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Perceptions on benefits and challenges of cloud computing technology adoption by IT SMEs: a case of Gauteng Province

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Abstract

Cloud computing is considered an important virtualisation technology that uses the Internet and remote servers to offer on-demand resources. While there have been several studies on the factors influencing the adoption of information systems by organisations, there has been little attention given to the adoption and usage of cloud computing by SMEs in South Africa, and perceptions on the benefits and challenges of this technology. SMEs face various challenges ranging from the high cost to deploy resources, maintenance of hardware, and the ability to compete globally.

This study investigates SMEs in the IT sector located within the province of Gauteng, to assess the extent of adoption and usage of cloud computing services, and to ascertain their perceptions on the benefits and risks associated with cloud computing. A survey research strategy was adopted, and a sample of forty-two respondents participated in the study, with each respondent representing an IT SME.

The findings indicated that 71.4% of respondents used cloud computing, and that SaaS, IaaS, and PaaS services were implemented by IT SMEs in the province of Gauteng. The findings also provided insights into perceived technology benefits and challenges of cloud computing.

Key phrases

adoption of cloud computing; benefits of cloud computing; challenges in cloud computing; cloud computing; service level agreement; SMEs; regulatory issues in cloud computing

1. INTRODUCTION

Organisations of the twenty-first century strongly emphasise quality and productivity through organisational development and business strategies. These organisations are perceived to integrate new technologies in their business to ensure high returns and accrue benefits. Cloud computing has emerged as one of the most recent technology models used for the ultimate purpose of benefiting and uplifting business in a secure manner. The National Institute of Standards and Technology defines cloud computing as a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction (Glance & Mell 2011:3).

The challenges currently faced by organisations in terms of high storage cost, increased power consumed by computers, and other hardware has driven many organisations to look for alternatives in order to support their business operations. Chandravathy, Kumar & Murugaboopathi (2013:212) argue that cloud computing is one of the platforms being considered by organisations to increase their economic efficiency, improve their resource utilization level, and decrease their equipment's energy consumption.

In South Africa, small and medium enterprises (SMEs) experience challenges such as the lack of access to capital and technology resources, which prevents them from meeting their organisational needs. Erol, Gulsecen, Karatas & Ozen (2012:1516) argue that cloud computing has been identified as a key driver to improve productivity and create jobs especially for SMEs. Avram (2014:530) and CEBR (2010:34) provide evidence that the adoption of cloud computing has helped SMEs with lower initial entry costs for new products, fast expansion and maintenance of service quality levels. In the European Union (EU), SMEs that have adopted cloud computing have proved to have created about one million new jobs, and their economic contribution is said to reach billions annually (CEBR 2010:34).

Kshetri (2010:7-9) highlighted various benefits that SMEs in the developing world accrued in the adoption of cloud computing as a technology model. The literature provides ample evidence of the adoption of cloud computing by a number of organisations (Carroll, Kotze & Merwe 2011:3). However, there is a lack of empirical research with regard to cloud computing adoption and usage among SMEs in the IT sector in Gauteng in South Africa.

Hence, the main aim of the study is to investigate the perceptions on benefits and challenges of cloud computing adoption amongst SMEs in the IT sector located within the province of Gauteng. This article focuses specifically on the following objectives: (1) the extent of cloud computing adoption and usage by IT SMEs in Gauteng; (2) the perceptions of IT SMEs on the benefits of cloud computing technology; (3) perceptions of IT SMEs on the limitations and challenges of cloud computing technology.

It is important to conduct this study because various organisations, in particular SMEs are interested in integrating new technologies to streamline their business processes. These SMEs can learn from the experiences of other SMEs on the services, benefits and challenges of cloud computing adoption. Thereby the study's findings could add value by creating a point of reference to non-users of cloud computing.

The article provides a literature review of cloud computing in section 2, followed by the research methodology in section 3. The findings and analysis are presented in section 4 followed by a discussion in section 5. The conclusion is presented in section 6.

2. LITERATURE REVIEW

2.1 Cloud computing technology model and services

Seenham & Singh (2013:1214) define cloud computing as an important virtualisation technology that uses the Internet and central remote servers to offer the sharing of resources such as infrastructure, software, applications and business processes to meet elastic market environment demands.

A number of applications and services offered are delivered over the Internet. Ali, Khan & Vasilakos (2015:358) compared the Internet delivery model of cloud computing to metered services that are similar to a utility. Services in cloud computing are presented at three main levels: Software-as-a Service (SaaS), Infrastructure-as-a Service (IaaS), and Platform-as-a-Service (PaaS). A clear understanding of these services is very important in order to link them to the various benefits and their role in the adoption of cloud computing.

Software-as-a Service (SaaS) takes into consideration the use, the management and maintenance of application software, operating systems and resources (Youssef 2012:838).

Infrastructure-as-a Service (IaaS) offers a set of virtualised computing resources such as capacity, memory, network bandwidth and processing power in the cloud (Youssef 2012:838).

Infrastructure as a Service (IaaS) is a way of delivering Cloud Computing infrastructure, namely servers, storage, network and operating systems as an on-demand service. Rather than purchasing servers, software, datacentre space or network equipment, clients acquire those resources as a fully outsourced service on demand.

The circumstances suitable for the uptake of cloud infrastructure include: significant spikes and troughs in terms of demand on the infrastructure; new organisations without the capital to invest in hardware; organizations growing rapidly and scaling hardware is problematic; organization pressurised to limit capital expenditure and to move to operating expenditure; and any specific line of business that has temporary infrastructural needs.

With Platform-as-a-Service (PaaS), the cloud computing service provider is in total control of the system software and computing resources (Youssef 2012:839). PaaS can be defined as a computing platform that allows the creation of web applications quickly and without the complexity of buying and maintaining the software and infrastructure underneath it.

In addition to these three main cloud computing services, there are other forms of cloud services known as the X-as-a-Services (XaaS), which stands for anything as a service. According to Mujinga (2012: 1167-1168) these services are developing on a regular basis and are taking the form of already known services: SaaS, IaaS or PaaS.

Choudhary (2012: 2249-7277) refers to X services as any computing function provided via cloud computing. Some of the services included in this category are Backup-as-a-Service (BaaS), Security-as-a-Service (SecaaS), Information Technology-as-a-Service (ITaaS), Business Process-as-a-Service (BPaaS) and Database-as-a-Service (DBaaS).

According to Joubert (2012), the SaaS, IaaS or PaaS services that have been adopted by large organisations in South Africa, include mail and messaging, archiving, backup, storage, security, virtual servers, customer relation management (CRM), collaboration, hosted PBX and video-conferencing.

2.2 An overview of SMEs

Bautista-Godinez, Canales-Sanchez, Lopez-Ortega & Marcia-Herrera (2016:62) define a small business as a separate and distinct entity that operates in a sector or sub-sector of the economy, which may include branches or subsidiaries, and are managed by one or more owners. The National Credit Regulator (2011:24) classifies a small business if it meets the following criteria: has a small market share, is managed by an owner, is independent, is the size of a small firm sector in terms of its contributions to the country's GDP, and its general contribution revenues as compared to other firms within the country.

In South Africa, the contribution of SMEs is estimated in the region of 52% to 57% of the gross domestic product (GDP) (SEDA 2012:1-124). SMEs are, therefore, positioned to create more employment opportunities, generate higher production volumes, increase exports and implement innovation and entrepreneurship skills (NCR 2011:24). While SMEs are reported to contribute to the growth and development of the South African economy, the SEDA (2012:38) notes that SMEs have limited opportunities to compete at both the national and international level.

The availability and accessibility of capital and technology resources have been identified as challenges for small organisations in South Africa to meet their business need (TheDti 2013:4). The South African government has acknowledged the problem underpinning the South African economy by encouraging SMEs to play a vital role in the national economy. The greatest challenge for SMEs to compete nationally and globally in their respective fields, and further maximise on technology capabilities in order to expand, compete and achieve their business goals (SEDA, 2012:38).The perceptions among SMEs are that they have to overcome barriers whether it is access to capital and local or regional legislations and regulations in order to meet their organisational needs (TheDti 2013:4).

The study chose to focus on SMEs in Gauteng following a number of considerations. There is a strong focus on business expansion and SME creation in Gauteng when compared to the rest of the country, Gauteng has been identified as one of the well-vested environments with good ICT infrastructure to facilitate the expansion of SMEs and adoption of ICT as well as contribute largely to economic growth (GIDSD 2012:1-46).

SMEs in general use premise-based and in-house technologies. These house based-technologies are characterised by a typical customer–vendor relationship and usage of licensed software packages (Dubey & Wagle 2007:1-7). This typically entails a cycle of purchasing software and maintenance contracts, as well as having to undertake expensive upgrades.

According to Berisha-Namani (2009:1-8), SMEs in Kosova used computers for financial reporting text processing, and internet connectivity. Kosovar enterprises were reported to be in the early stages of e-business adoption. In a study conducted by Modimogale and Kroeze (2009:504-513) on the role of ICTS in the SME sector in South Africa, it was found that point of sale terminals (POS) were used to capture business transactions for accounting purposes. Marnewick (2014:1) reported that ICT such as PCs, laptops, cell phones and smartphones were used for business objectives amongst township and small businesses in Soweto. The author further revealed that cell phone banking, internet banking, email and internet browsing were amongst the main uses of information and communication technology.

2.3 Cloud computing adoption and usage

Cloud computing is set to radically transform the IT business landscape and many organisations are weighing the advantages and risks of this technology before making adoption decisions.

Dubey and Wagle (2007) touted the concept of software as a service which offered buyers more flexibility to switch between vendors, and have fewer maintenance problems than the traditional licensed software delivery model. Initially designed for large organisations, Dubey & Wagle (2007:2) argued that small organisations could benefit from cloud computing due to its underlying customisation facilities.

The Gartner report compiled by Cearley (2010:2) predicted an excess in IT global spending toward cloud computing adoption or migration. The report has noted an increase in cloud computing around 10-15% for the past two years alone and this is said to increase. Lamoureux & Matuszak (2013:11) note that organisations are likely to consider using cloud computing when they need major technology upgrades and some form of business transformation. With the constant growth of cloud computing technology, Carlin & Curran's

(2012:62) short term forecast is that the adoption of cloud computing technology is set to rise exponentially with many in-house applications being moved to the cloud (Carlin & Curran 2012:61).

From an international perspective, it is believed that 54% of organisations in emerging and developed countries are already using SaaS, 44% are already using IaaS and 27% are using PaaS (Etro 2009:185). Brown & Malden (2012:12) conducted a study on SMEs in the European Union and reported that small organisations have started investing in cloud-based services as part of their daily business activities. Brown & Malden (2012:12) argue that the first step in the adoption and migration to cloud computing is the usage of SaaS. They also conclude that SaaS has accumulated a higher level of investment from decision-makers, shortly followed by IaaS and PaaS.

A study conducted by Avram (2014:530) and CEBR (2010:12) on SMEs in the European Union indicates that there is ample evidence that the adoption of cloud computing has helped lower initial entry costs for new products, with fast expansion while maintaining the quality of services. They further argue that the start-up or upfront cost to start a business has been reduced or eliminated in some instances by cloud computing, and further provided a means for SMEs to grow and become not only productive but also competitive.

Cowhey and Kleeman (2013) have conducted their study on SMEs in both developing and developed countries. Cowhey & Kleeman's (2013:11) study on SMEs in developing countries reveal that cloud computing has been proved to reduce barriers to new products and improve existing business models. Kavitha & Subashini (2011:3) claim that SMEs are looking at cloud computing and its wide range of benefits to meet their business needs.

A study conducted by Erol et al. (2012:1524) on SMEs indicates that cloud computing has been identified as a key driver to improve productivity and create jobs. Erol et al. (2012:1517) argued that the adoption of cloud computing has been perceived as a good opportunity to maximise profitability and concentrate on core objectives. In addition, a study conducted by Hinde and Van Belle (2012:3) also indicates that the interest to implement cloud computing as a technology model has exponentially grown for IT markets including South Africa. In studies conducted on small organisations in South Africa by Tredger (2013); Jones & Simorjay (2013:5) and Carroll & Ramsingh (2012:4-5) findings indicate that small organisations are

making use of cloud-based services and solutions. According to Tredger (2013), the first step toward cloud computing adoption seems to be SaaS in South Africa

The Microsoft report compiled by Jones & Simorjay (2013:5) suggests that around 40% of organisations, especially SMEs are considering the migration to cloud computing with a clear focus on SaaS. The report also concludes that the global perception of SMEs on cloud computing adoption and migration is geared toward SaaS aspects such as Email and collaboration offerings (Lync Online, Office web applications, SharePoint Online).

Mujinga (2012:1168) and the Microsoft report compiled by Jones & Simorjay (2013:5) report that organisations in South Africa are making use of some cloud-based services such as Office 365 Live, as well as other customised cloud-based services such as business analytics, human resources, storage, as well as customer relationship management. The reports indicate that the usage of cloud computing is currently expanding beyond SaaS.

The literature review provides some insight into adoption of cloud computing and usage patterns in organisations in both developed and developing economies. However, the literature does not provide a clear indication on the extent of cloud computing adoption and usage of services among SMEs in the IT sector of Gauteng and the manner in which they tap into the cloud benefits to meet their business objectives.

While previous studies have shed light on economic, productivity, resource customisation and growth benefits that SMEs can achieve from the adoption of cloud computing, there is limited information on the perception of SMEs on the entire suite of benefits accrued from the adoption and usage of the cloud computing technology model in South Africa. This is supported by the study of Mohlameane and Ruxwana (2014:9) who reveal that SMEs in South Africa lack awareness of cloud computing, which an impediment to testing and exploring the benefits of cloud computing.

2.4 Benefits and usefulness of cloud computing technology model

Carroll *et al.* (2011:3) argue that the adoption and usage of cloud computing technology should be largely observed in line with the perceived benefits that the model offers.

The section presents a literature review on the benefits and usefulness of the cloud computing technology model.

2.4.1 Cost efficiency

Cost-efficiency is considered as an important benefit, as well as an important characteristic in cloud computing (Youssef 2012:839). Cost-efficiency is related to the lower expenditure on cost and a high return on investments (Youssef 2012:839). Erol et al. (2012:1519) argue that cost-efficiency associated with cloud computing technology assisted SMEs to compete both nationally and internationally, which was one thing many SMEs could not do due to the high up front-cost and capital to run their businesses.

Avram (2014:531) argues that the perceived benefits and usefulness of cloud computing allow potential entrants including small enterprises to save on the fixed costs of investments in the adoption of the technology model and turn part of the costs into variable costs. A study conducted by Carroll *et al.* (2011:6-7) revealed that cost efficiency was the main driver for cloud computing adoption.

2.4.2 Lower implementation and maintenance cost

Cowhey & Kleeman (2013:6) and Erol *et al.* (2012:1524) attribute lower implementation and maintenance cost to a reduction of upfront capital and operational costs associated with the implementation and maintenance of IT resources.

Carroll *et al.* (2011:6-7) explain that the adoption and shift to cloud computing can largely be influenced by the reduction in cost as the technology requires less hardware and software to be purchased, as well as low support on maintenance and implementation.

2.4.3 Scalability

Youssef (2012:840) defines scalability in cloud computing as a high ability to handle IT resources and accommodate growth as per customer's needs. A study conducted by Bamiah & Brohi (2011:287) indicated that scalability in cloud computing was a benefit since the characteristic provided flexible on-demand business. Nusca (2012:34) emphasised that

scalability is one of the key factors considered by decision-makers when deciding whether or not to move their business to the cloud. Kaur & Singh (2013:472) claimed that scalability is one of the important benefits offered by cloud computing.

2.4.4 Saving time and money

Cowhey & Kleeman (2013:10) reported that since the cost associated with cloud computing implementation and maintenance has been drastically reduced, there is a resultant increase in cost savings. A study conducted by Erol et al. (2012:1517) reported that smaller organisations were now able to penetrate markets that were previously reserved for large organisations.

Avram (2014:531) claimed that this benefit played an important role in the deployment and maintenance of applications. He further argues that the reduction of the constraints for entering the IT market could eventually promote business creation and help SMEs to be part of the global market.

Carroll *et al.* (2011:6-7) indicate that issues around power cooling, floor space and storage capacity are largely eliminated in cloud computing, thus providing a reduction in operational costs, as well as a great business opportunity for considering cloud computing adoption.

2.4.5 Sustainability

Carroll *et al.* (2011:3) refer to sustainability as a high probability of continuing using services and IT resources due to their high availability in the cloud.

A study conducted by Cilleruello, Garechana, Gavilanes, Rio-Belver & Zabalza (2012:641-642) explained that the sustainability of a business should be the focus of its existence.

In addition, Cilleruello *et al.* (2012:642) argued that cloud computing technologies offer immense capabilities to sustain the IT side of a business.

Youssef (2012:840) indicates that organisations considered sustainability as a benefit in cloud computing. Etro (2009:187) reported that cloud computing allows SMEs to sustain business operations especially during the inception phase.

2.4.6 Customisation

Youssef (2012:840) defines customisation as the ability to adjust cloud resources based on consumer demand. Youssef (2012: 840) explains that customisation provides flexible ways to rearrange resource in a cost-effective manner as compared to in-house technology.

Dubey & Wagle (2007:5) argue that small enterprises are in a better position to maximise the use of technology because of the higher level of customisation and flexibility offered by cloud computing. Carroll et al. (2011:3) reported that customisation was considered by organisations as a benefit as it offers a high possibility to reconfigure IT resources and infrastructure to suit customer's needs.

2.4.7 Virtualisation

According to Joubert (2012:Internet) and Youssef (2012:840), cloud computing technologies provide enough capacity and performance through virtualised servers for consumer usage as and when required.

A study conducted by Baskar, Karthick & Kumar (2013:314) indicated that virtualisation was an important benefit in cloud computing. As a result of virtualisation in cloud computing, organisations were able to improve their work performance, ensure portability of high level functions, aggregate and consolidate resources in a seamless fashion.

2.4.8 Agility on computing platforms

Carroll *et al.* (2011:4) refer to agility on computing platforms as the high flexibility to transform and customise resources based on customer's needs. The authors reported that respondents considered this theme as an important benefit in cloud computing. Nusca (2012:34) emphasised that agility is one of the key factors considered by decision-makers when deciding whether or not to move their business to the cloud.

2.4.9 High performance of resources

Carlin & Curran (2012:63) argue that performance in cloud computing is associated with virtualisation where computing resources are enabled to release more than required

capabilities in respect of processing power, storage and memory. Kaur & Sing (2013:474) and Carlin & Curran (2012:61) refer to higher performance of resource as the capacity of resources in the cloud that is readily available for use anytime when needed by the user.

2.4.10 High reliability and availability of computing resources

Nivedita & Sravani (2013:32) refer to higher reliability and availability of computing resources as the capacity of resources that can be accessed and used based on customers' needs at any time. A study by Buyya, Calheiros & Garg (2011:5) argued that customers expect higher reliability and availability of data in cloud computing. A study conducted by Youssef (2012:840) revealed that higher reliability and availability were considered as important benefits in cloud computing.

2.4.11 Better IT resource management

Youssef (2012:841) refers to better IT resource management as a result of resources in the cloud being easily manageable to respond to user's needs. With better IT resource management in cloud computing, Carroll et al. (2012:4) explain that organisations have ample time to focus on core IT functions and respond to customers' needs. Studies conducted by Carroll et al. (2011:4); Joubert (2012); Youssef (2012:840) revealed that better IT resource management is an important benefit in cloud computing.

2.4.12 Improved security

Kumaraswamy, Latif & Mather (2009:112) refer to improved security in the cloud as the tailoring of security to meet user's requirements. While security has been perceived by many organisations as one of the greatest concerns in cloud computing, Chang, Kuo & Ramachandran (2016:26) explain that consumer responsibility for managing security has been alleviated.

Cloud computing service providers do everything they can to ensure security and protection of consumers' data while consumers only pay for the amount of service used (Joubert 2012).

2.4.13 Flexibility

Youssef (2012:839) refers to flexibility as the capacity offered in cloud computing where IT resources can be added or removed as per customer's requirements. Studies conducted by Carroll *et al*. (2011:4); Youssef (2012:839); Cilleruello *et al*. (2012:642) revealed that flexibility was considered by many organisations as a benefit in cloud computing.

2.4.14 Rapid development

Cilleruello *et al.* (2012:642) refer to rapid development as a high possibility and capability to develop applications in the cloud as compared to in-house environments. Haig-Smith & Tanner (2016:124-125) consider rapid development as a game changer in cloud computing as applications can be built quickly to respond to a business need.

With regard to rapid development in the cloud, organisations have a great opportunity to eliminate internal frictions between business and IT, and build applications with few resources with a great platform for testing and integration (Haig-Smith & Tanner 2016:124-125).

2.4.15 Greater mobility

Cilleruello *et al.* (2012:642) refer to greater mobility as a high possibility to move resources and adjust them based on the customer's needs in cloud computing. Cilleruello *et al.* (2012:643) and Joshua & Ogwelela (2013:43) reported that mobility was considered as a benefit and an important characteristic in cloud computing.

2.4.16 Improved automation

Carroll *et al.* (2011:7) refer to improved automation as the capability of cloud computing services to be automated based on user's requirements**.** Youssef (2012:839) cited improved automation as an important characteristic in cloud computing, which benefited organisations that adopted cloud computing. Carlin & Curran (2012:61) argued that cloud computing has made it easy to not only automate resources, but also to allow resources to be provisioned and released on-demand with little consumer interaction.

2.4.17 Green IT data centers

Carlin & Curran (2012:61); Kaur & Singh (2013:473) and Cilleruello *et al.* (2012:643) refer to green IT data centers as the high provision of IT resources and services with a reduced need for large power consumption. Walden (2012:3) claimed that cloud computing technology could be more energy efficient as compared to traditional premises-based computing technologies. Carlin & Curran (2012:62); Kaur & Singh (2013:472) and Kulkarni, Gambhir & Palwe (2012:12) reported that organisations that adopted cloud computing, cited this theme as a benefit.

The literature review presents numerous generic technological benefits that could potentially influence or act as drivers to cloud computing adoption. However, the perceptions of IT SMEs on the technological benefits of cloud computing adoption as opposed to the use of traditional premise-based and in-house technologies are unknown. Hence there is a need to assess the perceived technology benefits that cloud computing offers to SMEs in the IT sector.

2.5 Challenges and limitations to cloud computing adoption

Despite the various benefits that cloud computing technologies present, the other side of the technology model must also be understood in terms of issues and challenges in the implementation or deployment process.

This section briefly discusses challenges and limitations to cloud computing adoption.

2.5.1 Data privacy and security issues

Chandravathy *et al.* (2013:212) define data privacy and security in cloud computing as the manner in which data is accessed, shared and protected across various organisations. Security is one of the most important challenges reported in cloud computing, and as such has received much attention in the adoption process (Chandravathy *et al.* 2013:213; Walden 2012:3).

The responsibility remains with the service provider to ensure security, protection of data from theft, malicious attacks, and unauthorised access (Walden 2012:4). A study conducted by Chandravathy *et al*. (2013:213) indicated that organisational leaders consider security in cloud computing as a great concern.

2.5.2 Availability issues

Nivedita & Sravani (2012:32) refer to availability in cloud computing as the capability that cloud computing services offer in being readily available to users whenever they are needed. With data being held as a conglomeration of computing resources, customers expect data to be available in the event of the failure of one or more data centres (Goya & Supriya 2013:232; Nivedita & Sravani 2012:31). A study conducted by Kumaraswamy *et al*. (2009:243) explained that while cloud computing provided mechanisms to ensure that resources were available at any time to all the users, organisations found it difficult when data was not available even for a short period of time.

2.5.3 Shared technology issues

Buyya *et al.* (2011:4) refer to shared technology as various IT resources shared within the IT infrastructure given the capabilities of cloud computing. A study conducted by Buyya *et al.* (2011:3) revealed that shared technologies in cloud computing posed serious challenges. The sharing of these resources required a high level of planning on behalf of both the users and service providers that takes account of relevant policies, standards, and legislation, as well as encryption mechanisms to ensure that resources were fully protected.

2.5.4 Trust and transparency issues

Alsudiari, Mohammed & Vasista (2012:165) refer to trust and transparency in cloud computing as representing aspects related to data sharing, privacy and communication. Sarojini, Selvamani & Vijayakumar (2016: 507) explain that trust refers to when something or someone is reliable, honest and effective. They further argue that the provision of cloud services in a transparent manner is an expectation of the consumer and enhances the reputation of the service provider. A study conducted by Alsudiari *et al.* (2012:166) indicated that trust and transparency issues were even more complex to manage in the cloud.

2.5.5 Disaster recovery issues

Buyya *et al.* (2011: 4) refer to disaster recovery in cloud computing as the mechanism of data backup ensuring that data is restored after a threat, security breach, and/or man-made

disaster. Tudor (2013) explains that organisations sometimes overlook robust and backup strategies, and as a result are faced with immense financial and organisational consequences in the event they are not able to recover from data loss or unforeseen harmful disasters.

Chou (2015:165) indicates that organisations need to be aware of the time frame it takes to recover from outage, disaster or power failure in the cloud, and specification requirements about data or service restoration should be clearly stipulated in the service level agreements.

2.5.6 Service level management issues

Alsudiari *et al.* (2012:165) argue that a service level management should be considered as the cornerstone in the adoption of the cloud computing model. The challenges posed to-date are how the service should be measured and what should be included in contract agreements. Alsudiari *et al.* (2012:166) argue that that there has never been a true implementation of cloud due to the complexities and various interpretations of the contract and service level agreement.

2.5.7 Regulatory requirements issues

The legal and practical liability of data is another cloud computing concern that needs to be addressed by cloud computing providers and consumers as well. Alsudiari *et al. (*2012:165) refer to regulatory and legal issues in cloud computing in the context of the legal framework governing data around the globe, relating to data recovery, data restoration, data migration, data ownership, and data retention.

A study by Walden (2012:4) revealed that regulatory and legal issues posed a challenge to users in respect of the way data was controlled, managed and protected around the globe. He also explained that the challenges posed by regulatory and legal issues in cloud computing were caused in many instances by the location of data, which tended to take precedence on jurisdiction.

2.5.8 Security scheme challenges

Nivedita & Sravani (2012:32) describe challenges of security schemes to complexities associated with the conceptualisation, design, control and implementation of security aspects in cloud computing. These challenges relate to data privacy, availability, authentication, data recovery, trust and transparency, confidentiality, risks and security policy formulation. A study conducted by Chou (2015:139) indicated that security schemes challenges posed challenges in cloud computing deployment.

2.5.9 Virtualisation paradigm challenges

Together with the high performance that the cloud computing technology model provides through virtualisation, it also presents challenges in cloud computing deployment and implementation of applications (Nivedita & Sravani 2013:32). With the capability to use needed resources on-demand for specific operations and release or relinquish unneeded resources, the main challenge remains on how data should be controlled and protected during the virtualisation process (Carlin & Curran 2012:62).

Nivedita and Sravani (2013:31) further argue that while performance is praised as one of the greatest contributions in cloud computing, consumers and service providers remain vulnerable to a number of security issues, internal and external threats, denial of services (DOS), policy driven enforcement, segmentation, isolation, governance just to name a few.

Studies conducted by Chou (2015:140) and Nivedita & Sravani (2013:33) revealed that the virtualisation paradigm in cloud computing constituted a challenge of its own.

2.5.10 Policy integration and governance

Buyya *et al.* (2011:4) refer to policy integration and governance as key requirements that are aligned to good service levels in cloud computing. Buyya *et al.* (2011:3) reported that there were challenges from the consumers' perspective in the understanding and interpretation policies. They reported that policy and integration had become a stumbling block for many users in the adoption and usage of cloud computing.

The literature review presents several technological issues and challenges related to cloud computing adoption for organisations in general. However, there is a knowledge gap on the perceptions of IT SMEs with regard to the technological challenges experienced in the implementation and deployment process of cloud computing. There is a thus a need to assess the perceived technology challenges that cloud computing presents to IT SMEs located in the Gauteng Province.

3. RESEARCH METHODOLOGY

A survey research strategy was adopted in order to investigate the adoption and usage of cloud computing in IT SMEs located in Gauteng. The survey strategy used quantitative data gathering techniques in the form of questionnaires. Quantitative data technique assumes that the reality is relatively independent of the context (Bhattacherjee 2012:67). The technique uses objective techniques such as numeric data or standardized measures.

The study was conducted in Gauteng, which is one of the eleven provinces of South Africa. Gauteng is considered as one the fastest growing provinces economically and technologically as compared to the rest of the provinces, and it is considered as an important business and financial hub of South Africa as indicated in the Gauteng ICT Development Strategy Draft (GIDSD 2012).

For the purpose of this study, a probability sampling technique was used to select a sample size of forty-two IT SMEs from a list of four hundred registered IT organisations. IT SMEs were chosen as the target population as prior studies by Mohlameane & Ruxwana (2014), Yeboah-Boateng & Essandoh (2013) and Tarmidi, Rasid, Alrazi & Roni (2014) reported a lack of cloud computing awareness among SMEs, which subsequently meant that they had limited knowledge on services and benefits offered by the technology. In another study conducted by Yeboah-Boateng & Essandoh (2013) in Ghana it was found that IT respondents from SMEs had a considerable knowledge on cloud computing. From this it emerges that IT SMEs are better positioned to provide data on the benefits, services and challenges associated with cloud computing adoption.

The list of IT SMEs was generated from the following online resource: Gauteng Business News. The target population comprised IT SMEs located in the Sandton, Midrand, Centurion,

and Pretoria areas of the Gauteng province, since these areas were considered to be the heart of IT SME sector in Gauteng.

The researcher identified one decision-maker from each selected IT SME and invited him/her to participate in the survey. The decision maker representing each of the 42 SMEs completed the survey thereby yielding a 100% response rate. The respondents from the sample of IT SMEs formed the unit of analysis. These decision-makers from the IT SME sector were purposively selected on the basis that they were knowledgeable and experienced in IT technology and had an influence in the alignment of IT with business goals.

The quantitative data collected was analysed using descriptive and inferential statistics. Descriptive statistics used in the analysis included means and standard deviations and frequencies, which were represented in tables or graphs. The Wilcoxon Signed Ranks test was applied, which is a non-parametric test used in this study to test whether the average value is significantly different from a value of 3 (the central score).

The Mann Whitney U Test was applied, which is a non-parametric equivalent to the independent samples t-test. The Binomial test used compared the observed frequencies of the two categories of a dichotomous variable to the frequencies that are expected under a binomial distribution with a specified probability parameter of 0.5 for both groups.

4. RESEARCH FINDINGS

This section presents the quantitative findings for the study in accordance with the aim and objectives of the study. The findings were analysed using a number of tests to interpret data.

Some of the tests used in this study include descriptive statistics, as well as inferential statistics, namely the Wilcoxon Signed Ranks test, Mann Witney U test, as well as the Binomial test. The SPSS 22 package was used to analyse the quantitative data.

4.1 Demographic details

Forty-two respondents took part into this research and the findings revealed that respondents were IT consultants, IT managers, executive managers, middle managers, and company owners, employees with IT expertise or knowledge, as well as IT specialists. The computing

devices used by the SMEs are PCs, laptops, tablets and mobile devices. The software deployed for business use included the Windows Operating System, MS Office package suite, Web browsers and Android for Mobile devices.

Figure 1 presents the demographic details such as employment status, the position of the employees in the organisation, and the number of employees in the organisation.

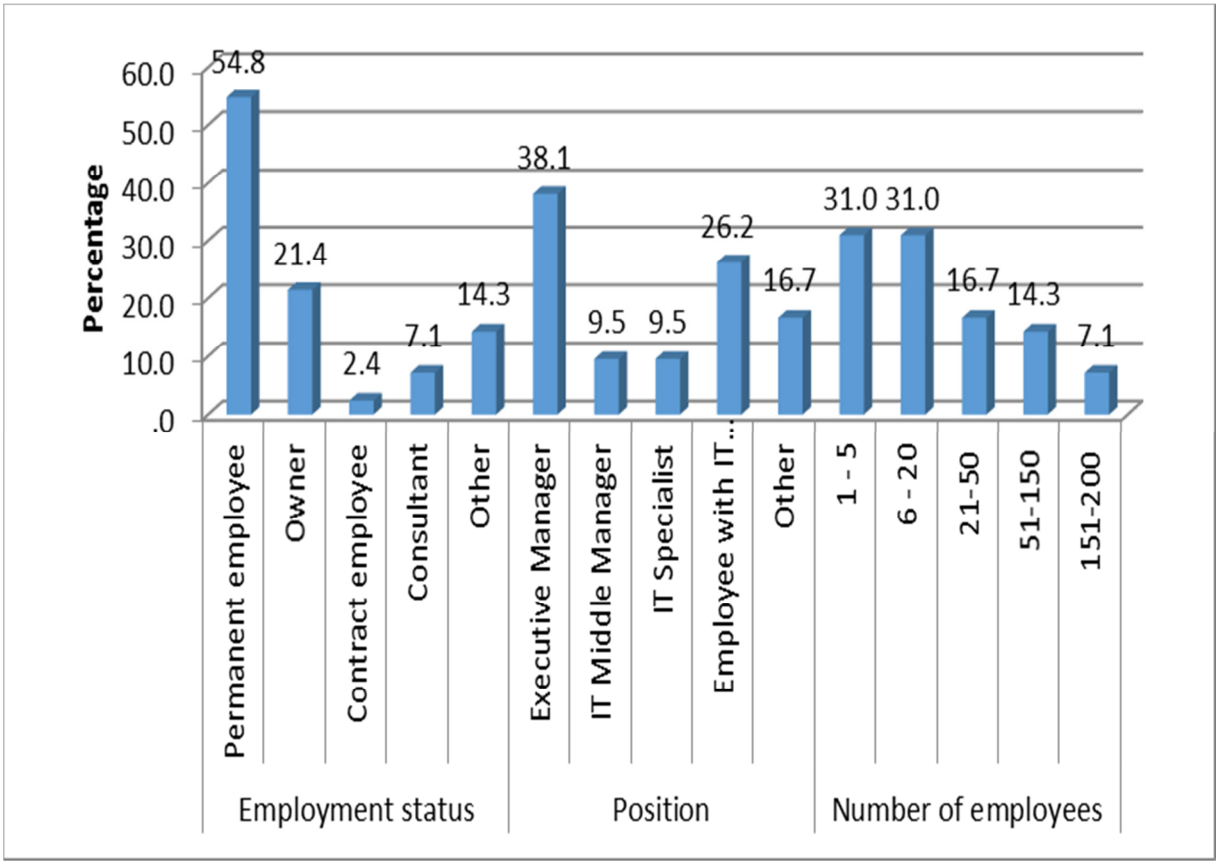

FIGURE 1: Demographic details of respondents

Source: Author's own construction

SMEs that took part into the research had between 1-200 employees with primary users of computing devices being employees followed by clients.

The findings revealed that SMEs operated in the following three sectors: computer/IT, mobile business, as well as digital solutions. These organisations were in business for a period ranging from one month to twenty years.

4.2 Adoption and usage of cloud computing

The research findings on the adoption levels of cloud computing indicate that 71.4% of the respondents used cloud computing as compared to 28.6% of the respondents who did not use cloud computing, as depicted in Figure 2. The results of a binomial test show that a significant proportion of the sample indicated that they are using cloud computing (p=0.008).

The findings also indicated that 75% of non-users were planning to use cloud computing and 25% of non-users were not planning to use cloud computing.

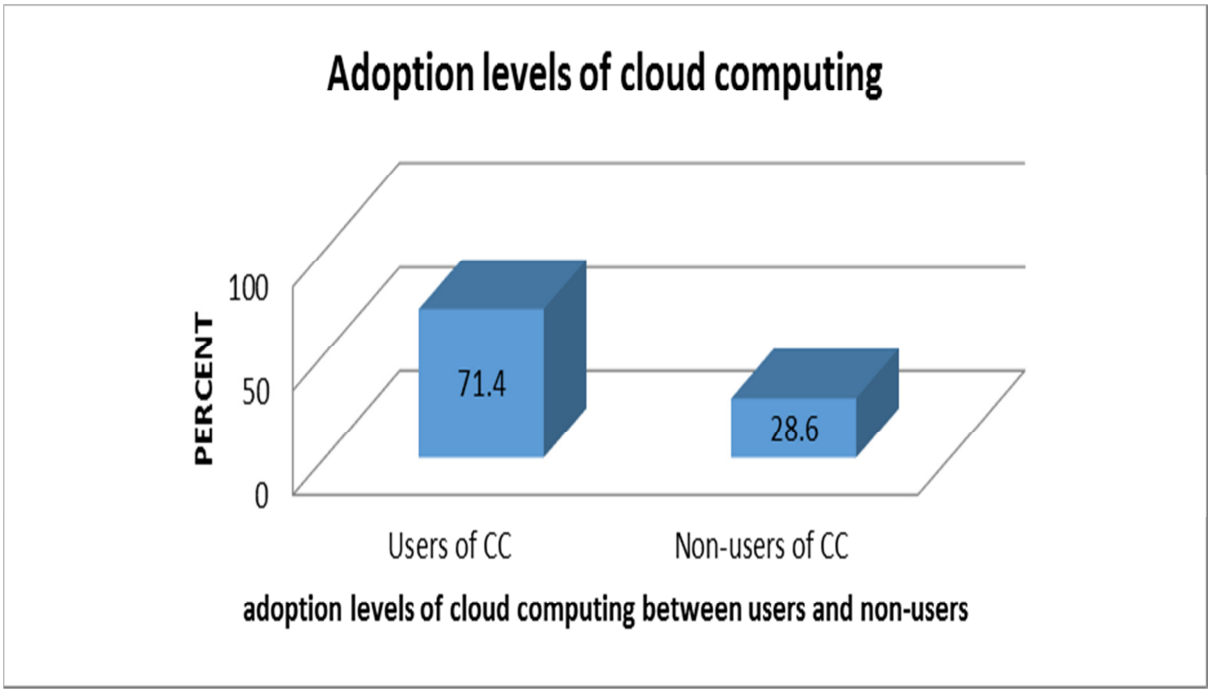

FIGURE 2: Adoption levels of cloud computing

Source: Author's own construction

While there is no historical data on the adoption levels of cloud computing among SMEs in the IT sector in Gauteng, the Deloitte (2012) survey results revealed that SMSs were fast adopters of cloud computing technology and that 62% of the respondents in the SME segment had to some extent moved their computing to the cloud (Carroll & Ramsingh 2012:4-5). Figure 3 represents the adoption levels of cloud computing services by respondents that use cloud computing.

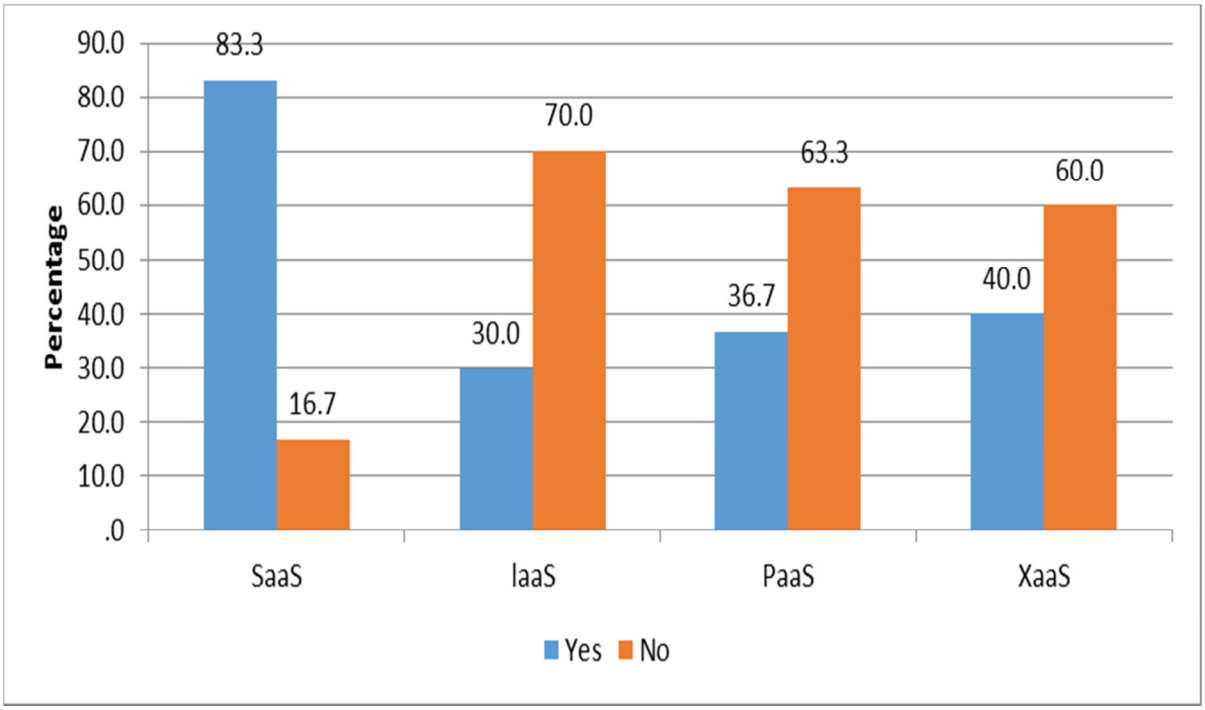

FIGURE 3: Adoption levels of cloud computing services

Source: Author's own construction

The findings of SaaS usage show that 83.3% of respondents used SaaS and 16.7% of users did not use SaaS. These findings support the claim by Erol et al. (2012:1519) and Tredger (2013) that SMEs were using readily available services in the cloud for the operation of their business. The Saas services reported to be in use included MS Office 365 Live, mail services, mail services, social networking sites, and CRM_ERP_HRM.

IaaS usage results indicate 30.0% of respondents used IaaS and 70.0% of respondents did not use IaaS. According to Avram (2014:533), the adoption and usage of IaaS was considered

to be lower as compared to SaaS. Among the IaaS services used were Dropbox, Amazon EC2, Google Drive, Microsoft SkyDrive and IBM Blue cloud.

PaaS usage results indicate that 36.7% of respondents used PaaS and 63.3% of users did not use PaaS. According to Brown & Malden (2012:13), the adoption and usage of PaaS was considered when real investments were made in regard to SaaS and a real transformation need existed within in the organisation. The PaaS services reported to be in use included Windows Azure, Google Apps Engine, Cloud Foundry, Cloud Control and Wave Maker.

XaaS findings indicate that 40.0% of respondents used XaaS and 60.0% of users did not use XaaS. Lamoureux & Matuszak (2013:12) reported that companies consider to use XaaS when there was a need for a major upgrade or transformation required. The XaaS services reported to be in use included SecaaS, BPaaS, DBaaS, BaaS, and ITaaS.

The results of a binomial test showed that a significant proportion of the sample agreed that they used SaaS (p=<0.0005), while a significant proportion disagreed on the usage of IaaS (p=.0005). These findings supported the arguments presented by Avram (2014:531) and Brown & Malden (2012:12) that the first step in the adoption and migration to cloud computing is SaaS. They also conclude that SaaS has accumulated a higher level of investments from decision-makers.

4.3 Perceived benefits of cloud computing

Figure 4 presents the findings on benefits of cloud computing as perceived by respondents of IT SMEs located in Gauteng.

Awa, Emecheta & Ukoha (2012:13) reported that respondents who adopted cloud computing seemed to understand the benefits and related challenges or risks associated with the adoption and usage of the technology model. In addition, they understood related aspects of technological change or transformation and competitive advantage for the organisation.

For the purpose of the analysis, the Wilcoxon signed ranked test was applied for each of the benefits to test for significant agreement or disagreement. Wilcoxon signed ranks test indicates whether the mean score is significantly different from a neutral score of ‘3’.

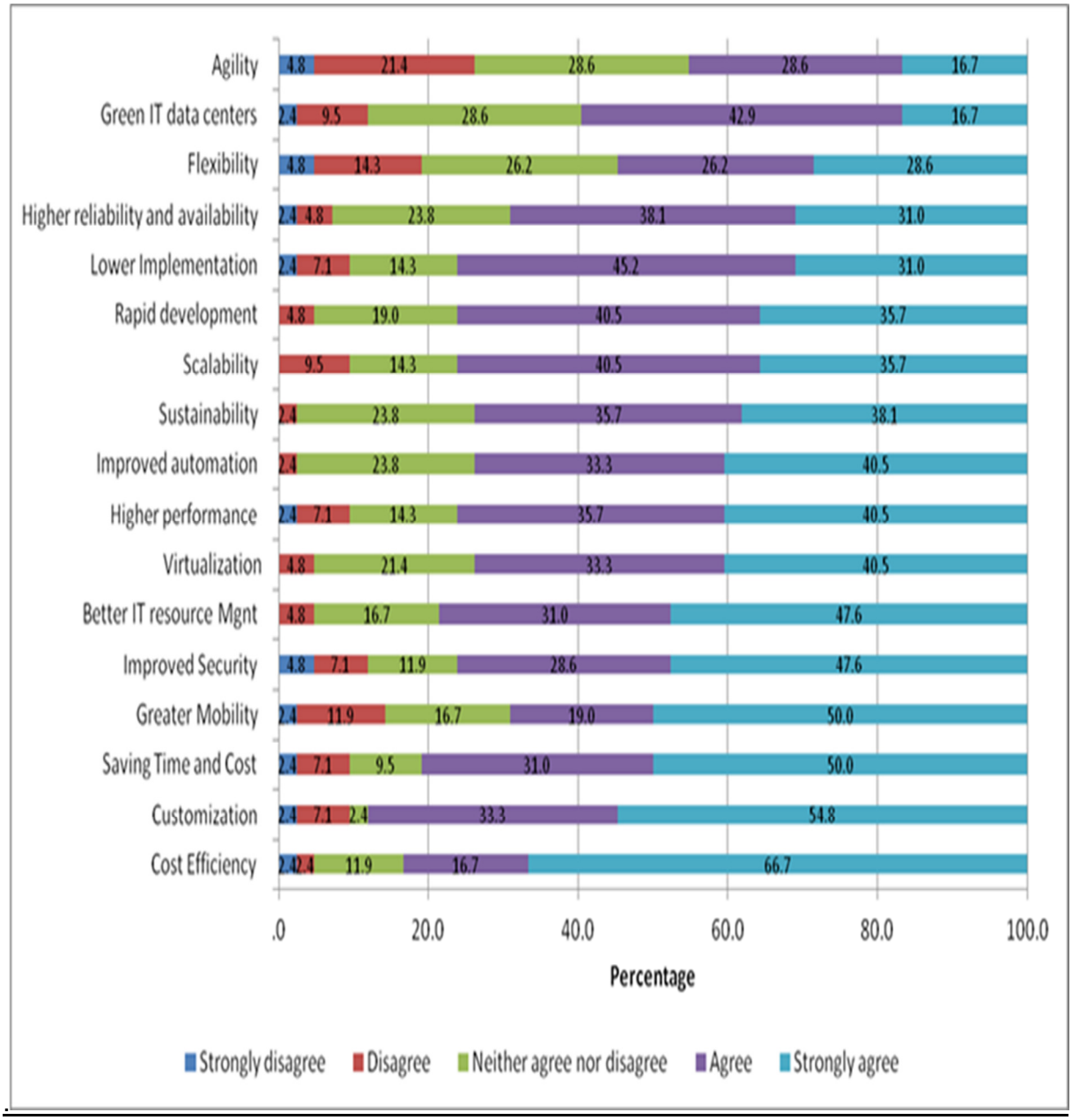

FIGURE 4: Perceived benefits of cloud computing

Source: Author's own construction

If there is a significant difference, one can identify either agreement or disagreement from the size of the mean (>3 or <3). The mean values were ordered for comparative purposes. A

Mann Whitney test was applied to see whether users and non-users differ in their opinions of benefits

4.3.1 Cost-efficiency as a benefit in cloud computing

The findings indicate that 66.7% of respondents strongly agreed that cost-efficiency was a benefit, 16.7% of respondents agreed that cost-efficiency was a benefit, 11.9% of respondents neither agreed nor disagreed, 2.4% of respondents disagreed that cost-efficiency was a benefit, and 2.4% of respondents strongly disagreed that cost-efficiency was a benefit. The findings indicated that there was a significant difference in the perceptions of cost-efficiency as a benefit between users and non-users (Z ($N=42$) $=-3.783$, $p<0.0005$). Users ($M=4.77$, $SD=0.626$) believed that cost-efficiency was a great benefit in cloud computing than do non-users ($M=3.58$, $SD=1.165$).

This finding supports Youssef (2012:840) findings who reported that cost-efficiency was considered as an important factor and characteristic in cloud computing. Erol *et al*. (2012:1519) argue that cost-efficiency associated with cloud computing technology assisted SMEs to compete both nationally and internationally, which was one thing many SMEs could not do due to the high up front-cost and capital to run their businesses. Avram (2014:531) argues that the perceived benefits and usefulness of cloud computing allow potential entrants including small enterprises to save on the fixed costs of investments in the adoption of the technology model and turn part of the costs into variable costs.

4.3.2 Lower-implementation cost as a benefit in cloud computing

The findings on lower-implementation cost indicate that 50.0% of respondents strongly agreed that lower-implementation cost was a benefit, 31.0% of respondents agreed with lower-implementation cost as a benefit, 9.5% of respondents neither agreed nor disagreed with lower-implementation cost as a benefit, 7.1% of respondents disagreed with lower-implementation cost as a benefit, and 2.4% of respondents disagreed with lower-implementation cost as a benefit in cloud computing.

The findings indicated that there was a significant difference in the perceptions of lower-implementation as a benefit between users and non-users (Z ($N=42$) $=-2.575$, $p<0.0005$).

Users (M=4.40, SD=1.003) believed that lower-implementation cost was a great benefit in cloud computing than do non-users (M=3.67, SD=0.985).

This finding supports the results of a study conducted by Cowhey & Kleeman (2013:24) on emerging economies including Mexico, India and South Africa, These authors reported that there was a considerable reduction of up-front capital and operational cost associated with the implementation and maintenance of IT resources, which was beneficial to SMEs. In addition, Avram (2014:532) explained that the cost to implement and maintain IT resources assisted SMEs to become competitive at both national and international levels. He further argued that lower-implementation contributed immensely to a high competitiveness among businesses, something that was not possible with in-house-based environments.

4.3.3 Scalability as a benefit in cloud computing

The findings on scalability as a benefit indicate that 38.1% of users strongly agreed that scalability was a benefit, 35.7% of users agreed with scalability as a benefit, 23.8% of users neither agreed nor disagreed with scalability as a benefit, and 2.4% of users disagreed with scalability as a benefit.

The findings indicated that there was a significant difference in the perceptions of scalability as a benefit between users and non-users (Z (N=42) =-3.106, p<0.0005). Users (M=4.33, SD=0.844) believed that scalability was a great benefit in cloud computing than do non-users (M=3.50, SD=0.522).

The research finding supports the results of a study conducted by Bamiah & Brohi (2011:287), who indicated that scalability in cloud computing was a benefit since this characteristic provided flexible on-demand business. This cloud computing benefit is of particular relevance to SMEs as their demand for more IT resources can be accommodated in accordance with projected business growth.

4.3.4 Saving time and cost as a benefit in cloud computing

The findings indicate that 54.8% of users strongly agreed that saving time and cost was a benefit, 33.3% of users agreed with saving time and cost as a benefit, 2.4% of users neither

agreed nor disagreed with saving time and cost as a benefit, 7.1% of users disagreed with saving time and cost as a benefit, and 2.4 % of users strongly disagreed with saving time and cost as a benefit. The findings indicated that there was a significant difference in the perceptions of saving time and cost as a benefit between users and non-users (Z (N=42) =-3.972, p<0.0005). Users (M=4.67, SD=0.661) believed that saving time and cost was a great benefit in cloud computing than do non-users (M=3.42, SD=1.165).

This research finding supports the argument presented by Avram (2014:533) that the reduction of the constraints for entering the IT market could eventually promote business creation and help SMEs to be part of the global market. A study conducted by Erol et al. (2012:1517) reported that smaller organisations were now able to penetrate markets that were previously reserved for large organisations.

4.3.5 Sustainability as a benefit in cloud computing

The findings on sustainability indicate that 47.6% of respondents strongly agreed that sustainability was a benefit, 31.0% of respondents agreed with sustainability as a benefit, 16.7% of respondents neither agreed nor disagreed with sustainability as a benefit, and 4.8% of respondents disagreed with sustainability as a benefit.

The findings indicated that there was a significant difference in the perceptions of sustainability as a benefit between users and non-users (Z (N=42) =-2.630, p<0.0005). Users (M=4.43, SD=0.817) believed that sustainability was a great benefit in cloud computing than do non-users (M=3.67, SD=0.888).

This finding supports the argument of Cilleruello et al. (2012:642) that cloud computing technologies offer immense capabilities to sustain the IT side of a business. Etro (2009:187) reported that cloud computing allows SMEs to sustain business operations especially during the inception phase.

4.3.6 Customisation as a benefit in cloud computing

The findings on customisation indicate that 35.7% of respondents strongly agreed that customisation was a benefit, 40.5% of respondents agreed that customisation was a benefit,

19.0% of respondents neither agreed nor disagreed that customisation was a benefit, and 4.8% of respondents disagreed that customisation was a benefit.

The findings indicate that there was a significant difference in the perceptions of customisation as a benefit between users and non-users (Z (N=42) =-3.262, p<0.0005). Users (M=4.33, SD=0.802) believed that customisation was a great benefit in cloud computing than do non-users (M=3.42, SD=0.669).

This finding supported studies conducted by Carroll *et al*. (2011:7), Youssef (2012:839-840) and Cilleruello *et al.* (2012:643) who cited customisation as both a benefit and an important characteristic in cloud computing. Dubey & Wagle (2007:5) argue that small enterprises are in a better position to maximise the use of technology because of the higher level of customisation and flexibility offered by cloud computing.

4.3.7 Virtualisation as a benefit in cloud computing

The findings about customisation indicate that 40.5% of respondents strongly agreed that virtualisation was a benefit, 33.3% of respondents agreed that virtualisation was a benefit, 23.8% of respondents neither agreed nor disagreed that virtualisation was a benefit, and 2.4% of respondents disagreed that virtualisation was a benefit.

The findings indicated that there was a significant difference in the perceptions of virtualisation as a benefit between users and non-users (Z (N=42) =-2.903, p<0.0005). Users (M=4.37, SD=0.765) believed that virtualisation was a great benefit in cloud computing than do non-users (M=3.50, SD=0.798).

This finding concurred with the results of studies conducted by Carlin & Curran (2012:60) and Nivedita & Sravani (2013:33) who reported extensively on virtualisation as a benefit in cloud computing. Carlin & Curran (2012:60) defined virtualisation as a high provision of IT resources and capabilities to be utilised as on-demand basis, which has relevance to SMEs as they have the flexibility to utilise IT resources for specific operations and release IT resources that were no longer required.

4.3.8 Other technological benefits

[agility, higher performance, higher reliability and availability, better IT resource management, improved security, flexibility, rapid development, great mobility, improved automation, and green IT data centres.]

The research findings indicated that respondents did not consider the following variables as benefits, namely, agility, higher performance, higher reliability and availability, better IT resource management, improved security, flexibility, rapid development, great mobility, improved automation, and green IT data centers. Table 1 summarises the findings of the above-mentioned variables not perceived as benefits in cloud computing, as well as their significance values between the users and non-users.

TABLE 1: Summary of variables not perceived as benefits by respondents

Perceived benefits	Significance of values	Users considerable median and standard deviation values	Non-users' considerable median and standard deviation values
Agility	(Z (N=42) =-1.310, p>0.0005)	(M=4.03, SD=1.066)	(M=4.08, SD=0.754).
Higher performance	(Z(N=42=-251,p>0.0005)	(M=4.10, SD=4.10, SD=0.960)	(M=4.08, SD=0.793)
Higher reliability and availability	(Z(N=42=-1.791, p>0.0005)	(M=4.17, SD=0.950)	(M=3.67, SD=0.888)
Better IT resource management	(Z(N=42=-.976, p>0.0005)	(M=3.93, SD=1.112)	(M=4.33, SD=0.778)
Improved security	(Z(N=42=-1.809, p>0.0005)	(M=4.27, SD=1.048)	(M=3.58, SD=1.311)
Flexibility	(Z(N=42=-1.656, p>0.0005)	(M=4.07, SD=0.907)	(M=3.50, SD=1.087)
Rapid development	(Z(N=42=-1.429, p>0.0005)	(M=3.73, SD=0.980)	(M=3.33, SD=0.888)
Great mobility	(Z(N=42=-.057, p>0.0005)	(M=3.30, SD=1.241)	(M=3.33, SD=0.985)
Improved automation	(Z(N=42=-.647, p>0.0005)	(M=3.67, SD=1.241)	(M=3.42, SD=1.084)
Green IT data centers	(Z(N=42=-1.934, p>0.0005)	(M=4.23, SD=1.104)	(M=3.50, SD=1.243)

Source: Author's own construction

These research findings refuted the results of studies conducted by Avram (2014:531), Carroll *et al*. (2011:6-7) and Youssef (2012:840-841) who indicated that these variables were important benefits in cloud computing. Awa *et al.* (2012:13) and Lamoureux and Matuszak (2013:18) suggested reasons why respondents might have not perceived these variables as important benefits in cloud computing. They explained that aspects related to awareness, technology know-how, technological needs, as well as competency might be contributing factors for not being able to identify these variables as benefits.

4.4 Perceived limitations and concerns in cloud computing

This section assesses the perceptions of users on the limitations and challenges in cloud computing. The Wilcoxon signed ranks test was applied for each of the limitation and concerns to test for significant agreement or disagreement.

4.4.1 Data privacy and security

The findings indicate that 66.7% of users strongly agreed with data privacy and security as a limitation and concern in cloud computing, 10.0% of users agreed with data privacy and security as a limitation and concern, 13.3 % of users neither agreed nor disagreed with data privacy and security as a limitation and concern, 6.7% of users disagreed with data privacy and security, and 3.3% of users strongly disagreed with data privacy and concern as a limitation and concern in cloud computing.

The research findings indicated that there was a significant level of agreement with data privacy and security as a limitation and concern in cloud computing (Z (N=42=-4.170, $p<0.0005$). Users considered data privacy and security as an important limitation and concern in cloud computing (M=4.30, SD=1.149).

This finding supports the argument by Chandravathy *et al.* (2013:213-214), that given the data was shared across various organisations, the issue of data protection and unauthorized access posed serious concerns and limitations in cloud computing. This concern is shared equally by both large and small organisations and has ramifications for their businesses.

4.4.2 Availability

The research findings indicate that 53.3% of users strongly agreed with availability as a limitation and concern in cloud computing, 26.7% of users agreed with availability as a limitation and concern, 16.7 % of users neither agreed nor disagreed with availability as a limitation and concern, and 3.3% of users strongly disagreed with availability as a limitation and concern in cloud computing. The findings indicated that there was a significant level of agreement with availability as a limitation and concern in cloud computing (Z ($N=42$=-4.085, $p<0.0005$). Users considered availability as an important limitation and concern in cloud computing ($M=4.27$, $SD=0.980$).

This finding supports the claims of Carroll et al. (2011:5), Goyal & Supriya (2013:232) and Nivedita & Sravani (2012:33), that the challenge presented by cloud computing was when data becomes unavailable for a period of time. The availability of data is an issue that affects all organisations irrespective of size. The fact that data needs to be readily available when needed affects SMEs as it ensures continuity of business operations

4.4.3 Trust and transparency

The findings indicate that 33.3% of users strongly agreed with trust and transparency as a limitation and concern in cloud computing, 36.7% of users agreed with trust and transparency as a limitation and concern, 26.7 % of users neither agreed nor disagreed with trust and transparency as a limitation and concern, and 3.3% of users strongly disagreed with trust and transparency as a limitation and concern in cloud computing.

The findings indicated that there was a significant level of agreement with trust and transparency as a limitation and concern in cloud computing (Z ($N=42$=-3.663, $p<0.0005$). Users considered trust and transparency as an important limitation and concern in cloud computing ($M=3.97$, $SD=0.964$).

The research finding supports the findings of Alsudiari et al. (2012:167) who reported that the adoption and usage of cloud services made trust and transparency issues very complex. SMEs have the same expectations as large organisations that the reputation of service

providers are credible and they are capable of providing cloud computing services in a transparent manner.

4.4.4 Shared technology issues

The research findings indicate that 30.0% of users strongly agreed with shared technology in cloud computing as a limitation and concern in cloud computing, 30.0% of users agreed with shared technology in cloud computing as a limitation and concern, 23.3 % of users neither agreed nor disagreed with shared technology in cloud computing as a limitation and concern, and 16.7% of users strongly disagreed with shared technology as a limitation and concern in cloud computing.

The findings indicated that there was a significant level of agreement with shared technology in cloud computing as a limitation and concern in cloud computing (Z (N=42=-3.164, p<0.0005). Users considered shared technology in cloud computing as an important limitation and concern in cloud computing (M=3.73, SD=1.081).

The research finding supports the study of Nivedita & Sravani (2013:33) who reported that the sharing of IT resources in the cloud had put a lot of pressure on consumers since there was a need for more planning on behalf of the consumers to ensure that relevant policies were in place. This concern affects both large organisations and SMEs alike as they have to put together a plan that takes cognisance of relevant policies, standards and legislation, as well as encryption mechanisms to ensure the protection of their resources.

4.4.5 Disaster recovery

The findings indicate that 23.3% of users strongly agreed with disaster recovery as a limitation and concern in cloud computing; 36.7% of users agreed with disaster recovery as a limitation and concern, 33.3 % of users neither agreed nor disagreed with disaster recovery as a limitation and concern, 3.3% of users disagreed with disaster recovery, and 3.3% of users strongly disagreed with disaster recovery as a limitation and concern in cloud computing.

The findings indicated that there is a significant level of agreement with disaster recovery in cloud computing as a limitation and concern in cloud computing (Z (N=42=-3.165, p<0.0005).

Users considered shared technology in cloud computing as an important limitation and concern in cloud computing (M=3.73, SD=0.980).

These research findings support the findings of Buyya et al. (2011:7) who reported that organisations face challenges when it comes to executing disaster recovery in the event of any security threats. Chou (2015:165) reported that organisations need to be aware of the time frame it takes to recover from outage, disaster or power failure in the cloud, and specification requirements about data or service restoration should be clearly stipulated in the service level agreements. Disaster recovery has relevance for SMEs as well as large organisations as it has implications for continuity of business operations in the event of a disaster.

4.4.6 Service level agreement

The findings indicate that 30.0% of users strongly agreed with service level agreement as a limitation and concern in cloud computing, 40.0% of users agreed with service level agreement as a limitation and concern, 23.3 % of users neither agreed nor disagreed with service level agreement as a limitation and concern, and 6.7% of users strongly disagreed with service level agreement as a limitation and concern in cloud computing.

The findings indicated that there is a significant level of agreement with service level agreement as a limitation and concern in cloud computing (Z (N=42=-3.872, p<0.0005). Users considered service level agreement as an important limitation and concern in cloud computing (M=3.93, SD=0.907).

The finding on service level agreements supports the claim by Alsudiari et al. (2012:167) who reported that contracts in the cloud were usually open to various interpretations by both the consumers and users, which had always led to a no true implementation of a service level agreement. This claim is particularly true for SMEs who may not have the legal expertise to vet agreements.

4.4.7 Regulatory and legal issues

The findings indicate that 33.3% of users strongly agreed with regulatory and legal issues as a limitation and concern in cloud computing, 46.7% of users agreed with regulatory and legal issues as a limitation and concern, 10.0% of users neither agreed nor disagreed with regulatory and legal issues as a limitation and concern, and 10.0% of users strongly disagreed with regulatory and legal issues as a limitation and concern in cloud computing.

The findings indicated that there was a significant level of agreement with regulatory and legal issues as a limitation and concern in cloud computing (Z ($N=42=-4.038$, $p<0.0005$). Users considered regulatory and legal issues as an important limitation and concern in cloud computing ($M=4.03$, $SD=0.928$).

This finding is in agreement with Walden (2012:4) who argues that regulatory and legal issues posed a challenge to users when it comes to the way data was controlled, managed and protected around the globe. This is pertinent to SMEs who may lack the knowledge and understanding of legal and regulatory issues, and do not have access to legal counsel as is the case with large organisations.

4.4.8 Challenges of security schemes

The findings indicate that 60.0% of users strongly agreed with challenges of security schemes as a limitation and concern in cloud computing, 36.7% of users agreed with challenges of security schemes as a limitation and concern, and 3.3 % of users neither agreed nor disagreed with challenges of security schemes as a limitation and concern.

The findings indicated that there was a significant level of agreement with challenges of security schemes as a limitation and concern in cloud computing (Z ($N=42=-4.875$, $p<0.0005$). Users considered challenges of security schemes as an important limitation and concern in cloud computing ($M=4.57$, $SD=0.568$).

This finding supports the outcome of the study conducted by Chang, Kuo & Ramachandran (2016:26), who reported that security schemes have become a great concern in cloud computing. They explained that while security has been tailored to suit consumers based on specific requirements, the security mechanisms still forced consumers to exercise a high level

of caution in order to reinforce security controls. These concerns affect SMEs as well as all organisations have a responsibility to maintain the integrity of transactions.

4.4.9 Virtualisation paradigm

The findings indicate that 56.7% of users strongly agreed with virtualisation paradigm as a limitation and concern in cloud computing, 30.0% of users agreed with virtualisation paradigm as a limitation and concern, and 13.3 % of users neither agreed nor disagreed with virtualisation paradigm as a limitation and concern.

The findings indicated that there was a significant level of agreement with virtualisation paradigm as a limitation and concern in cloud computing (Z ($N=42$=-4.636, $p<0.0005$). Users considered virtualisation paradigm as an important limitation and concern in cloud computing ($M=4.43$, $SD=0.728$).

Carlin & Curran (2012:61) claimed that organisations that used cloud computing, have established virtualisation paradigm as a limitation and concern. These authors argued that the main challenge remains on how data should be controlled and protected during the virtualisation process (Carlin & Curran 2012:62). The challenge to control and protect data is a concern for both SMEs and large organisations.

4.4.10 Policy integration and governance

The findings indicate that 63.3% of users strongly agreed with policy integration and governance as a limitation and concern in cloud computing, 26.7% of users agreed with policy integration and governance as a limitation and concern in cloud computing, 6.7% of users neither agreed nor disagreed with policy integration and governance as a limitation and concern, and 3.3% of users disagreed that policy integration and governance as a limitation and concern in cloud computing.

The findings indicated that there was a significant level of agreement with policy integration and governance as a limitation and concern in cloud computing (Z ($N=42$=-4.705, $p<0.0005$). Users considered policy integration and governance as an important limitation and concern in cloud computing ($M=4.50$, $SD=0.777$).

Buyya et al. (2012:7) reported that there were challenges from the consumers' perspectives in understanding and interpreting policies in a language that could be understood and interpreted by everyone. They reported that policy and integration had become a stumbling block for many users in the adoption and usage of cloud computing. This is of particular concern to SMEs who do not have ready access to legal counsel who can advise them on relevant policies.

5. DISCUSSION

The research findings indicated that 71.4% of respondents used cloud computing and 28.6% of respondents did not use cloud computing. An interesting result was that 75% of non-users were planning to use cloud computing as compared to 25% of non-users, who had no such plans. With regard to the extent of usage of cloud computing services, it was found that SaaS, IaaS, PaaS, as well as XaaS services were currently used by IT SMEs in Gauteng.

The research findings and analyses have also provided an understanding of IT SMEs perceptions on the benefits and challenges arising from the adoption and usage of cloud computing technology.

Figure 5 depicts the factors perceived as important technological benefits and challenges in cloud computing adoption.

The important factors perceived as benefits by users of cloud computing are cost-efficiency, lower-implementation, scalability, saving time and cost, sustainability, customisation, as well as virtualisation. The factors perceived as important concerns and limitations by users of cloud computing are data privacy and security issues, availability, trust and transparency, shared technology issues, disaster recovery, service level agreement, regulatory and legal issues, challenges of security schemes, virtualisation, as well as policy integration and governance.

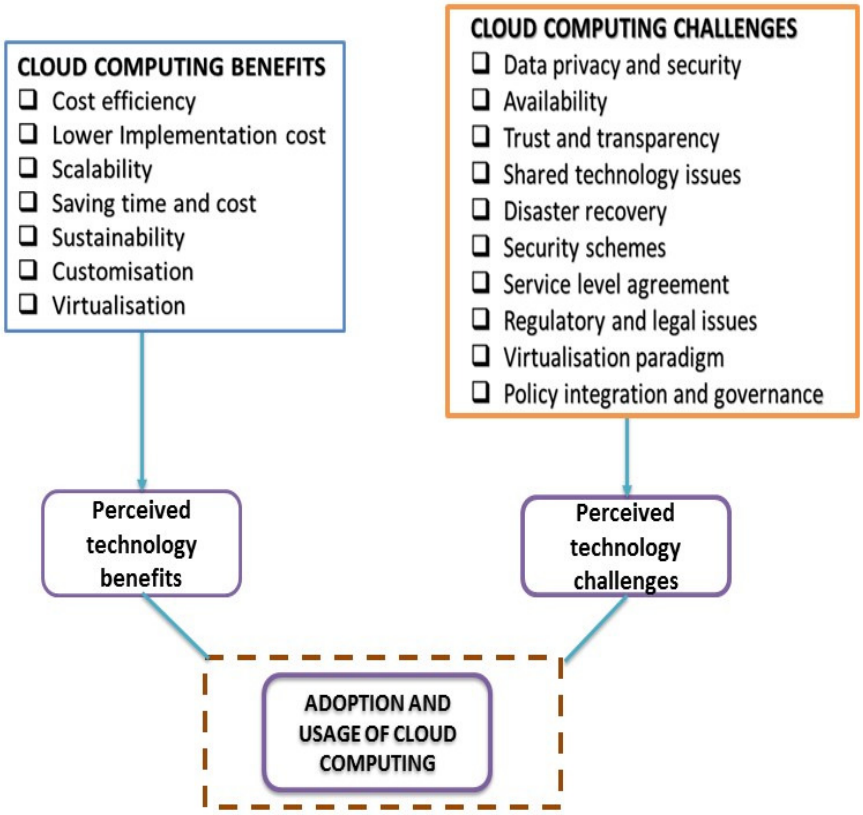

FIGURE 5: Technological benefits and challenges in cloud computing adoption

Source: Author's own construction

6. CONCLUSION

The presence of cloud computing as a model has shown real potential for innovation, business expansion and other great benefits from its inception. The study contributes to the body of knowledge by identifying the current status of cloud computing adoption, as well as usage of SaaS, PaaS, IaaS, and XaaS services by IT SMEs in Gauteng. The study makes a practical contribution by improving awareness and knowledge among non-adoptees of the potential benefits to be accrued from cloud computing adoption. The results add to the body of

knowledge by confirming/refuting perceptions of IT SMEs on theorised technological benefits and challenges of cloud computing.

This study also provides insight to providers of cloud computing technology on consumers' perceptions of technological challenges and limitations that impact on the business, for which measures or interventions need to be initiated.

Given the high percentage of IT SMEs that have adopted or planning to adopt cloud computing, more SMEs are likely to implement cloud-based services to support their business operations in the future. The study's findings add value by creating a point of reference for non-users of cloud computing. From a theoretical perspective, this study contributes by understanding the role of technological benefits and challenges in the adoption and usage of cloud computing services among SMEs in the IT sector.

One of the limitations of the study was that the target population comprised only IT SMEs located within the areas of Sandton, Midrand, Centurion, and Pretoria. The decision to select the population of IT SMEs from these areas was motivated by the fact that these areas were at the heart of the IT SME sector. Another limitation was that the study did not investigate the causal effect of perceived technological benefits and challenges on adoption rates.

The research findings are beneficial to company decision makers, IT professionals, as well as researchers. The study's findings can assist SME decision-makers to take full responsibility to engage their organisations on new technologies, their benefits, as well as their limitations for a successful implementation. IT professionals could use the research findings to address the perceived challenges and limitations involved in the implementation and deployment process.

Researchers can extend the findings by carrying out similar studies using SMEs in diverse sectors and in different provinces of South Africa. In addition, other factors should be considered such as awareness, technology know-how, technological needs, and competency and assess whether these factors contribute to the adoption and usage of cloud computing technology.

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