

Barriers of Cloud Computing Adoption by Small and Medium Enterprises in Polokwane Municipality

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Abstract:- Small and Medium Enterprises (SMEs) are important to job creation and poverty reduction in South Africa. Although these businesses suffer from a high failure rate and the causes of failure include the non-availability of financial and information technology (IT) resources. Cloud computing is one of the ways to address the challenge faced by SMEs in adopting technological innovations. The study examines the adoption of cloud computing by SMEs in Polokwane Municipality. In addition, the study will determine the barriers to the adoption of cloud computing by these SMEs in Polokwane Municipality. The study used the quantitative approach with descriptive research design. Data was collected from two hundred and thirty SMEs based in Polokwane Municipality using self-administered survey questionnaire. The data analysis included descriptive and t-test statistics. The results reveal that SMEs are still engaged in traditional Information Technology Services as compared to innovative Information technology solutions. One of the major barriers to the adoption of cloud computing is lack of knowledge toward competitive IT solutions and security issues around cloud computing being another concern. The study recommends that SME should be proactive in adopting cloud computing to reduce operational costs. Department of Small business and its agencies in collaboration with cloud service providers, must offer awareness and seminars to SMEs on information technologies resource planning like cloud computing services.

Keywords: cloud computing, adoption, barriers, information technology, cost and benefits, SMEs, South Africa.

1. Introduction

Small and medium enterprises (SMEs) are broadly considered as the driving force in economic growth and job creation in both developed and developing countries [47]. In South Africa, SMEs contribute 56% of private sector employment and 36% of the gross domestic products [25]. Reference [1] asserts that government have acknowledged SMEs as a major player in reducing the unemployment rate of South Africa which is estimated at 27.1%. In utmost cases, SMEs do not attain their desire development and sustain their business. SMEs experience various challenges which include lack of financial and information technology resources. Information and Communication Technology (ICT), is the vital tool in business operations in the current sphere [15]. ICT is an acronym for information technology (IT). The usage of information technology offers companies the advantage to reach more customers, announce new products and services rapidly and cooperate with suppliers and business associates globally [7]. The development of this innovation, universally known as cloud computing, characterizes an essential revolutionary approach of information technology services that are invented, developed, deployed, scaled, updated, maintained and paid for [36]. Cloud computing comprises an innovative economic model for Information and Communication Technology - a model by far represents innovative methods of investment in and operation of IT resources [28]. It adds value to organisations by improving business efficiency and effectiveness. By adopting cloud computing, SMEs will be able to obtain the latest technology, without the need for upfront cost [40]. The study is guided by the following research questions.

2. Literature Review

A. Small and Medium Enterprises

There is no generally recognised definition of SMEs [4]. The definitions of SMEs are guided by various dynamics in relation to a state's social-economic background. Most definitions presently follow quantitative and qualitative descriptions [29]. In South Africa, SMEs are defined both qualitatively and quantitatively [45]. SMEs contribute to a national gross domestic product (GDP) through manufacturing goods of value, or the delivery of services to both consumers and enterprises. SMEs can contribute to economic growth and development, employment, poverty alleviation and income inequality [31] [1] [3] [2] [5]. SMEs play a vital role for economies by offering large number of opportunities for employment [43]. Small firms have the largest shares of job creation, and highest sales growth and employment growth, even after controlling for firm age [4]. The development of the SME sector will contribute to poverty reduction by creating jobs and improving people's living standards [18]. Regardless of the possible role of SMEs to enhanced growth and job creation in developing countries, various holdups impact their capability to realise their full development [39]. SME development is hampered by a number of factors, including finance, lack of managerial skills, equipment and technology, regulatory issues and access to international markets [1].

B. Information Technology and Cloud Computing

Information and communications technology (ICT) is another meaning for information technology [50]. ICTs have transformed businesses, markets and organisations, revolutionized learning and knowledge sharing, empowered citizens and communities, and created significant economic growth in many countries [21]. By adopting information technology, businesses can gain more power of attracting customers, announce their new products and services rapidly, and cooperate with suppliers and business partners worldwide [7]. The IT environment innovates from mainframes to client servers, the Internet, virtualization and cloud computing [10]. Cloud computing is a fairly new advancement in IT [48]. There is several definition of cloud computing by different authors. Cloud Computing is a generic term for anything that involves delivering hosted services and computing resources over the Internet, where users can access applications remotely as a product that is purchased [35] [20] [30]. According to Reference [25], cloud computing is capable of presenting an exceptional reduced operating cost to small and medium and enterprises (SMEs), whereby resources are kept at the greatest benefits. The use of IT is one of the ways to reduce the high failure rate of SMEs in South Africa. Cloud computing is a relatively inexpensive way of using IT. The adoption of cloud computing can help to improve the performance of SMEs in South Africa.

1. *Characteristics of cloud computing:* The cloud model consists of five essential characteristics namely: on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service [37].
 - a) **On-demand self-services:** to enable consumers to use Cloud provisions as and when required by business demands [35].
 - b) **Broad Network Access:** to provide and facilitate easy monitoring, controlling and reporting [35] [48] [30] [13].
 - c) **Resource pooling:** to allow dynamically assigned computing resources to serve multiple consumers through the use of virtualization technologies [35]. Cloud computing enables businesses, particularly SMEs and consumers to access resources from a resource pool on-demand; the latter benefiting from greater flexibility and the lower costs of managing computer resources [33].
 - d) **Rapid elasticity and scaling:** to allow Cloud services, resources and infrastructures to be automatically provisioned as business requirements change [35]. For consumers, computing resources become immediate rather than permanent: there is no up-front commitment and contract as they can use them to scale up whenever they want, and release them once they finish scaling down [13].
 - e) **Measured service:** to provide a metering capability to determine the on-demand usage for billing purposes [35]. Although computing resources are pooled and shared by multiple consumers, the cloud infrastructure is

able to use appropriate mechanisms to measure the usage of these resources for each individual consumer through its metering capabilities [13].

2. *Service Models of cloud computing*: Cloud computing services are delivered through three different models namely: Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS), and Infrastructure-as-a-Service (IaaS) [8].
 - a) **IaaS**: is a set of IT equipment's that are owned, managed, and maintained by a cloud provider and then used by a cloud customer in a pay-as-you go manner [43]. IaaS services include such as storage, networking, backup and recovery. Customers benefit by hiring computing equipment for these services.
 - b) **SaaS**: Instead of installing software on the client's machine and updating it with regular patches, frequent version upgrades etc., applications like word processing, Customer Relationship Management (CRM), Enterprise Resource Planning (ERP) are made available (hosted) over the internet for the consumption of the end-user [23]. SaaS provides software applications to users. Customers benefit by hiring easy to use functionality for these services.
 - c) **PaaS**: provides users with development platforms to develop and execute software [11]. These services benefit customers on time allocation and cost savings.
3. *Deployment Models*: Cloud computing can be deployed by using private, community, public or hybrid models. The deployment models used for the implementation of cloud computing will affect the level of direct control that organisations have over cloud computing services [48].
 - a) **Public cloud** is accessible from a cloud supplier through Internet and the cost for setting up the IT services is very reasonable for SMEs. For instance, Google Apps [23].
 - b) **Private cloud** is formed when IT resources are virtualized, so that they are available as a pool of resources that can automatically be provisioned on demand within a single organization. A private cloud belongs to only one organisation and is managed either by the user organisation or by a third party.
 - c) **Community cloud** shares infrastructure between several organisations from a specific community with common concerns (security, compliance, jurisdiction, etc.), whether managed internally or by a third-party and hosted internally or externally [20].
 - d) **Hybrid cloud** is a composition of two or more clouds (private, community or public) that remain unique entities but are bound together, offering the benefits of multiple deployment models [20].
4. *Cost and benefits of cloud computing*: The potential benefits of adopting cloud computing can be assessed from both the financial savings and resource management perspectives [33]. With cloud computing, the IT expenses generally associated with developing, procuring, administering and maintaining in-house IT infrastructure can be shifted to the cloud vendor [19]. Reference [10] further maintain that cloud computing offers convincing reduction in IT operations costs, which includes lesser execution and maintenance costs and minimal procurement of hardware and support. Reference [24] point out that; as cloud computing begins to take hold, several major benefits like; cost access, scalability and capacity, resource maximization, collaboration and customization have become evident. There are many benefits that a small business can realize from using the cloud computing services. These benefits include: Cost savings, improved flexibility, improved scalability and greener computing [48].
5. *Barriers of Cloud Computing Adoption by SMEs*: According to Reference [27] [41] [44], the barriers towards adoption of cloud computing by SMEs are both operational and technical issues. Those barriers include the following: Technological factors, Organisational factors and Environmental factors.
 - a) **Technology context** refers to the technological characteristics (employees IT or computer skills) available in the organisation for the adoption of technology [41].

- b) **Organisational context** found to be an influential aspect in the adoption of new [27]. Four relevant factors were identified to be investigated within this context, and they are firm size, top management support, innovativeness of the enterprise and information systems (IS) knowledge experience.
- c) The factors within the **environmental context** are the market scope and external computing support [27]. Reference [38] maintain that SMEs have very limited knowledge of cloud computing and this lack of knowledge contributes as an inhibiting factor towards cloud computing adoption. Reference [49] further assert that, factors influencing the adoption of cloud computing by SMEs in developing economies found the following barriers: lack of internal expertise and knowledge, poor internet access and connectivity, security and data privacy, lack of trust, integration with in-house and existing systems, loss of control, differences in international laws and regulations, delays in the transfer and migration of data and lack of confidence in the ability and promise of the cloud and associated standards. Security concerns present the greatest barrier to cloud adoption [9]. Security issues are at the top of the list of factors that negatively impact on cloud ERP adoption by SMEs, followed by unpredictable performance during deployment and the users' lack of control of their data [44].

3. Conceptual Framework: Technology Acceptance Model (TAM)

The acceptance towards the adoption of cloud computing is validated by using the Technology Acceptance Model (TAM) developed by [12]. TAM is an information systems theory that models how users come to accept and use a technology [12]. According to Reference [34], the TAM can be used as the theoretical background for the adoption of cloud computing by SMEs. The contribution of cloud computing as innovation can only be appreciated if the technology is extensively utilised and accepted [43]. Acceptance of any new technology depends on technical factors of IT [6]. The TAM was developed by Davis and often cited as the best established model of IT adoption and use [42]. Reference [32] further asserts that the technology acceptance model TAM, proposes that ease of use and usefulness predict applications usage. The TAM focuses on the attitude explanations of intention to use a specific technology or service; it has become a widely applied model for user acceptance and usage [34].

4. Research Methodology

The quantitative research method was used for the research. Quantitative research involves the systematic empirical investigation of a phenomenon through statistical or mathematical techniques. The descriptive and positivist research approaches were followed. Descriptive research describes the features of the phenomenon or population being studied. Positivist research ensures that the research is independent of the researcher and that it is purely objective. The survey method (self-administered questionnaire) was used for data collection. The survey area was Polokwane Municipality located in the Limpopo province of South Africa. The motivation for the survey area was the large number of small business owners. Because of the lack of a sampling frame of SMEs in Polokwane Municipality, purposive and snowball sampling methods was used to represent SMEs in Polokwane Municipality. Data was collected between October 2016 and February 2017. The participants were reminded through telephone calls and emails obtained during the distribution of questionnaires to complete the questionnaires. The study focused on SMEs in all sector industry in the Central Business District (CBD) of Polokwane Municipality. A pilot study (pre-testing) was conducted with ten SMEs in the study area on the questionnaires to validate and check questions; in order to verify that they have been clearly and unambiguously phrased. The Cronbach's alpha was used as a measure of reliability. Participants in the study were assured of anonymity and confidentiality. The questionnaire consisted of four sections: (A) Participant background information, (B) Organisation background information and (C) Cloud computing (D) Barriers towards cloud computing adoption. Descriptive statistics, T-test, correlation and regression analysis were used for data analysis.

A. Research Questions

- What are the IT methods deployed by SMEs in the Polokwane Municipality?
- What are the cost and benefits of adopting cloud computing services by SMEs in Polokwane Municipality?
- What are the barriers of cloud computing adoption by SMEs in the Polokwane Municipality?

B. Measures

The survey questionnaire was divided into four sections. Section A covered the personal background of the SME; Gender was measured by “1” male and “2” female. Age of the participants was measured using by “1” 23-30 years (young owners) and “4” 41-60 years (old owners). According to the National Youth Commission Act of South Africa [46], Youth in South Africa is considered from the ages 14 to 35. Position of the responsible person for the SME was measured by “1” owner and “2” manager. Level of education was measured by “1” Matric and below and “4” Tertiary post-graduation education. Section B discussed the background of the organisation; Age of the business was measured using by “1” less than a year of operation and “5” 16-20 years of operation. Number of employees was measures by “1” 0-5 and “5” 101-200 in number and Section C included the cloud computing adoption and were measured by four items. These are knowledge of cloud computing and its services, IT methods used by the SME and the period of using the chosen method (traditional IT method or cloud computing) and lastly section D covered the TAM associated questions regarding the barriers of adopting cloud computing technology. A five point Likert scale rating from “1 strongly disagrees” to “5 strongly agree” was used to measure the perception of participants involved.

C. Research Findings and Discussions

230 questionnaires were distributed to small business owners and 106 questionnaires were completed and returned. The response rate for the study was 46.08%.

a) Biographical information

“Table I” represents the biographical details of the respondents. The results show that majority of participants in the survey were males, in addition the majority of the respondents are SME owners, who have graduate qualification with the age below thirty one years and their enterprises have been in operation for between one and five years. The majority of the respondents has employees below five in number and according to the National Small Business Act of South Africa [45], can be classified as micro enterprise.

b) Adoption of ICT by SMEs

“Table II” depicts that, most SMEs are using internet and traditional IT methods to operate their businesses. Reference [17] remarks that there is a positive relationship between business performance and the use of internet. The use of internet can enable SMEs to perform online sales and purchases and can improve the competitive advantage of the business. The SMEs are still using traditional IT methods such as: in-house data server, cable networking and manual data back-up and protection to mention the least. The results reveal that the majority of SMEs in the study area have not yet adopted cloud computing for running their businesses. This is due to lack of knowledge of cloud computing and its services. Reference [38] maintain that SMEs have very limited knowledge of cloud computing and this lack of knowledge contributes as an inhibiting factor towards cloud computing adoption. This study also established that there is a minimal adoption of cloud services by SMEs.

c) Barriers to the adoption of cloud computing by SMEs

“Table III” depicts the results used to measure the barriers to the adoption of cloud computing by SMEs. The Cronbach’s alpha is 0.742, which indicates the reliability of the measuring scale. The results shows that the two most important barriers to the adoption of cloud computing by SMEs are cost and limited knowledge towards cloud computing. Reference [9] explain that insufficient financial resources to support cloud migration is regarded as a perceived barrier or reason for not adopting Cloud Computing and it may indicate a lack of understanding of the benefits of the cloud environment and how it may alleviate some SME concerns regarding lack of financial resources for new technology projects. Furthermore, SMEs have very limited access to external capital from commercial banks [18]. This lack of funding hinders the development of SMEs to become competitive in the market. Therefore, SMEs have limited resources to be able to adopt ICTs. Many SME owners are unfamiliar with the cloud computing services and their costing; including the cost models offered by cloud vendors. Reference [49] found that the factors influencing the adoption of cloud computing by SMEs in developing economies found the following barriers: lack of internal expertise and knowledge, poor internet access and connectivity, security

and data privacy, lack of trust. A study by Reference [49] further found that top management support, trial ability, competence of cloud vendors, resistance to new technology, compatibility and existence of IT infrastructure are realised as key factors influencing cloud computing adoption for SMEs. Furthermore, most SME owners and managers are still using traditional IT methods due to lack of expertise. According to the TAM, cost is one of the major factors that affect the use of ICTs by SMEs [12]. The results of this study indicate that the lack of expertise on cloud computing services and cost modelling strategies offered by the vendors in the market is one of the major barriers to the adoption of cloud computing by SMEs in South Africa.

D. Implications for theory and practice

The study was a regional study and focused on small and medium enterprises in the Polokwane Municipality, South Africa. Therefore it must be acknowledged that, due to the snowball sampling technique and relatively small final sample size, the study's findings cannot be generalized or considered as a representative of all Limpopo Province or South Africa SMEs. There was a significant response bias with a larger proportion of adopters responding than non-adopters. Due to financial and time constraints it was not possible for the researcher to cover the province or country. A similar study can be extended to other provinces or at a national level. Further studies can also be carried out to investigate the performance of SMEs who have adopted the cloud computing services. The knowledge of cloud computing services by SMEs can also be studied. Other studies can be conducted to investigate the customer perception towards and the adoption of cloud computing in South Africa. The adoption of cloud computing services to increase the number of employees in SMEs can also be investigated. Other studies can also be undertaken to investigate whether the location of the cloud service providers has an impact on the adoption of cloud computing services.

5. Conclusion And Recommendations

The first objective of the study was to investigate the adoption of cloud computing by SMEs in the Polokwane Municipality. The conclusion of the study is that most of the SMEs are still relying on traditional IT methods and internet to run their operations. The previous similar studies have revealed that the operational costs on traditional IT methods are extreme. Cloud computing is capable of presenting an exceptional reduced operating cost to small and medium enterprises (SMEs), whereby resources are kept at greatest benefits [25]. Furthermore, the study established a minimal adoption on types of cloud services by SMEs. Cloud computing is a new method to add capabilities to a computer without licensing new software, investing in new hardware or infrastructure or training new personnel [22]. Since the findings of the study indicated a high usage of traditional IT methods and internet but a low usage of cloud computing services. It is imperative for SMEs to increase their use of cloud computing services. SMEs should consider using cloud computing services such as Google Apps for emails, backup and business location services like Gmail, Dropbox, Google maps. With applications like Gmail and Dropbox, SMEs can communicate and backup their data and access it anywhere at lower cost or free.

The second objective of the study was to determine the barriers to the adoption of cloud computing by SMEs in the Polokwane Municipality. The conclusion of the study is that the two most important barriers to the adoption of cloud computing by SMEs are cost and limited expertise on ICT. Many SME owners are unfamiliar with the cloud computing services and the cost related, including the cost models offered by cloud vendors. Reference [39] explains that insufficient financial resources to support Cloud migration is regarded as a perceived barrier or reason for not adopting Cloud Computing and it may indicate a lack of understanding of the benefits of the cloud environment and how it may alleviate some SME concerns regarding lack of financial resources for new technology projects. Additionally, most SME owners and managers are still using traditional IT methods due to lack of expertise. Many SMEs do not have the financial capacity to implement strategic ICT solutions to make their business competitive. Therefore the Department of Small Business and their provincial government agencies such as Limpopo Enterprise Development Agency (LEDA) and Small Enterprise Development Agency (SEDA), should partner with cloud service providers like Telkom, Cell C, MTN and Vodacom to mention a few, to promote and encourage SMEs to engage in the innovative Information Technology strategies such as cloud computing by establishing training programmes and awareness for SME owners on types of cloud services and plans available in the market and offer this services to SMEs at a discounted rate.

Table I. Biographical Information of the Respondents (N=106)

Biographical Characteristics	Frequency (n=106)
<i>Gender of owner/manager</i>	
Male	76
Female	30
<i>Age of owner/manager (Year)</i>	
26-30	39
31-35	32
36-40	16
41-60	19
<i>Position of owner/manager</i>	
Owner	66
Manager	30
Other	10
<i>Education level of owner /manager</i>	
matric or grade 12	20
undergraduates	5
graduates	47
postgraduate	34
<i>Age of the business (years)</i>	
Less than a year	24
1-5	46
6-10	6
11-15	18
16-20	12
<i>Number of employees</i>	
0-5	70
6-10	16
11-50	14
101-200	6

Table II. Adoption of ICT by SMEs (N=106)

ICT Adopted <i>ICT Service</i>	Yes		No	
	<i>Frequency</i>	<i>Percentage</i>	<i>Frequency</i>	<i>Percentage</i>
Internet Service	100	100	0	0
Traditional IT Methods (Fax and telephone line, cable networking)	100	100	0	0
Cloud Computing: Service Types	22	22	78	78
Software-as-a-service (SaaS)	7	7	93	93
Platform-as-a-service (PaaS)	15	15	85	85
Infrastructure-as-a-service (IaaS)	4	4	96	96

Table III. Barriers to the Adoption of Cloud Computing by SMEs (N=106)

Statement	Mean	Standard Deviation
I cannot use cloud computing since is not trustworthy.	3.49	1.007
I cannot use cloud computing since I am afraid it is not reliable.	3.25	1.286
Cloud computing is not credible (Privacy and Secure) because I am afraid that my organisation information would be leaked during data transfer and back-up.	2.72	0.923
Using cloud computing increases my/our operational expenditure.	2.23	1.140
It cost a lot to use cloud computing services.	2.33	1.093
I prefer a secure location by a service provider for the hosting and storage of my organisation's sensitive information/data.	3.91	1.047
I would need to be notified when my service provider relocates my organisation information/data to a new location.	4.36	0.830
Cloud computing is mostly frustrating due to constant access password requirement or log-in (accessibility).	2.95	1.297
I do not know what is cloud computing and I have no interest to know how it works.	3.88	1.232
Cronbach's alpha		0.742

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