

Cloud-Based Enterprise Adoption by SMEs in Ghana

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Abstract - Cloud computing (CC) is a set of services that provide infrastructure resources using internet media and data storage on a third party server. SMEs are said to be the lifeblood of any vibrant economy. They are known to be the silent drivers of a nation's economy. This paper seeks ascertain how SMEs could adopt this new revolutionary to its operations. If SMEs have access to scalable, on demand and robust technologies they could possibly deliver products and services that in the past only large enterprises could deliver, levelling the competitive field. By adopting the Technological, Organizational and Environmental (TOE) framework as a theoretical base, this research will use quantitative exploratory study by closed-questionnaires to collect data from 25 SMEs in the Ghana.

The study ascertained that though some SMEs have basic knowledge of the ICT infrastructure yet they are a bit skeptical about adopting this revolutionary in IT world due to inherent security issues and limited knowledge about the prospects that CC offers them. Therefore, the study recommends IT players to engage and make the term a home buzz word as it offers a competitive edge to SMEs.

Key Words: Cloud Computing, SME, Adoption, TOE, Ghana

1. INTRODUCTION

ICT arguably has improved business competitiveness and thus has provided an edge for Small and Medium-sized Enterprises enabling them to compete with large firms (Bayo-Moriones & Lera-Lo'pez, 2007) (Swash, 1998). SMEs are regarded as the economic drivers of any state. Even though, IT in SMEs is an essential technology, limited research has studied, the adoption, implementation and usage of this new technology in small enterprises within the Ghanaian context. The modus operandi of traditional IT environments requires the increasingly complex management of software, hardware and networking equipment.

However, the cloud computing technology promised essential benefits that are appealing to SMEs, which need to

maximize the return on their investment and still remain competitive in an ever-demanding business environment. Saya et. al, (2010) points out that while extant research has studied cloud computing architecture (Rochwerger, et al., 2009), potential applications and costs and benefits (Assuncao, Costanzo, & Buyya, 2009), the decision making on the adoption of cloud computing has not (Assuncao, Costanzo, & Buyya, 2009) been empirically examined. Consequently, this paper's main research objective is to contribute to a growing body of research on cloud-based enterprises systems, by investigating the influential factors that impact adoption of cloud-based technologies by Small and Medium Enterprises (SMEs) in Ghana. To achieve the major objective, the specific objectives below were followed;

- a. To examine the knowledge base of IT infrastructure and the existing challenges inherent therein
- b. To examine the concept of CC
- c. To examine the security issues of CC adoption
- d. To design a framework for CC adoption

The next section details a succinct relevant literature, and the theoretical framework adopted in this study is discussed. The description of the study's research design and methodology adopted are highlighted. Then follows the study's main findings and future research recommendations.

2. LITERATURE REVIEW

CC Concept and Benefits: Cloud computing is the delivery of software and technology as services over the internet by service providers. According to the National Institute of Standards and Technology, it is a model for enabling ubiquitous, 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 (Mell & Grance, 2010). Cloud Computing, according (Leimeister, Riedl, Bo'hm, & Krcmar, 2010) infer that it is a new paradigm

and emerging technology while others such as (Foster, Yong, Raicu, & Lu, 2008), maintains that it's not a new concept, as it implements on the traditional computing technologies. Either perspective, the on-demand self-service, broad network access, rapid elasticity, resource pooling and pay-per-use computing model is expected to influence the way many enterprises approach IT-related services (Cyber Security Operations Center, 2012).

The reviewed extant literature suggest that even though cloud concept seemed mouth-watering, however, that notwithstanding the following factors hinders the adoption of cloud computing: size of IT resources, resources deployment patterns, (Misra & C., 2011) Moreover, institutional influences such as perceived accessibility, perceived scalability, perceived cost effectiveness, and a perceived lack of security to hinder the adoption cloud computing (Saya, Pee, & Kankanhalli, 2010).

2.1 Layers of Cloud Computing Architecture

Cloud service models are classified based on the computing requirements of the clients and represent different layers of the cloud computing architecture: infrastructure as a service, platform as a service and software as a service (see fig-1).

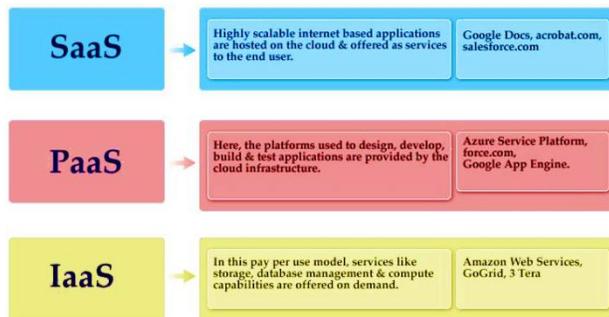


Fig-1: Layers of CC Architecture

2.1.1 Software as a Service (SaaS), or Cloud application services, represent the largest cloud market and are still growing quickly. SaaS uses the web to deliver applications that are managed by a third-party vendor and whose interface is accessed on the clients' side. Most SaaS applications can be run directly from a web browser without any downloads or installations required, although some require plugins.

2.1.2 Platform as a Service (PaaS) involves the vendor providing Infrastructure as a Service plus operating systems and server applications such as web servers. PaaS enables customers to use the vendor's cloud infrastructure to deploy web applications and other software developed by the customer using programming languages supported by the vendor. (Cyber Security Operations Center, 2012).

2.1.3 Infrastructure as a Service (IaaS) encompasses the vendor providing physical computer hardware including data storage, CPU processing, network connectivity and memory. This model allows the vendor to share their hardware among multiple customers referred to as "multiple tenants" using virtualization software. IaaS enables customers to run operating systems and software applications of their choice (Cyber Security Operations Center, 2012).

2.2 Cloud Deployment Models

Cloud deployment models are classified according to type of exclusive and non-exclusive method of providing cloud services to the clients as follows: public cloud, private cloud, hybrid cloud and community clouds (Mell & Grance, 2010). **The private model** is deployed for a single organization; where it has an exclusive use of the cloud infrastructure and services, and can be internally or externally hosted. **The public model** is provisioned for open use for the public where a vendor's cloud infrastructure is shared via the internet with many organizations. **Community Cloud** is where several organizations with similar security requirements share a private cloud (store and process related sensitivity). **Hybrid cloud** combines the various economic and security benefits of cloud models.

2.3 Cloud and SMEs Adoption

Business creation and delivery undoubtedly has been improved due the introduction of IT cloud services. This revolution in the IT has offered businesses ubiquitous access to computing services which invariably has enhanced their operations in a flexible manner and at reduced cost (Jain & Bhardwaj, 2010). For SMEs, cloud computing promises to deliver tangible business benefits, often at much lower cost as they only pay for the resources needed, offering them good return on investment of their limited resources. In turn they can focus on what truly delivers value to their

customers and results in a competitive advantage (Alshamaila & Papagiannidis, 2013) (see fig 2).



Fig-2: Cloud based service solution to SMEs compared to traditional IT based solutions

2.4 Cloud, SMEs and Security

Knowledge of the physical locations and configurations of the systems that delivers relevant services to end users in the cloud computing environment remains obscure and this tends to create a mix-feeling for adoptees of this model (Voorsluys, Broberg, & Buyya, 2011). Threats emanating from both inside and outside the cloud posit as security and privacy issues that are often cited as objections to cloud adoption (Armbrust, et al., 2010). However, what is more perturbing, is the fact that many companies believe that they are simplifying security issues by effectively ‘outsourcing’ them to another party (Anthes, 2010) or due to the limited resources, small companies or start-up companies, often turn to the cloud to deflect cybersecurity concerns (Kaufman, 2009).

Pursuant to vulnerabilities such as ‘insider’ attack, (Subashini & Kavitha, 2011), difficulties of data ownership and location (Hayes, 2008), responses to security incidences, disaster recovery and provider’s economic stability (Takani, Joshi, & Ahn, 2010) are pervasive threats that may ensue. Therefore SMEs must be on the foreknown to ascertain the security policies that prospective vendor places on the table before they engage them. The vulnerability of the cloud is similar to the vulnerability of all web applications. However, SMEs must be confident that information security is now viewed as a socio-technical problem that requires a thorough understanding of the weakest link in the defence against security threats: human behaviour (Dinev & Hu, 2007)

2.5 TOE Framework

The TOE, **Technology-Organization-Environment**, framework is an organization-level theory which was developed by (Tornatzky & Fleischer, 1990). TOE as (Baker, 2012) asserts, is a representation of an innovation process, which explicates the influences it has on organization’s adoption and implementation of innovations. The research model basing on this framework incorporates technological, organizational, and environmental perspectives as essential determinants of cloud computing adoption.

For a firm to adopt technological innovation, TOE proposes three forms of organizational factors to consider. The **Technological** perspective describes the internal and external technologies which are relevant to the organisation, and integrates extant as well as incipient systems and takes account of the various influences on the firm (Chau & Tam, 1997). The **Organisational** aspect describes the physiognomies of an organisation that encourage or discourage the adoption of technological innovation.

Examples of these characteristics include firm size, organisational structure, executive support, human resource competencies, and available resources. The **External Environment** includes the market characteristics, competitors, regulations, and access to external resources (Tornatzky & Fleischer, 1990).

The TOE framework has been utilized widely by researches to study e-commerce adoption in many environments and over time such as e-commerce (Sparling, Cater-Steel, & Toleman, 2007), e-business (Oliveira & Martins, 2010); B2B e-market (Zhai, 2010)(see fig 3).

2.6 Summary of Literature Review

The competitive nature of businesses can be improved by an efficient utilization of the advanced ICT. CC offers immediate access to modern applications of IT which augment SMEs services by enhancing customer interaction and market reach. Thereby, maximizing SMEs investment and aiding them to operate in a competitive corporate environment. Therefore, SMEs in developing countries such as Ghana cannot but cease this opportunity to employ this revolutionary paradigm in its operations.

3. METHODOLOGY

Descriptive and quantitative were the preferred research approaches employed to ascertain the readiness of Ghanaian SMEs to adopt cloud computing in their operations. The study is descriptive as little information about cloud services usage is being utilized aware or otherwise (Lake, 2009). The information gathered will help understand the surrounding issues and develop a suitable framework. This study employed a quantitative research approach through utilization of an online survey instrument (questionnaire) through Google Forms. The online questionnaire is increasingly recognized as an expedite invaluable

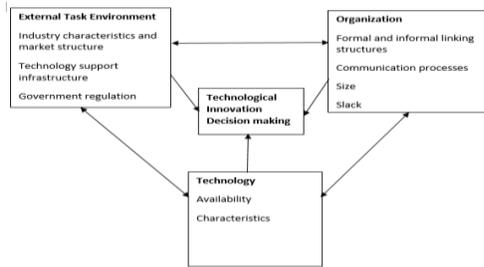


Fig- 3: Technology-Organisation-Environment framework (Tornatzky & Fleischer, 1990)

Means of data collection (Doherty, 2012) due to benefits such as higher response speed (Adams & Deans, 2000); lower respondent error (Weible & Wallace, 1998); and removal of interviewer bias (Van Selm & Jankowski, 2006). The survey also consisted of closed questions which were developed into four categories. The use of closed questions served to generate and gather information quickly by the researcher (Boynton & Greenhalgh, 2004).

Frequency distribution and percentages were used for the quantitative data analysis to determine the proportion of respondents choosing the various responses. Descriptive analysis factors like frequency tables, mean scores and percentages were generated, and their interpretations thoroughly explained. The statistical tool used for the analysis of data is the SPSS v20. Data was further analyzed in terms of descriptive Statistics to examine the readiness of SMEs in adopting the concept of CC and in furtherance, develop a framework for its adoption in Ghana.

4. FINDINGS/RESULTS/DISCUSSIONS

The study sampled 25 usable correspondence. Each respondent organization was located in Ghana and employed less than 200 individuals. The majority of the respondents (62.5%, n=15) were micro-sized firms, with 1-9 employees;

Table- 1: Size of Organization

Size of Organization	Frequency	Percent (%)
1-9 Employees	15	62.5
10-50 Employees	2	8.3
100-200 Employees	7	29.2
Total	24	100.0

8.3% (n=2) were small firms, with between 10-50 employees; 0% (n=0) were macro firms with 50-100; while 29.2 percent (n=7) were of medium size with between 100-200 employees (see Table 1).

Q1. What is the knowledge base of IT infrastructure of respondents?

In terms of type of organization (see Table 2), the largest sector, represented by almost half of all respondents (41.7%, n=10), were those firms from the IT Services sector. The smallest group of respondents (8.3 percent, n=2) were from the Banking, Finance and Insurance, Retail and Wholesale; Education and Services sector.

The results and the discussions were tailored towards the objectives that this piece set out to ascertain.

Table-2: Type of organization

Type of Organization	Frequency	Percent (%)
IT Services	10	41.7
Banking, Finance and Insurance	2	8.3
Retail and Wholesale	2	8.3
Government	3	12.5
Education	2	8.3
Health	3	12.5
Services	2	8.3
Total	24	100.0

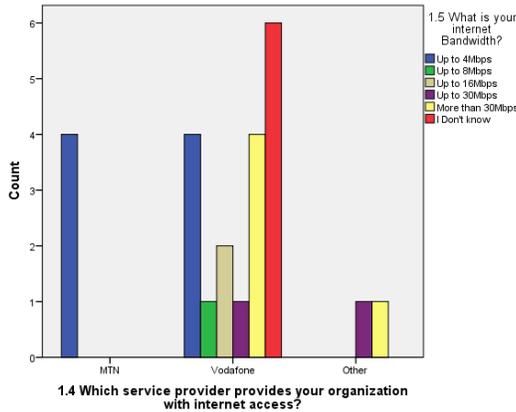


Fig-4: Internet Provider and Bandwidth

Two major Telco’s were predominant in the type of service providers SMEs engage. With 18, 4 and 2 responses from Vodafone, MTN and Other ISP. SMEs are skewed towards Vodafone network which provides varying internet bandwidth (see Fig 4) depending on the size of the organization. However, high bandwidth network improves throughput in the operations of SMEs.

With a mean value of 6.02, (Table 4) SMEs who uses the traditional IT services are able to access their systems and applications over the internet. The available data clearly suggests that current SMEs players in Ghana have knowledge of the current IT infrastructure services they are using in advancing their prospects in the competitive market.

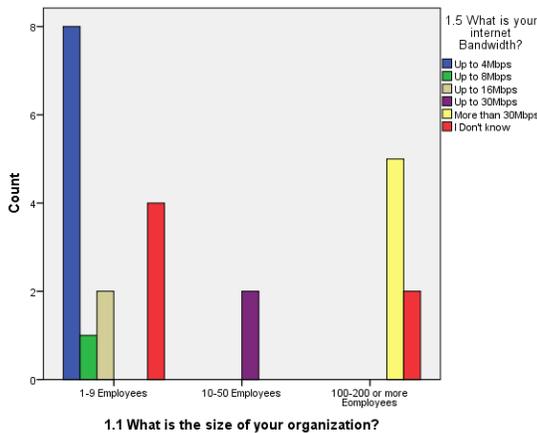


Fig-5: relationship between size of organization and internet bandwidth.

Though, IT infrastructure posits a lot of advantages but it has its own challenges with the current infrastructure as shown

in table 4 and figure 6 with network connectivity provided by Vodafone having a lot of difficulties for SME users.

This would help them make an informed decision as to the architectural layer they will adopt may be due to data bandwidth

Q2. CC Concept Awareness

Given the responses gathered, its resounds positive that considerable number of respondents have heard of the CC concept with a mean value of 1.68 being familiar with the concept as shown in Figure 6 and Table 5 respectively. This has given a wave that adoption of concept with the following technologies: PaaS, IaaS and SaaS are not germane to them.

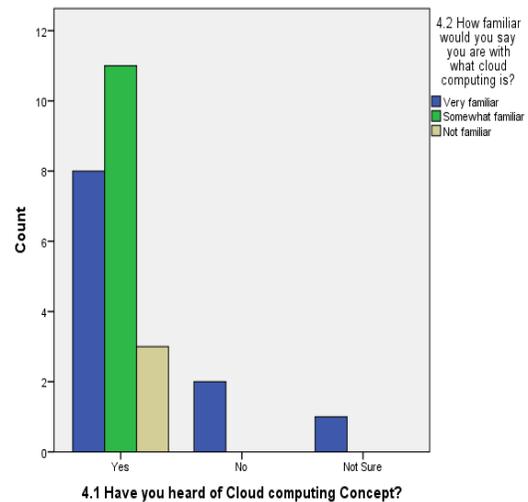


Fig-6: CC Awareness

Thus the researcher can make a deductive inference from the available data that the IT buzz word is a concept known but little has to be done for SME organizations be comfortably familiar with to them.

Q3. Security related-issues with cloud

As a growing economy, SMEs are pessimistic though some assert that their philosophy to IT are innovators and early adopters of technology as their philosophy. Security breaches, provider lock in and loss of control are some of the security issues SMEs regarded as barriers to adopting cloud services in the operations. More so, just 3 respondents asserted that they have experienced security breaches(see Table 3), yet they aren’t going to host any critical apps in the cloud.

Table -3: Security breaches and hosting critical apps in the cloud

	5.4 Host critical app in the cloud?		Total
	Yes	No	
5.1 Experienced an Internet security breach?	3	0	3
Yes	4	14	18
No	3	1	4
I don't know			
Total	10	15	25

Table -4: CC expensive than TC or otherwise

	Frequency	Valid Percent
CC more expensive than TC	16	66.7
TC is more expensive than CC	8	33.3
Total	24	100.0

Though SMEs perceive CC as a model with barriers yet they observe it as an advantageous tool to bridging gap in the job market.

5. CONCLUSION AND RECOMMENDATION

This research aimed to explore the knowledge base of the current IT infrastructure and the challenges therein. Fair knowledge about the organizations’ ISP and the bandwidth they require based on their size and some challenges they encounter as they interact with those systems. A framework Adams, S., & Deans, K. (2000). Online Business in Australia and New Zealand: crossing a chasm, in Treloor. A. and Ellis, A. (Eds) *Proceedings of AUSWEB2K, The Sixth Australian World Wide Web Conference* (pp. 19-34). Southern Cross University, Lismore: Cairns.

Alshamaila, Y., & Papagiannidis, S. (2013). Cloud computing adoption by SMEs in the north east of England, A multi-perspective framework. *Journal of Enterprise Information Management*, 26(3), 250-275.

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is thus proposed basing on the TOE framework to assist SMEs in the adoption of CC recognizing the importance it offers them the market sphere. Nevertheless, security, privacy and confidentiality were the major concerns for the cloud adoption.

Additionally, SMEs are encouraged to invest and integrate cloud services into their business operations and activities to stay competitive, better customer service, and ensure fast and efficient delivery and different access markets. More so, SMEs must place emphasis on provision facilities in ICT for their employees to increase knowledge.

To sum it up, Ghana needs to establish an ICT-driven ecosystem (by incorporating CC as a holistic national ICT framework for development) capitalizing on a creative and talented youth opportunity that can become the base for an entrepreneurial culture and a startup nation.

A PROPOSED FRAMEWORK FOR SMEs IN GHANA

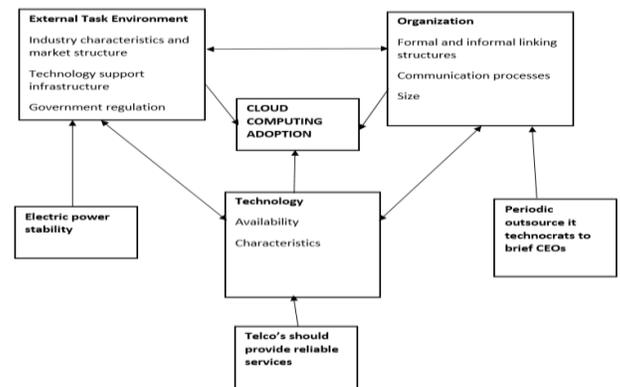


Fig-10: Proposed TOE framework for SMEs in Ghana

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