The Awareness of Cloud Computing: A Case Study of South African SMEs

Mpho Mohlameane and Nkqubela Ruxwana

Abstract—South African SMEs are faced with several challenges which negatively affect their growth and sustainability, such as marketing factors, financial issues, management skills and lack of investment in Information and Communication technology (ICT). The evolution of ICT solutions such as cloud computing, have the potential to counter some of the challenges that SMEs are facing. However, most technologies are not adopted due to lacking knowledge and perceptions on their potentials and value. Therefore this paper investigates the awareness of cloud computing within SMEs in South Africa. In addition, the paper identifies SMEs perceptions on cloud computing as an alternative ICT solution. The study adopted qualitative research approach, where case study research designs was used consisting of three SMEs organisation. The data was collected through interviews, expert reviews, literature and questionnaires, where a total of 19 participants were used. The findings reveals a lacking levels of cloud computing awareness, thus limited knowledge on cloud computing benefits and services. This paper concludes that the lacking awareness and understanding of cloud computing is the main cause of slow cloud computing adoption amongst SMEs in South Africa. The paper concludes by recommending methods which can be used to increase SMEs awareness of cloud computing.

Index Terms—Awareness, cloud Computing, ICT, SMEs.

I. INTRODUCTION

The evolution of Information and Communication Technologies (ICTs) has influenced the way in which organisations conduct their business. For instance, the evolution of ICTs has enabled businesses to automate their office and business operations through the use of ICT tools such as email, office suite products (i.e., Microsoft Word, Excel, etc.), and internet and network infrastructure. The use of internet has enabled businesses to enter new markets (local and international) through the use of websites, electronic marketing and electronic commerce. ICTs are perceived to be a value adding tool that can help improve SMEs competitiveness [1], [2]. However, there are several factors that inhibit SMEs to adopt and use ICTs to help support competitiveness and business sustainability.

This paper starts by defining SMEs within the study context. The notion of cloud computing is discussed, focusing on cloud computing definition and brief discussion

of cloud deployment models and services. The methodology section discusses the approach used to collect and analyse data. The results section present and discusses benefits, challenges awareness of cloud computing within SMEs sector in South Africa. The paper concludes by recommending alternative ways through which cloud computing awareness can be improved.

II. SMEs DEFINITION

SME definition is described in many ways and most authors define it by making use of number of employees employed within the enterprise [3]. On the contrary, the National Small Business Act defines SMEs by making use of three parameters, namely: number of employees, annual turnover and gross assets (excluding fixed assets) [4]. The National Small Business Act defines small enterprise with the number of employees amounting to fewer than 50 and medium enterprises with the number of employee amounting to fewer than 100 to 200 [4]. Therefore the National Small Business Act definition of SMEs was adopted in this study.

For the purpose of this study, the abbreviation SME was employed as the study focused on small and medium- sized enterprises, which are registered with the South African Receiver of Revenue (SARS) and have the potential to adopt ICT services to help them improve their competitiveness in the South African Economy. Therefore the study excluded very small and micro enterprises, which have fewer than 10 employees and do not have any potential of adopting ICT services.

III. THE NOTION OF CLOUD COMPUTING

A. Definition of Cloud Computing

Different authors, organisations and technologist have tried to define cloud computing in various ways. In a nutshell, cloud computing is a new computing model whereby computing services such as data storage, software applications, and so forth, are accessed over the Internet. The National Institute of Standard and Technology (NIST) provided us with the formal definition of cloud computing, and that is:

"Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service-provider interaction" [5].

B. Cloud Computing Deployment Models

Cloud deployment models are classified into four types: public, private, hybrid and community. These four cloud deployment models are discussed below.

- **Public cloud:** Public cloud consists of resources that are shared among cloud subscribers and the shared resources are accessible over the Internet [6]. Public cloud services are largely provided to the public by cloud service-providers [7]. Examples of public cloud are Google Apps, Amazon Web Services (AWS), Salesforce, etc.
- **Private cloud:** Enterprises can have their internal cloud and manage it themselves or get a third party to manage it [6]. Private clouds are largely designed and deployed within the enterprise to be used by internal users only [8].
- **Hybrid cloud:** Hybrid cloud consists of elements of public and private cloud [9]-[11]. NIST define hybrid cloud as "a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds)" [5].
- **Community cloud:** Community resources such as hardware and network resources are shared among community members [12]. Community cloud is formed by organisations and institutions that typical shares the same set of values, such as shared mission and goals, security requirements, policies and compliance [6], [7], [10].

C. Cloud Computing Service Models

Cloud services models can be classified into three types: Platform as a Service (PaaS), Infrastructure as a Service (IaaS), and Software as a Service (SaaS) [13]. These three cloud service models are discussed below

- **Platform as a Service**: PaaS cloud delivery model provides infrastructure and platform in the cloud for application developers to build deploy and run applications on the Internet and users are billed per-use [14]. Examples of PaaS include Microsoft Windows Azure and Google App Engine.
- **Infrastructure as a Service**: IaaS is the delivery of hardware infrastructure (i.e., servers, storage, and so forth.) as a service, accessible over the internet and hosted by the cloud provider [15]. The components of IaaS include Service Level Agreement (SLA), Utility Computing, Utility Computing, Cloud Software, Platform Virtualisation, Networks and Connectivity and Computer Hardware [16]. Examples of IaaS offerings include (EC2) and Secure Storage Service (S3).
- **Software as a Service:** SaaS is the delivery of software such as ERP, CRM, E-mail and Collaboration Software, among others, over the Internet as a service [6], [17]. Examples of SaaS offerings include Microsoft Office 365, Google Apps, Hosted Exchange Server, etc. which are offered on a subscription-based pricing model [18], thus paying for only what you use.

IV. RESEARCH METHODOLOGY

A. Research Philosophy

This study followed phenomenological philosophical approach in order to gain an in depth understanding of the complexity of phenomena investigated in this study in a natural setting and real-life context. Phenomenology is concerned with the study of individual experience regarding particular phenomena [19].

B. Research Approach

Research can either be quantitative or qualitative [20]. For the purpose of this study qualitative research was adopted and served to help the researcher understand the phenomena under study in a natural setting. Qualitative research is concerned with understanding the phenomena under study in a natural setting, that is, "real world setting [where] the researcher does not attempt to manipulate the phenomenon of interest" [21].

In this study, a multiple-case study design was employed. In a multiple-case design, multiple cases are explored in order to identify the differences between cases and replicate findings across cases [22]. Three different SMEs around Gauteng were part of the unit of analysis. The three enterprises are from different industries- insurance, financial and engineering. Because the operation of companies and their adoption levels for innovations differ per industry, it was necessary to choose companies from different business industries in South Africa in order to obtain rich qualitative data regarding their understanding and experience of the phenomena under study.

C. Sampling and Research Participants

A sample is a representative part of the targeted population that is methodologically selected to participate in a study [23]. Purposive sampling was applied when sampling the case studies and various participants. According to Babbie [24], purposive sampling involves the selection of the units to be observed on the basis of your own judgment about which ones will be the most useful or representative.

Therefore the three SMEs were purposefully selected as units of analysis and there were five (5) participants per SME business, thus total number of participants from all SMEs was fifteen (15). The primary data was sourced through questionnaires and interviews. To improve findings validity, and in addition to the literature reviews, experts in the field were asked to participate. In addition to the number of participants, three (4) experts were selected based on availability, access, and their current role as identified by the researcher in the adoption of cloud computing within the SME segment in South Africa. The total number of participants in this study was nineteen (19).

D. Data Collection Methods

McNiff [25] states that there are various sources of data, however, the data collection method should be appropriate for a specific research study. Oates [26] explains that the use of multiple data collection methods enable the researcher to look at the phenomena from different perspectives. The use of multiple data collection methods increases the credibility of data [21], [22]. In order to increase the credibility and

reliability of data, the researcher used multiple data collection methods – namely: interviews, expert reviews, questionnaires and literature findings.

E. Data Analysis Methods

Data analysis is referred to as a process of bringing order, structure and meaning to the evidence collected [27]. The process of data analysis was based on data reduction and interpretation. Creswell [28] asserts that data analysis in qualitative research involves data preparation, coding and interpreting data. In addition, the study analysis followed three phases where triangulation was adopted to answer the study objectives. Within these phases the case study analysis templates, namely within-case, cross-case and holistic-case, as recommended by Creswell [28] were adopted.

V. FINDINGS AND DISCUSSIONS

A. Awareness of Cloud Computing in South Africa

In order to elicit the participants' awareness and understanding of cloud computing; their respective experiences and use of cloud computing services, several questions were asked. Questionnaires, literature reviews, interviews and expert reviews were used to determine the level of awareness and understanding of cloud computing with SMEs in South Africa. Expert review data was considered primary as participants interviewed interact a lot with SMEs regarding business advice, cloud sales and general cloud research.

The participants were asked to rate their level of understanding of cloud computing. Fig. 1 shows that 40% of respondents have a very low knowledge of cloud computing, 13% have averagely low knowledge, 27% have a basic knowledge while 7% have a high knowledge and 13% have very high knowledge. Fig. 1 below depicts above findings.
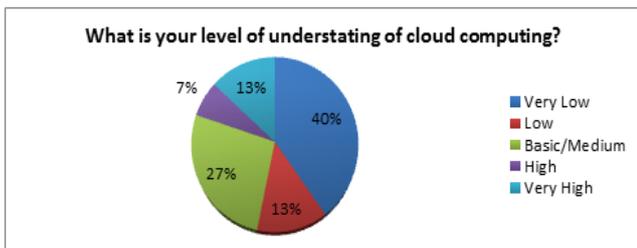
Fig. 1. Knowledge of cloud computing.

Findings in Fig. 1 reveal that there is a low and basic understanding of cloud computing among SMEs. This means that the concept and understanding of cloud computing has not yet filtered through in SMEs as less than 40% of the participants were confident about their understanding of cloud computing.

The findings from interviews revealed that SMEs have very limited knowledge of cloud computing and some are confused by cloud computing terminology: *"My knowledge is very limited and cloud computing terminology seems to be confusing to me"*. This finding is in concurrence with study findings by Goldstuck [29] whereby it was revealed that most SMEs lack understanding of cloud computing concept due to the terminology. This in turn limits SMEs to better understand the benefits of cloud computing for their businesses.

However, a few number of respondents mentioned that they know about cloud computing and have used it before: *"I know about cloud computing and I have used cloud application such as Google Apps and Skype"*. Therefore interview findings are in concurrence with questionnaire findings whereby it was revealed that most participants have low levels of cloud computing knowledge. The low levels of cloud computing knowledge can be attributed as one of the inhibitors of cloud computing adoption within SMEs sector in South Africa. This is because it might be difficult for SMEs to adopt an innovation if they do not know what an innovation is all about and how it works. This finding raises a need for cloud computing education specifically within SMEs as they stand to benefit most.

There was a consensus from expert reviews that cloud computing concept is still at its infant stage within the SMEs sector as most of SMEs do not know about cloud computing. Some experts who interact with SMEs gave the following comment: *"Most SMEs that I know have not yet implemented cloud computing and I think they do not even know about it. Cloud computing is still a new phenomenon and I think that as time goes on, SMEs will definitely start adopting it"*.

In concurrence to study findings, Walter [30] argues that most SMEs already use cloud computing services without being aware.

Therefore it is evident from study findings that the state of affairs regarding the adoption of cloud computing is very low amongst South African SMEs. This is resultant to the lacking awareness and exposure to cloud computing services, and the trails for SME's to establish and localise the benefits and fit of cloud computing various forms for SME's. There seemed to be concurrence between interviews, expert reviews and questionnaire findings that the level of cloud computing understating by some SMEs is very low. In addition, expert reviews revealed that most SMEs struggle with cloud computing concepts and terminology, therefore making it challenging for them to understand the benefits that cloud computing can bring to their business.

B. Perceived benefits of Cloud Computing

Participants were asked to identify their perceived benefits of cloud computing. The findings in Fig. 1 reveal that 24% of respondents consider quick and easy implementation as a key benefit, followed by cost savings (16%), guaranteed uptime (16%) and competitive advantage (16%). Fig. 2 shows the findings regarding this research sub-question.
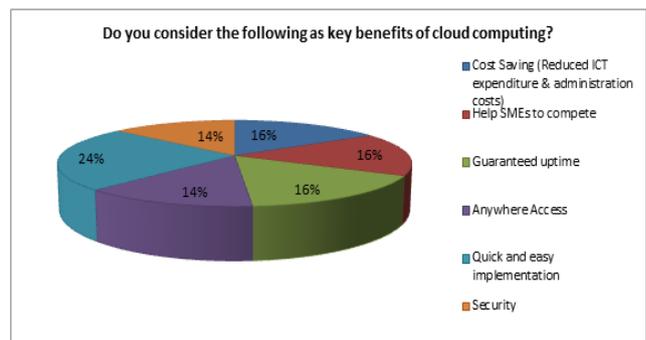
Fig. 2. Perceived benefits of cloud computing.

One of the key benefit of cloud computing is that is saves on capital expenditure [31]. Cloud computing enables organisations to move from capital expenditure (CAPEX) to operational expenditure (OPEX), therefore giving them the flexibility to manage their operational cost. By moving to the cloud, SMEs can reduce administration costs such as ICT services maintenance and upgrades and as well server administration costs. SMEs can save on labour costs by not employing and paying IT professional as there will be no need for such skills because the cloud provider does administration processes on behalf of the customer. By moving ICT infrastructure and software applications to the cloud, SMEs can utilise resources in a more efficient and effective manner, thus giving them business focus [6].

Scalability provides subscribing cloud users with the ability to pay for cloud resources [32] when needed and the ability to scale up or scale down resources as per demand. This is made possible by having a large pool of virtualised servers in the cloud. Moreover, Investment in ICTs has the potential of improving organisations competitive advantage and cloud computing can improve SMEs' competitive advantage [33]. Furthermore, One of the key advantage of cloud computing is accessibility [17]. Cloud computing consist of cloud services which are accessible via the Internet. Such models give SMEs mobility to access cloud services from any location [34].

Interview findings revealed that most SMEs perceive cloud computing as a cost-effective solution that can be easily implemented and accessed anywhere, as some participant made this comment when asked about the benefit of cloud computing: *"I would say cost reduction, availability and accessibility as well as shifted risk. Cloud computing has proven to be cheaper than traditional ICT and the good advantage about cloud is that the services are accessible anywhere as long as there is internet connectivity. Risk is shifted from internal to cloud provider because there is expertise available to manage such risks better than internal ICT staff"*. Therefore cloud computing is perceived to be cost effective as there is no additional costs such as software licenses, hardware, ICT infrastructure support and maintenance.

Expert review findings identified cost saving, anywhere access and quick and easy implementation as some of the benefits of cloud computing: *"The common benefits are cost savings, agility and anywhere access. Cost savings is evident because when a company moves to the cloud, it saves on electricity, server cost, licensing cost and salaries to pay staff that support in-house ICT services"*. These findings are in concurrence with the questionnaire and interview findings. Furthermore these findings indicate that there is a lot that SMEs can benefit by moving their ICT infrastructure to the cloud.

C. Perceived Challenges of Cloud Computing

Participants were asked to identify their perceived challenges of cloud computing and Fig. 3 below depict the findings:

The findings in Fig. 3 reveal that participants are least concerned with issues of security, the cost of cloud, compatibility, usability, reliability and relative advantage.

However the findings show that participants are more worried about the performance and availability of cloud services as they are accessed over the internet. Issues of bandwidth cost, quality and connectivity speed can be big barriers to cloud adoption. Bandwidth cost and quality are some of the key barriers to cloud computing adoption in South Africa [35].
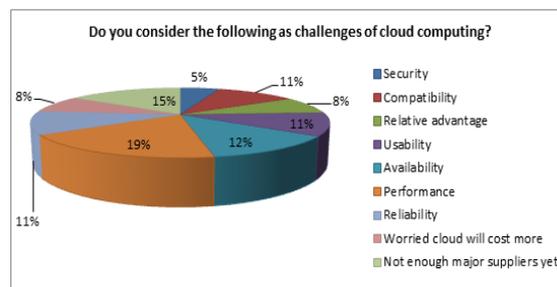
Fig. 3. Perceived challenges of cloud computing.

Cloud services availability was perceived as a challenge and cloud service unavailability can be due to what is called "cloud-provider outages". Kim *et al.* [36] states that cloud-provider outages can be temporary or permanent. A temporary outage is when cloud services are unavailable for a short period of time. However, a permanent outage occurs when a cloud provider is out of business. Provider outages can negatively affect clients' business operations.

One of the key barriers to cloud computing adoption is industry regulation and compliance [6]. There are some countries that prohibit companies to store data on data centers that are outside the country. Additionally, Kim *et al.* [36] argues that some laws and regulation in some countries were drafted without considering cloud computing.

The interview findings revealed that SMEs have several challenges with cloud computing, such as bandwidth cost, quality and data security: *"The risk of cloud computing that I can think of is information security. The question is how secure is cloud computing when it comes to information security and I think that is my major challenge"*. Bandwidth quality is very important as cloud computing services are accessed over the Internet. Cloud computing services require quality and reliable internet connectivity. The issue of data security on the cloud is a huge concern and this can be a barrier for cloud computing adoption unless the cloud computing provider assures SMEs that their data will be safe and secure.

Therefore interview findings are in concurrence with expert review findings whereby it was revealed that bandwidth cost and security is one of the key challenges of cloud computing: *"The cost and availability of bandwidth is a major challenge for cloud computing adoption within South African SMEs. Another challenge is the availability of local cloud providers. Currently there more international cloud providers compared to local suppliers"*.

According to a study conducted by IDC [35], most of South African companies perceive value in cloud computing, however issues of bandwidth quality and cost are one of the key barriers for adoption. Reed [37], like IDC [35], argues that the cost of bandwidth in South Africa is one of the barriers that contribute to the slow adoption of cloud

computing. Cloud computing is heavily dependent on the quality of bandwidth, as majority of cloud computing services are accessed over the internet. Therefore they require high internet connectivity speed and reliability.

Lastly, participants were concerned that currently there is no enough cloud providers in South Africa. Therefore this can inhibit the cloud adoption rate as SMEs are not aware of cloud providers in South Africa, such us Advance force, Vodacom, Microsoft SA, Exordia, Internet Solutions amongst the list.

VI. CONCLUSION

Findings from case studies revealed that most participants have limited knowledge and understanding of cloud computing concepts. Some did mention that they have used SaaS applications such as Google Apps. SMEs can benefit from cloud computing as it is perceived to be cost-effective solution that can be easily implemented and accessed anywhere. Cloud computing is perceived to be cost effective as there is no additional costs such as software licenses, hardware, ICT infrastructure support and maintenance. The ICT infrastructure hosting, support and maintenance are provided by the cloud provider. There is no need for upfront capital investment as ICT solutions are provided as a service on monthly or annual based subscriptions. Secondly, cloud computing services are accessed over the Internet providing SMEs with the flexibility of accessing cloud computing services anywhere and anytime.

However, there were challenges found with cloud computing, such as bandwidth cost and quality and data security. Participants were concerned about the cost and quality of bandwidth as they perceive it to be expensive. Bandwidth quality is very important as cloud computing services are accessed over the Internet. Cloud computing services require quality and reliable internet connectivity. The issue of data security on the cloud is a concern. SMEs that participated in the study fear for the security of sensitive data to security risks such as data loss and privacy. This can be a barrier for cloud computing adoption unless the cloud provider assures SMEs that their data will be safe and secure.

Although some participants in this study mentioned that they have used cloud computing applications such as Google Mail and online e-mail archiving, and showed greater interest on the solution, the lacking awareness of cloud computing (as revealed in this study findings) inhibits the SMEs the opportunity to experiment and explore cloud computing benefits.

Nonetheless, the SMEs seemed to be optimistic about cloud computing as they are more likely to first adopt SaaS (e-mail services) followed by IaaS. The preference of SaaS over IaaS and PaaS can be influenced by some of the participants' experience with SaaS applications such as Google mail, cloud redundancy application and e-mail storage application such as MIME Cast.

VII. RECOMMENDATIONS

The awareness of cloud computing can be improved through the use of communication channels such as mass media and interpersonal communication channel. Mass media includes newspapers, internet, television or radio. Interpersonal communication channel can consist of communication between two or more people. SMEs should make use of cloud service providers to present workshops/demonstration on cloud computing concepts and benefits. This will help address some of the challenges and concerns that SMEs have regarding cloud computing.

In addition, cloud computing service providers can play a critical role towards increasing the awareness of cloud computing, by developing cloud computing proof of concepts (POC) for SMEs as well as conducting cloud computing presentation to SMEs. These presentations can be beneficial to SMEs; firstly, they introduce the concepts of cloud computing, and secondly, they present cloud computing benefits, and thirdly, they provide demonstration on how to use cloud computing services. Furthermore, SMEs can increase their awareness of cloud computing through learning from other SMEs who have already implemented cloud computing services, their experiences, benefits and challenges with the adoption of cloud computing.

Cloud computing services can be put on trial as most providers such as Microsoft, Salesforce, Google, and so forth, offer limited trial periods for SMEs to experiment cloud computing services. Google offers a 30-day free trial version for their Google Apps for SaaS solutions. Salesforce offers a 30-day free trial period for their CRM SaaS solutions. Microsoft also offers a 30-days free trial version for Office 365 SaaS solutions. Therefore as part of increasing the awareness and knowledge of cloud computing, it is recommended that SMEs start to learn to make use of such cloud computing applications as they will also have an opportunity to understand the benefits that cloud computing can bring to their business.

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