of our time and resources was directed towards manual analysis.

13. **Please elaborate on how Big Data has aided your firm in terms of productivity.**

    Although the system is not a hundred percent accurate, it has helped us reduce the time we take one analyzing signal and making quick decision about opening and closing entry. It has to some extent increased our productivity.

Participant 13 (J)

1. You mentioned that you employ software as a service cloud computing model. Why did you opt for that?

It was better than the others because it did not require a lot of technical know-how. All you have to do is sign up and set up a few things

2. Why did you opt for a monthly prepaid subscription pricing model?

I paid one month first because I did not know how well the service would help my business.

3. Do you have any regrets for opting into monthly prepaid subscription pricing plan over the others offered by cloud computing platform?

Come to think of it, I have been paying monthly subscription because it is what I started with. I could not start with annual subscription because it was expensive and I did not know how well the service was but now I can comfortably pay yearly subscription.

4. You mentioned you use big data for data mining and predictive analysis. Would you mind explaining how you do this?

I use Twitter and Instagram to get the latest trends in fashion so that I can stock my business appropriately. Like those dresses behind you, they are the latest trend on Instagram. Once I have a design that is trending, the service offers me best places to source them and their prices but I have my own sources for the clothes.

5. You mentioned your venture into big data was successful, why and how did you come up with this?

I get the latest information about women's fashion, which helps me stay ahead of other sellers in this area. Once I have the top designs, I quickly make orders for my loyal clients before other people get information about the new clothes. Before I started doing my own analysis, I would wait for my fashion savvy clients to request trending designs.

6. Have you experienced a higher return on your investment into big data through cloud computing? Could you explain why you think this is, and how you think the situation can be improved further.

Yes. I am able to charge a relatively higher price for new designs that have not yet hit the market and this brings higher income.

7. Would you explain why you found it easy when employing big data analysis through cloud computing.

I only have a little technical knowledge, being a diploma holder in IT so I have no experience dealing with big data and cloud services. However, I found the servers easy to use and set up because it offers tutorials and set up procedures that are easy to follow. I found it easy because the servers are dedicated to helping users.

8. Do your customers know about the data you collect and how you use it. Can you explain why.

They do not know because it is not part of my business strategy to tell them.

9. Would you explain why you rated the experience of using cloud computing for big data services as highly effective.

Because it has helped my business, it is easy to set up and has a lot of data.

10. Could you explain why you opted for auto-managed platform.

It was easier for me because I do not have to worry about how the system works.

11. Has the option proved to be efficient or would you rather have another option. Please explain why.

It is effective because I can concentrate on my business full time without having to worry about the data it has collected.

12. Big data analysis requires expertise. Is that the main reason why you opted for sefl-managed managed big data analysis.

I chose auto-managed big data because it does not require expertise.

13. Can you elaborate on how big data has aided your firm in terms of productivity.

I can say that using social media has made my firm productive because I currently rely on the information I get form the servers to determine where fashion trends are headed. So I stock up accordingly and set the price right so more customers can come to my shop.

Participant 14 (J.A.)

1. You mentioned that you employ a software as a service cloud computing model. Why did you opt for this over the others?

Software as a service model was most ideal for us because it was the quickest to set up and deploy since the application is already in installed and configured. This therefore saves us a lot of time

2. Why did you opt for a prepaid monthly subscription pricing model over the others?

Since we incorporated SaaS cloud computing model, we have to maximize the output by using prepaid monthly subscription in order to be in a position to focus on the business.

3. Do you have any regrets for opting into monthly prepaid subscription pricing plan over the others offered by cloud computing platform?

No. it has proven to be relatively cheaper compared to annual subscription.

4. You mentioned you use big data for data mining and predictive analysis. Would you mind explaining how you do this?

Being in the fashion industry, this helps me in predicting future coming designs

5. You mentioned your venture into big data was successful, why and how did you come up with this?
Yes. It has been very successful because it has increased our overall revenue by being in a position to work on multiple large projects.
6. Have you experienced a higher return on your investment into big data through cloud computing? Could you explain why you think this is, and how you think the situation can be improved further.
Yes. We have been able to increase our sales by working on multiple large projects
7. Would you explain why you found it easy when employing big data analysis through cloud computing.
It took us a long time developing the system since we were planning and implementing at the same time.
8. Do your customers know about the data you collect and how you use it. Please explain why.
Yes. They know that we collect data and use it to offer them better designs and services.
9. Would you explain why you rated the experience of using cloud computing for big data services.
It can be quite tiring and time consuming when collecting information from social media but at this, our services are better now.
10. Could you explain why you opted for auto-managed provider.
Since we did not have the capital to hire a dedicated employee or freelance manager, we opted for auto-managed provider.
11. Has the option proved to be efficient or would you rather have another option. Please explain why.
Yes. The option has proven to be efficient because the service provider has gone an extra step of training us on how to handle some of the analyses.
12. Big data analysis requires expertise. Is that the main reason why you opted for a self-managed big data analysis.
Yes. Because our staff needed expertise training on how to handle data analysis
13. Please elaborate on how big data has aided your firm in terms of productivity.
Big data analysis has aided the growth of our firm in terms of productivity. We have been able to increase our overall revenue by being in a position to work on multiple large projects without compromising quality.

Participant 15 (J.Y.A.)

1. You mentioned that you employ a platform as a service (PaaS) cloud computing model. Why did you opt for that?

We found it best to use this model since it provided direct support for the agility of the business and enabled fast development of the business

2. Why did you opt for PaaS cloud computing model pricing model over the others?

Our service provider found it best to incorporate PaaS cloud computing model which would offer rapid allocation and de-allocation of resources

3. Do you have any regrets for opting into prepaid monthly pricing plan over the others offered by the cloud computing platform?

No.

4. You mentioned you used big data for predictive analysis. Would you mind explaining how you do this?

Yes. It helps in predicting the future of the business and the fame in general, therefore informing me how to embrace the future as a trader.

Participant 16 (K.A.)

1. **You mentioned that you employ a platform as a service cloud computing model. Why did you opt for that?**

Because it provided what we were looking for. It provided improvements and consistencies in the leeway of our service.

2. **Why did you opt for pay as you go pricing model over the others?**

Pay as you go pricing model is ideal for us because we really wanted upgrade

3. **Do you have any regrets for opting into pay as you go pricing plan over the others offered by the cloud computing platform?**

No.

Participant 17 (K.K.)

1. You mentioned you employ a platform as a service cloud computing model. Why did you opt for this over the others?
I opted for PaaS because it supported collaboration. Being a financial officer in the company, I needed team collaboration in planning management of financial risks and record keeping and this is exactly what PaaS provided.
2. Why did you opt for a pay as you go pricing model over the others?
Pay as you go offered better terms since it appeared to offer flexible model. While we could shape payments as we wished.
3. Do you have any regrets for opting into pay as you go pricing plan over the others offered by cloud computing platform?
No. At the moment, the method seems to be working perfectly
4. You mentioned you use big data for data mining for machine learning. Would you mind explaining how you do this?
We use machine learning because this will enable the planning for the future in terms of analyzing the current company data. Moreover, we have been in the best position to plot the future of the company in terms of financial status.
5. You mentioned your venture into big data was successful, why and how did you come up with this?
Since we incorporated this venture, we have been in the position to manage our resources effectively. Our planning for the future and being in the position to project our income improved. We have also been able to reduce our expenditure.

6. Have you experienced a higher return on your investment into big data through cloud computing? Could you explain why you think this is, and how you think the situation can be improved further.
Yes. We have not seen any fault in the current system that justify changes.
7. Would you explain why you found it moderately difficult when employing big data analysis through cloud computing.
It has never been easy trying out something new but for the better tomorrow of our business, we have to pull all our resources towards this, so far, so good.
8. Do your customers know about the data you collect and how you use it. Please explain why.
Yes. Most of our data is publicly sourced, and we found it wise to engage our customers through every step so that they can offer feedback.
9. Could you explain why you rated the experience of using cloud computing for big data services.
We have been in a position to incorporate our previous means of operation to the new one effectively. However, we have not achieved optimum outcome.
10. Could you explain why you opted for a self-managed approach.
We found this most ideal because we can fine-tune the program accordingly.
11. Has the option proven to be efficient or would you rather have another option. Please explain why.
Yes. Since we incorporated this venture, we have been in the position to manage our resources effectively while planning for the future.
12. Big data analysis requires expertise. Is that the main reason why you opted for a self-managed big data analysis.
Yes. We wanted perfection in our firm.
13. Can you elaborate on how big data has aided your firm in terms of productivity.
Yes. Since we incorporated this venture, we have been in the position to manage our resource effectively while planning for the future and being in the position to project income.

Participant 18 (K.S.)

1. You mentioned that you employ a software as a service cloud computing model. Why did you opt for this over the others?
SaaS suited my needs. Since I needed something flexible to help me deliver my services to my customers and be in a position to reach them and I managed to easily reach them over the internet.
2. Why did you opt for a prepaid monthly subscription pricing model over the others?
Because of the flexibility that comes with monthly prepaid subscription as compared to annual subscription. I also found that it suits me more compared to other subscriptions
3. Do you have any regrets for opting into monthly prepaid subscription pricing plan over the others offered by cloud computing platform?
No. I go for monthly prepaid subscription because I am able to plan for my finances in the future without any struggle.
4. You mentioned you use big data for data mining and predictive analysis. Would you mind explaining how you do this?
Business is all about planning for the future and knowing what to do or not do. So expanding to new markets and ensuring you can deliver to your newly acquired market is one of the strategies for market so as a retailer I use big data to predict the future market demand and supply forces and plan accordingly.
5. You mentioned your venture into big data was successful, why and how did you come up with this?

Its ability to predict the future of business trends, so I have been able to take risks some of which have come out well and I have also produced quite promising outcomes.

6. Have you experienced a higher return on your investment into big data through cloud computing? Could you explain why you think this is, and how you think the situation can be improved further.

Yes. I think the system can be changed in a way that it will cover a larger market in the future.

7. Would you explain why you found it less difficult when employing big data analysis through cloud computing.

A lot of developers have entered the business field especially the retail and wholesale. That is the reason why it was easy for me to find someone to work with and based on the experience he had, we worked towards our goal fast.

8. Do your customers know about the data you collect and how you use it. Please explain why.

Yes. I normally let them know that the data would be used to help me sell them better products.

9. Could you explain why you rated the experience of using cloud computing for big data services.

I have been able to increase the size or number of my customers and I also have a few target customers which I am yet to explore. So I can say the service has been effective

10. Could you explain why you opted for auto-managed provider.

I would say the developer knew exactly how to customize the services to suit my business.

11. Has the option proved to be efficient or would you rather have another option. Please explain why.

The option to me has proven to be very effective because it has made my work much more easy for me and also I have been able to expand my business.

12. Big data analysis requires expertise. Is that the main reason why you opted for a self-managed big data analysis.

No.

13. Can you elaborate on how big data has aided your firm in terms of productivity.

As I said earlier, I have been able to increase my market size and I also have a couple of potential market for business that I am yet to explore. So I would say that big data has aided my firm in terms of productivity and efficiency because it has made my work easier, enabled me to expand and it is cheap.

Participant 19 (K.Y.)

1. You mentioned that you employ a software as a service cloud computing model. Why did you opt for this over the others?

It was straight forward. I was looking for a service that would enable medium data analysis and SaaS provides these.

2. Why did you opt for a prepaid monthly subscription pricing model over the others?

The service provider only offered either monthly or annual subscription. I chose monthly because I can terminate at any time unlike the annual subscription which requires a lot of commitment.

3. Do you have any regrets for opting into monthly prepaid subscription pricing plan other tha annual subscription offered by cloud computing platform?

As I have said, I opted for monthly because I can terminate at any time.

4. You mentioned you use big data for data mining and predictive analysis. Would you mind explaining how you do this?

I use social media to analyze trends. Since I deal in selling newest computers, through data analysis, I can predict products that will be released and I solve the demand for those products here in Accra by making order for the new products early.

5. You mentioned your venture into big data was successful, why and how did you come up with this?

Other sellers in this area wait for me to bring new products. Before using big data, I used to wait for customers to ask for new products but now I bring new products before they request.

6. Have you experienced a higher return on your investment into big data through cloud computing? Do you have any suggestion about how the service can be improved to increase productivity?

I just explained that. It can be better if the service can deliver more data from more different websites.

7. Would you explain why you found it very difficult when employing big data analysis through cloud computing.

Big data through cloud computing does not require any technical know-how.

8. Do your customers know about the data you collect and how you use it. Please explain why.

Yes. They know I use the data for market prediction.

9. Could you explain why you rated the experience of using cloud computing for big data services as highly effective?

It is because the services enable me to know more about the market conditions.

10. Please explain why your firm opted for auto-managed provider.

Since it solves my problems, it is easier instead of hiring someone.

11. Has the option proved to be efficient or would you rather have another option. Please explain why.

Yeah. I do not have to worry about collecting data and analyzing them.

12. Big data analysis requires expertise. Is that the main reason why you opted for a managed big data analysis?

Yes.

13. Please elaborate on how big data has aided your firm in terms of productivity.

I think I already answered that in the other question. Productivity and revenue increase compared to when I started the business. The information I get has enabled my productivity to grow because when I started I used 50,000 but now I double that.

Participant 20 (M.F.)

1. You mentioned that you employ a platform as a service cloud computing model. Why did you opt for this over the others?

Business application requires integration and dual process involves speed. As a proprietor, I find that PaaS integrated these two features into one and I therefore I had it as a better option.

2. Why did you opt for a pay as you go pricing model over the others?

Business involves making fast decisions that will favor your business in times of increasing revenues. Pay as you go offered me the flexibility whereby I was not bound to one provider if I felt that the service was not beneficial.

3. Do you have any regrets for opting into pay as you go pricing plan over the others offered by cloud computing platform?

No.

4. You mentioned you use big data for data mining and predictive analysis. Would you mind explaining how you do this?

I collect data so that o can predict future business trends and demands.

5. You mentioned your venture into big data was successful, why and how did you come up with this?
The increase in sales I experienced, I can comfortably say that venturing into big data has been successful.
6. Have you experienced a higher return on your investment into big data through cloud computing? Could you explain why you think this is, and how you think the situation can be improved further.
Yes. It can be improved when we find it fit.
7. Would you explain why you found it moderately difficult when employing big data analysis through cloud computing.
I was not prepared for the change considering that it was a completely new thought for me.
8. Do your customers know about the data you collect and how you use it. Please explain why.
Yes.
9. Could you explain why you rated the experience of using cloud computing for big data services.
I can say that it is manageable at the moment because it started by experiencing some losses since the developer I had did not understand what my needs were so he ended up building up a system that was totally different from what I wanted.
10. Could you explain why you opted for auto-managed provider.
Since I started on the wrong foot, I needed someone who would help me decode information and explain it to my father hence I found a relevance in choosing auto-managed provider.
11. Has the option proven to be efficient or would you rather have another option. Please explain why.
Yes. The option has been very efficient; expenses have reduced significantly.
12. Big data analysis requires expertise. Is that the main reason why you opted for a managed big data analysis.
Yes.
13. Can you elaborate on how big data has aided your firm in terms of productivity.
Despite having a bad start, I finally got things running and I can say that productivity has improved. I have increased sales, expanded my market and increased my revenue.

Participant 21 (O.K.)

1. You mentioned you employ a software as a service cloud computing model. Why did you opt for this over the others?
We did not have an IT guy when we started so when we consulted someone, he directed us to purchase a software rather than purchase an entirely new server that would increase our costs.
2. Why did you opt for a prepaid monthly subscription pricing model over the others?
The option was the first we got from Google cloud and since we did not know much about it, we went with the suggestion because when we did comparison, it showed that it was more affordable.
3. Do you have any regrets for opting into prepaid monthly subscription pricing plan over the others offered by cloud computing platform?
No. I still think it is the best option because when we had our IT manager, he did not advise us otherwise. He told us to go on with the plan because it was more affordable.
4. You mentioned you use big data for predictive analysis. Would you mind explaining how you do this?
We gather data from free signals provided and match it against our own predictions and data from social media and financial websites to determine if the signals are viable.

5. You mentioned your venture into big data was successful, why and how did you come up with this?
Before we started analyzing the signals, we had open trades and closed based on our own intuition and in most cases we would end up breaking even or making a loss at the end of the month. But since we started using this system, we are able to make near accurate moves that reduce our losses substantially, increasing our overall revenue
6. Have you experienced a higher return on your investment into big data through cloud computing? Could you explain why you think this is, and how you think the situation can be improved further.
Yes. Since we started using the system, we do not use negative profits like before. We have a considerable amount of profit even after paying our investors at the end of the month.
7. Could you explain why you found it moderately difficult when employing big data analysis through cloud computing.
We had a big concern when we started because the developer was foreign and had cost us a lot of money. So, I can say that it is not a venture for the faint hearted.
8. Do your customers know about the data you collect and how you use it. Please explain why.
No. We do not see the need to let them know because they trust us to make strategic business decisions to make profits.
9. Could you explain why you rated the experience of using cloud computing for big data services.
It is because we had a difficult time setting up the server we purchased. Even after we installed the service, the developer was not very acquainted with Google cloud platform so it took us a month first figuring how best to deploy it.
10. Could you explain why you opted for a auto-managed provider.
We did not have an in-house IT team at the moment we started, so, we outsourced the services to another firm.
11. Has the option proven to be efficient or would you rather have another option. Please explain why.
Yes. They only charged us a small fee for maintenance and since they developed the system and did not want us to take did not want to take it away from them even after we hired our own IT expert.
12. Big data analysis requires expertise. Is that the main reason why you opted for a managed big data analysis.
Yes.
13. Can you elaborate on how big data has aided your firm in terms of productivity.
Today, we highly rely on the analysis we get from the system so I can say that it has greatly increased our productivity because we have been able gain considerable profit since we invested on it.

Participant 22 (O.N.)

1. You mentioned you employ a platform as a service cloud computing model. Why did you opt for this over the others?
A platform as a service model was more viable in terms of affordability and scalability compared to other models.
2. Why did you opt for a prepaid monthly subscription pricing model over the others?
It was the option we started with and since we wanted to restrain our program to a specific service, it was the most favorable and affordable option for us because we could not go beyond our monthly budget.

3. Do you have any regrets for opting into prepaid monthly subscription pricing plan over the others offered by cloud computing platform?
Yes. As our system grew, the server we initially purchased was not able to align with the requirement so we had to upgrade to a new, more equipped system. It would have been better if we selected the pay as you go model.
4. You mentioned you use big data for for machine learning. Would you mind explaining how you do this?
We use data mining for collecting data about purchase trends and customer feedback from social media thus enables us to sell hardware.
5. You mentioned your venture into big data was successful, why and how did you come up with this?
We have been able to gather data about most products in the market and show the information to the companies looking to expand their business in Ghana especially in major towns where most people are young and are sharing their views.
6. Have you experienced a higher return on your investment into big data through cloud computing? Could you explain why you think this is, and how you think the situation can be improved further.
Yes. Since it is used as a key driver for the sale of our primary products, I can say that we have had a high return on investment from using big data analysis.
7. Could you please explain why you found it moderately difficult when employing big data analysis through cloud computing.
It is because when we started, it took us a long time to get it right. We have had about three developers who worked on the system and the final one is the one who was able to help us see what we really wanted. So, I can say that it is difficult getting a developer and when you do, it takes to to get it right.
8. Do your customers know about the data you collect and how you use it. Please explain why.
Yes. They know that we collect data from the internet to offer them the required services.
9. Could you explain why you rated the experience of using cloud computing for big data services.
I can personally say that cloud platform is highly effective because the program we developed runs without major issues.
10. Could you explain why you opted for a self-managed approach using in-house model.
Since we are an IT company, we decided to hire developers because it created jobs, controlled the development and prevent unauthorized distribution of our software. Largely I can personally say it is because we wanted to maintain control of the software.
11. Has the option proven to be efficient or would you rather have another option. Please explain why.
Yes. We are able to maintain and update the software without much trouble and since the expert is part of our own team, we are even more abled when it comes to modifying the code as social media websites upgrade and change their appearance.
12. Big data analysis requires expertise. Is that the main reason why you opted for a managed big data analysis.
Yes.
13. Can you elaborate on how big data has aided your firm in terms of productivity.
Yes. Productivity to me has greatly increased because we are able to generate revenue from the analysis we get from the system.

Participant 23 (S.Y.)

1. You mentioned you employ a platform as a service cloud computing model. Why did you opt for this over the others?
A platform as a service model seemed appropriate because we did not want to incur additional cost and time setting up an entirely new server yet we could not use it.
2. Why did you opt for a prepaid monthly subscription pricing model over the others?
This pricing model was more efficient and cost-friendly because as the name says, it is pay as you go so you only pay for what you use
3. Do you have any regrets for opting into prepaid monthly subscription pricing plan over the others offered by cloud computing platform?
No. This model has proven to be efficient and very inexpensive in the long-run because we are able to pay lesser fee when we do not have much to do with the server.
4. You mentioned you use big data for data mining. Would you mind explaining how you do this?
We mine data for use with our current system as a way of determining trends in terms of gadgets and IT products, that we can use to our advantage to increase sales.
5. You mentioned your venture into big data was not successful, why and how did you come up with this?
We still have a lot of work to do before we are able to get the right analytics from the system. Currently, we are not making any money from the system because when we manually check the suggestions against the current state of the market, it was not very accurate. Last time we ended up selling some computers at a loss because we thought they were on demand yet actually people were complaining about them.
6. Have you experienced a higher return on your investment into big data through cloud computing? Could you explain why you think this is, and how you think the situation can be improved further.
No. I think it is because the system still needs work. But I believe when we finish working on it fully it will provide us with accurate data that can be used to penetrate into the market.
7. Could you please explain why you found it difficult when employing big data analysis through cloud computing.
Since we want to develop a system that is entirely ours and that is is what we want it to do, we are developing it in-house and it requires us to learn new languages for the analyses.
8. Do your customers know about the data you collect and how you use it. Please explain why.
No. the program will be used in-house so there is no need to tell customers.
9. Could you explain why you rated the experience of using cloud computing for big data services.
We have not been able to make a profit off the system. So, to me, that is a poor experience but I have no complaints about the server we purchased.
10. Could you explain why you opted for a self-managed approach using in-house manager.
We wanted to develop it in-house because we are targeting the local market. All the products we checked on the internet only provided ready-made system specifically designed for use in global markets.
11. Has the option proven to be efficient or would you rather have another option. Please explain why.
Given that we are determined to have it completed and working, I would not choose another option.
12. Big data analysis requires expertise. Is that the main reason why you opted for a self-managed big data analysis.

No. it was because we wanted to build a system that we could easily modify and change according to our requirements while learning how best to serve customers.

13. Can you elaborate on how big data has aided your firm in terms of productivity.

I can say that it has not increased our productivity at the moment but we are hoping that it will provide us with good analysis to enable us generate higher sales revenue in future.

Participant 24 (W.K.)

1. You mentioned you employ a platform as a service cloud computing model. Why did you opt for this over the others?

Infrastructure as a service model was more efficient in terms of price and performance and scalability compared to other models.

2. Why did you opt for a monthly prepaid subscription pricing model over the others?

For this type of service, Amazon only offers a monthly or yearly plan. So, the monthly option seemed friendlier on us because it does not require long-term commitment.

3. Do you have any regrets for opting into prepaid monthly subscription pricing plan over the others offered by cloud computing platform?

No. This plan is better because we can cancel any time without causing unwanted issues.

4. You mentioned you use big data for data mining. Would you mind explaining how you do this?

We mine data from the internet, specifically social media and use it to determine the trends and uptake of service and products across Ghana. We then sell the data to various suppliers, distributors and various vendors who fill the gap in the market. For example, we see a number of people complaining about poor services delivered by major retailers, we can sell the insight to a competitor who will attract the clients by offering them what major retailers could not.

5. You mentioned your venture into big data was successful, why and how did you come up with this?

It is largely because we are able to gather information about different products and services and gain from the sale of the report that we generate. I also like to think it is because we are offering a great service to the community by increasing competitive look

6. Have you experienced a higher return on your investment into big data through cloud computing? Could you explain why you think this is, and how you think the situation can be improved further.

Yes. I think it is because our main products depend on it and we could not be in the business if analysis are scaled to bear fruit. So I do not think an improvement is needed at the moment.

7. Could you explain why you found it difficult when employing big data analysis through cloud computing.

Initially, we had to find a good developer to develop the system for us, which was the biggest challenge because most people do not know how to build efficient algorithms that can turn raw data into valuable report.

8. Do your customers know about the data you collect and how you use it. Please explain why.

Yes. We explain to them that the data was derived from social media

9. Could you explain why you rated the experience of using cloud computing for big data services.

The server we used was high-end which means we can do both data analysis and host various websites. So, I can say the analysis has been highly effective.

10. Could you explain why you opted for a self-managed approach using an in-house manager.

As an IT company, we have to have a good in-house service administrator or in-house server administrator because we offer the same services to other businesses. So, it would not make sense choosing another option while we have someone who can do it on our payroll.

11. Has the option proven to be efficient or would you rather have another option. Please explain why.

Yes. It has been efficient because it has been a very good server administrator.

12. Big data analysis requires expertise. Is that the main reason why you opted for an in-house managed big data analysis.

Yes. Although we had a good administrator, we could not get a good developer who knew about data mining. So, we had to outsource it to a local company dedicated to data mining

13. Can you elaborate on how big data has aided your firm in terms of productivity.

Because we largely depend on analysis as a business strategy, I can say that big data has been largely productive because we are able to generate revenues that can sustain our business.

Participant 25 (Z.G)

1. You mentioned you employ a platform as a service cloud computing model. Why did you opt for this over the others?

A platform as a service model is more economic and friendly because we do not have to worry about the hardware and other things. We just get a platform and start developing.

2. Why did you opt for a pay as you go pricing model over the others?

In the long-run, pay as you go is more beneficial because speed and scalability are not limited to the configuration we initially purchased. If the system needs more power, it can easily scale up and do the required analysis without compromising the system.

3. Do you have any regrets for opting into the pay as you go pricing plan over the others offered by cloud computing platform?

No. This plan has proven to be effective and cost-friendly because we are not limiting the service.

4. You mentioned you use big data for data mining. Would you mind explaining how you do this?

We use it for data mining on social media. We gather people's opinion on social media regarding a certain product as a means of getting user feedback that we later sell to the companies offering the product. For example, we can gather data concerning a newly launched product on Facebook and Twitter and report back to the manufacturer about how they can modify the products.

5. You mentioned your venture into big data was successful, why and how did you come up with this?

Yes. Our entire business depends on the analysis that we conduct and since it had proven to be profitable, I can say the venture has been successful.

6. Have you experienced a higher return on your investment into big data through cloud computing? Could you explain why you think this is, and how you think the situation can be improved further.

Yes. Our main product depends on the analysis, so, I think I can say that we have had a huge return on our investment in big data because we provide clear insight regarding a product's overall acceptance and response.

7. Could you please explain why you found it moderately difficult when employing big data analysis through cloud computing.

It was initially difficult to explain to companies how our analysis was conducted and whether the results were validated. But since we got three companies on board, it has been easier because they act as our referees. Another thing is that it took us a long time to get the system

working as we wanted because we did not have a local developer who knew about big data analysis we had to use.

8. Do your customers know about the data you collect and how you use it. Please explain why.

No. they know that we collect data from social media posts mentioning their products and get the overall sentiments.

9. Could you explain why you rated the experience of using cloud computing for big data services.

Cloud computing model we got from Amazon is very efficient and reliable, which has largely impacted how effective our analyses is. So, I think I can rate the experience as highly effective.

10. Could you explain why you opted for a self-managed approach.

We did not get a developer locally, so, we ended up outsourcing the services to an Indian developer who charged us considerably well for such a wonderful job he did.

11. Has the option proven to be efficient or would you rather have another option. Please explain why.

I think we had exhausted accessible local developers before outsourcing a foreign developer. And since he delivered and was professional, I feel the plan has been efficient.

12. Big data analysis requires expertise. Is that the main reason why you opted for an in-house managed big data analysis.

No.

13. Can you elaborate on how big data has aided your firm in terms of productivity.

We depend on big data, so, I can argue that it has been productive because we have been generating stable revenue since we started using it.