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# Cloud Computing: The Level of Awareness amongst Small & Medium-sized Enterprises (SMEs) in Developing Economies

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## ABSTRACT

Cloud computing services are being touted as a major enabler for small businesses lately. This new paradigm is seen to offer unique opportunities to small and medium enterprises (SMEs) worldwide and developing economies are no exception. It presents SMEs access to similar technologies available to their larger counterparts and those in the developed world which inherently creates innovativeness, increases competitive advantage and impacts their operations and processes. This paper seeks to determine the level of awareness and familiarity with this emerging computing paradigm. The results of the study indicated that a slight majority of the respondents were familiar with cloud computing on the individual level but the level of awareness amongst the larger SME industry was low to medium. The finding therefore recommends education and sensitization on cloud computing in order to increase awareness and knowledge about this emerging technology and its prospects. This is seen as one sure way of enhancing its uptake in developing and emerging markets.

**Keywords:** *Cloud computing, developing economies, level of awareness, small & medium enterprises (SMEs)*

## 1. INTRODUCTION

Small and Medium Enterprises (SMEs) contribute significantly to the socio-economic development globally. SMEs employ an estimated 85% of persons in the manufacturing sector and contribute around 70% of Gross Domestic Product [1]. Therefore, developing systems and innovations that can boost SMEs efficiently and productively cannot be overemphasised. However, there is a slow response of small businesses towards the adoption of ICT [2]. This is largely due to the high costs and risks associated with investing in them. Cloud computing is therefore seen as the best alternative for addressing the challenge faced by SMEs in adopting technological innovations[3]. SMEs prefer low cost alternatives that produce competitive advantage[4] since traditional systems come along with hiring staff and experts, space, power and infrastructure [5]. Cloud computing offers the advantage of economies of scale, thereby decreasing the cost of electricity, bandwidth, operations and hardware [6]. It provides services on-demand just like other utility providers [7]. This allows that customers only use the computing resources they need and pay for the service used.

Also, the convenience of shifting from traditional systems to the cloud makes technology simple, scalable and accessible[8]. Due to such benefits of cloud computing, cloud computing have been recommended for SMEs[9] and are therefore increasingly being embraced by small businesses[10]. This has led to a rapid growth of the cloud as it presents SMEs significant turnaround in managing and maintaining their IT services and capabilities. Cognizant of the many benefits, there is also an emergence of Application Service Providers (ASPs) in developing markets [11]. Notwithstanding these factors, the rate of adoption and use of cloud services in the developing economies cannot be ascertained. This paper seeks to determine the level of awareness and familiarity of the Cloud Computing paradigm amongst SMEs in developing economies. It also discusses the business viewpoint of a technological innovation which

can greatly impact their operations and processes and also inform SMEs about cloud computing.

The foregoing has been a preamble to the study. The next section reviews relevant literature on cloud computing, its characteristics and different models. This is followed by a discussion on the Ghanaian SMEs sector. The methodological approaches adopted are then examined. The results and findings of the study are presented to show the level of awareness in the industry. Finally, the implications arising from the study are also offered and conclusions are drawn.

## 2. CLOUD COMPUTING

### 2.1 Evolution of Cloud Computing

Cloud computing is now a buzzword in the technology industry. The popularity of this term has led to its presence across multiple domains worldwide [6]. Bento & Bento [12] however, affirm that cloud computing lacks a clear beginning. Some researchers consider cloud computing as a new paradigm whilst others believe it relies on existing technologies [13][14]. The term 'cloud computing' however, came into prominence when Eric Schmidt, CEO of Google, used it at a conference in 2006 [14]. Cloud computing provides IT services such as applications, software and storage for individuals and businesses over the internet. It eliminates the need to install and run services on existing infrastructure allowing for simplified support and maintenance [15].

Users who subscribe to cloud services can access them on demand through a web interface or via a cloud-based resource from a service provider [16] as if they existed locally. Sales force, Amazon and Google are companies which initiated cloud computing at the turn of the millennium [17]. Further commercialization has also resulted in more providers [18]. Other Application Service Providers (ASPs) metamorphosed into delivering cloud-based services [19] since they are seen as the precursors to

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cloud computing. Cloud computing is reliant on existing and new technologies that enable its efficient functioning and performance [14][18] such as virtualization, service oriented architecture (SOA), web services, distributed, grid and utility computing and networking [20].

## 2.2 What is Cloud Computing?

There is not one universally accepted definition for cloud computing [16][21]. Different definitions have been proposed by different authors [7][6][21][22][16] and organizations such as CSA [23], ENISA [24], ETSI [25], Gartner Research [26], NIST [27]. Kramer [17] and the US Department of Commerce's National Institute of Standards and Technology (NIST) definitions are employed in this paper.

Kramer [17] defines cloud computing as "...a new computing paradigm. It changes the procurement, maintenance and disposal process of information technology. Large investments in fully-owned IT-assets are substituted by on-demand procurement of a dynamic basket of information technology resources. These resources are hosted in specialized data centers. Cloud computing can be purchased and scaled just over the Internet, on-demand and location independently. Direct data control is substituted by service contracts that specify availability, data-loss prevention, liability, flexibility and pricing." Alternatively, NIST defines cloud computing as 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" [27].

Kramer's [17] definition takes into cognizance the business perspective as it emphasizes the economic and strategic aspects of cloud computing thereby giving it a better understanding and making it more attractive to SMEs. On the other hand, the NIST [27] definition takes a purely technical perspective. This definition is well-written, complete and provides in-depth understanding on the subject of cloud computing from an internationally recognized standardization organization. Additionally, it also outlines five essential characteristics, three service models and four deployment models which are fundamental to this study.

## 2.3 Characteristics of Cloud Computing

Cloud computing has its own characteristics that differentiates it from other traditional IT infrastructure and similar technologies. Mell and Grance [27] outline them as follows:

- On-demand Self-service: Clients request and utilize services on need-as basis.
- Resource Pooling: Providers combine resources to serve multiple consumers using virtualization and multi-tenancy.
- Rapid Elasticity: Clients can automatically increase or decrease resources depending on their requirements and for only the duration of a specific task or period.

- Measured Service: No initial financial investment is required to subscribe to a service. Cloud computing is based on a pay-per-use or pay-as-you-go pricing model.

## 2.4 Cloud Service Models

Currently, cloud computing is delivered in three main service models.

### 2.4.1 Software as a Service (SaaS)

Here, applications and software are delivered on-demand over the internet or private networks either on a subscription basis or for free [28]. SaaS allows for subscribers to run software thereby minimizing costs associated with maintenance, upgrades and redundancy [29]. Notable SaaS applications include Google Apps, Salesforce.com, Drop Box, Face book and Twitter.

### 2.4.2 Platform as a Service (PaaS)

PaaS cloud services provide virtualized tools on which cloud applications and services are built and run [16]. The tools may come as virtual machines, operating systems, development environments and other applications [30]. PaaS allows users to develop, test, deploy and host custom-made and complex applications [31] using various computer languages. Examples are: Google App Engine, Azure Platform and Amazon EC2 Map Reduce.

### 2.4.3 Infrastructure as a Service (IaaS)

IaaS delivers infrastructural resources such as storage, operating systems, applications and other high-performance capabilities [27]. Although the provider owns the infrastructure, the client has control over the available services [5]. The provider only houses, runs and maintains the infrastructure [28]. Popular examples include Amazon Web Services, Eucalyptus, Go Grid, Flexi Scale and Rack Space Cloud.

### 2.4.4 Other Service Models

Cloud computing has often been referred to as Everything-as-a-Service (XaaS) [32]. Aside the three main service models explained above, Bose [32]proposes several 'X-as-a-Service'. For instance, Lenk et al. [33], Cloud Security Alliance [23] and Leimeister et al. [13] used Human-as-a-Service (HuaaS), Security-as-a-Service (SecaaS) and Communication-as-a-Service (CaaS) as examples of such XaaS respectively at different instances.

## 2.5 Cloud Deployment Models

Clouds are deployed as Private, Public, Community or Hybrid.

### 2.5.1 Public Cloud

In public clouds, resources are available to the general public over the internet for open use. These clouds are hosted and run fully on the premises of the provider [34]. This is used widely by industries and businesses. Its advantages are cost-efficiency, flexibility, resilience and easy management [28] but have deficiencies in security by way of malicious attacks and easy access [5].

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### 2.5.2 Private Cloud

This is also known as internal clouds which are operated solely for a single organization [14] that may comprise of many business units [27]. Private clouds are designed and managed within an organization usually by an internal IT unit [28] or an external provider. Private clouds are devoid of network bandwidth constraints, security exposures and legal requirements [28] and have high level of control over access with the ability to host and customize services to customer specifications [5].

### 2.5.3 Community Cloud

A community cloud is a shared infrastructure managed and hosted internally or externally by a cloud provider among several organizations that come together around a common concern, such as security, policy or compliance [27]. This model is predominant amongst governmental agencies, educational institutions and healthcare players operating under a common goal and also relies heavily on shared data.

### 2.5.4 Hybrid Cloud

The hybrid cloud infrastructure is a combination of two or more deployment approaches which are bundled together but each operates uniquely and separately [27]. The hybrid cloud caters for the deficiencies inherent in each cloud deployment approach used in the combination [14]. A common implementation of a hybrid cloud occurs in organizations where sensitive data are stored and managed on a private cloud whilst more general and non-critical processes are carried out in a public cloud [28].

## 3. METHODOLOGY

### 3.1 The Ghanaian SMEs Sector

SMEs are considered the engine of growth in the current world economy [35]. They make up the largest fraction of the private sector worldwide [36]. One of the key indicators of any thriving economy is the presence of a growing and vibrant SME sector. This assertion is justified by Akorsu and Agyapong [37] based on the impact SMEs have on employment, gross domestic product, entrepreneurial innovation and poverty alleviation of a country. Hence, SMEs play a crucial role in the development of a nation. In Ghana, the private sector of Ghana is one of the most prioritised sectors of the economy. Successive governments and regimes have regarded SMEs as partners due to its impact on national development [38]. The sector employs the highest percentage of the country's working class [39]. Additionally, Abor & Biekpe [40] point out that in Ghana, SMEs represent about 80% and 92% of the private sector and businesses respectively.

The NBSSI, the main regulatory body for SMEs, provides a working definition of an SME in Ghana. Micro enterprises employ up to 5 employees with fixed assets not exceeding the value of \$10,000; small enterprises employ between 6 and 29 employees with having fixed assets not exceeding \$100,000 and medium enterprises employ between 30 and 99 employees with fixed assets of up to \$1,000,000[41]. The uncertainties with revenues in

developing economies, coupled with fluctuating currencies render the above definition as a challenge. That, notwithstanding, the SME industry is supervised, regulated and promoted by different institutions and categorized into the Agriculture, Manufacturing and Services. SMEs in Ghana are characterised by weak management skills, single ownership or proprietorship, managers with little or no formal education, lack of adequate training and low access to technical expertise and new technology[41].

Aside financing [37][41][40][42], technology happens to be another major challenge facing the industry. Technological innovation contributes to the competitive edge of a company[35] and contributes to socio-economic developments[43]. The level of acceptance and implementation of information technology solutions is particularly low especially for small businesses in developing countries[44]. SMEs usually prefer low-cost technology solutions that fall within their meager budget but meet their needs[45]. Addo [46] opined that SMEs in Ghana have failed to take full advantage of the potential of technology particularly to stay competitive. Overall, SMEs have failed to adopt ICT because most of them do not perceive technology as innovation[47].

### 3.2 Research Approach

This study is a descriptive survey aimed at finding out the level of cloud computing awareness among SMEs in developing economies, using Ghana as a case study. The study is designed using a questionnaire to collect the required data and takes a quantitative approach in discussing the results. The methodology adopted involved a combination of random and purposive sampling techniques to reduce selection bias. The study targeted technology-driven or high-technology SMEs whilst the subjects adopted for the study consisted of business owners, IT officers and any decision maker in the SMEs concerned. This is due to their authority in the business especially in funding IT projects, their understanding of technology and their decision-making and other essential functions respectively. As Trochim [48] states, a subset drawn from the entire population can be used for generalization. The initial draft questionnaire was refined, peer-reviewed and pilot tested before a final questionnaire made up of 10 closed-ended questions was transformed into an online survey for a one-month period. 63 valid and complete responses out of an initial 120 emails (response rate of 52.5%) were received after the period and were used in the analysis. Descriptive statistics were employed in the presentation of the results.

### 3.3 Sample Characteristics

The 63 valid and usable responses were received from the online survey acted as the respondents of the study. 28.6% representing micro enterprises, 46.0% representing small enterprises and 25.4% representing medium enterprises participated. In terms of years of establishment, 6.3% had existed for less than a year, 33.3% for 1-4 years, 28.6% for 5-10 years whilst 31.7% were founded more than 10 years ago. Enterprises were sampled across the various business areas with the majority in Technology (12.7%) and Financial and Manufacturing (9.5%) each. Most of the

enterprises operated in Ghana with 38.1% in their locality and 33.3% nationwide. The rest had extended business operations in West Africa (6.3%), Africa (9.5%) and International (12.7%). The participants consisted of owners and managers (42.9%), IT Staff (31.7%) and other decision makers (25.4%).

#### 4. FINDINGS

From the results generated, almost half of the respondents (44.5%) agreed that employees in their company were Low ICT Users. So, generally most of the SMEs surveyed had minimal experience in the use of ICT tools. The results showed a slight majority of respondents in SMEs were familiar with cloud computing. From the study, 57.1% of respondents indicated their familiarity with the concept of cloud computing whereas the remaining 42.9% replied in the negative. A similar study conducted by Sahandi et al.[49] in the UK on SMEs showed 51.5% of respondents alluded to being familiar with cloud computing. Furthermore, the majority of staff members of their respective SMEs exhibited low awareness on both cloud computing services (55.6%) and their attendant benefits and challenges (44.5%). Only 16% of the respondents gave indication of a high level of awareness of cloud computing, whilst 19% had high awareness of cloud computing prospects. The mean values of the level of awareness and the prospects of cloud computing were 1.60 and 1.75 respectively. This signifies that even though a slight majority were familiar with the concept of cloud computing, most SMEs in developing economies had low to medium awareness of this emerging paradigm.

Overall, only a small portion of employees of the SMEs were fully aware of cloud computing generally and the likely benefits and challenges associated with its adoption. The level of information and knowledge about cloud computing among SMEs in developing economies also is low. More than 60.0% responded to having little or no knowledge whilst on 9.5% said they had excellent knowledge about cloud computing. The remaining 30.0% had average (some or good) knowledge about the technology. This suggests that whilst respondents may have heard or seen adverts of cloud services, only a few had exceptional knowledge and information in this regard. In analysing the data further, it was also realized that the familiarity with and level of knowledge about cloud computing was high among IT staff compared to business owners and other key decision makers. Additionally, the finding also showed a high awareness amongst the services sector compared to the manufacturing, industries and agriculture sectors. As Porter & Millar[50] postulate, the services sector is more likely to adopt cloud computing than manufacturing and industrial sector as the former has more information-intensive needs.

In the area of cloud adoption, approximately 20% reported they had already adopted; and 8% were still evaluating or testing cloud services; about 25% intended to adopt cloud services within the next three years; and 20% did not intend to adopt any cloud services in the foreseeable future. Nearly 40% did not know about any adopted cloud services in their current situation.

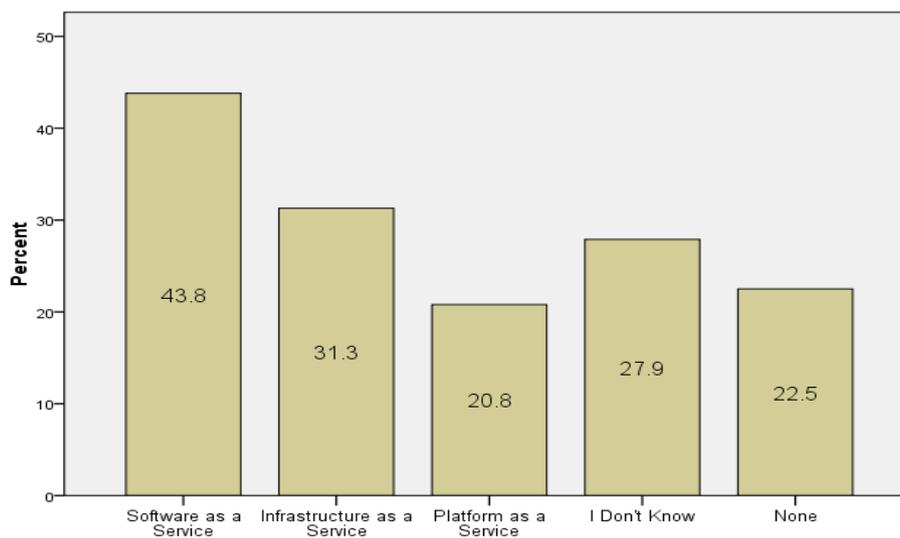


Fig 1: Cloud services models

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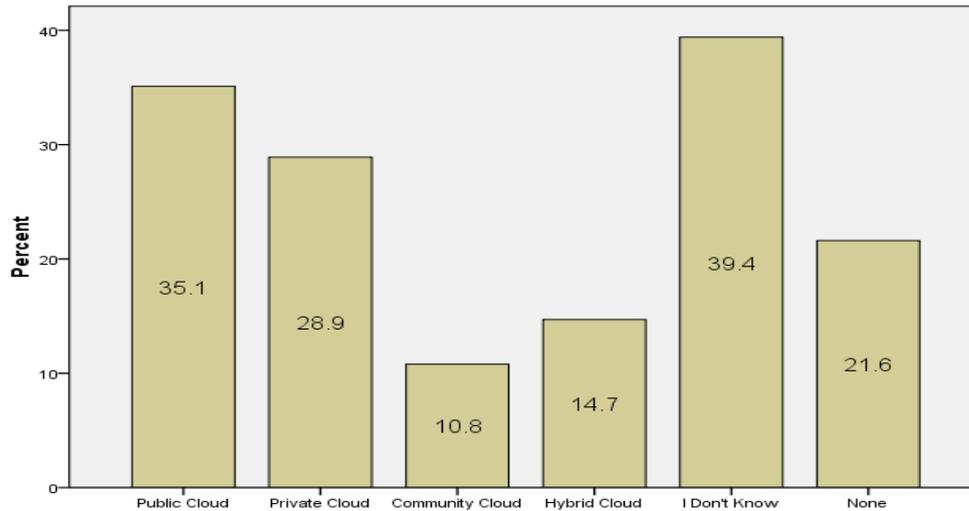


Fig 2: Cloud deployment models

Respondents were also asked to indicate whether their enterprise had already adopted or intend to adopt a service model (Fig. 1) or a deployment model (Fig. 2) currently or over the next three years. The study revealed SaaS as the foremost service delivery layer amongst the SMEs in developing economies. Prior studies by Rath et al.[51] and Hinde & van Belle[52] also confirm this trend. Vaquero et al. [16] agree SaaS has the most appeal to service users of cloud systems. Similarly, Public cloud is the most

prevalent and likely deployment models in the industry. This particular finding is in contrast to a similar study conducted by KPMG [53] where most SMEs have a preference to their own Private cloud. It must be noted however that, most SMEs did not about the various delivery models under cloud computing or had none installed on their premises or in their business operations.

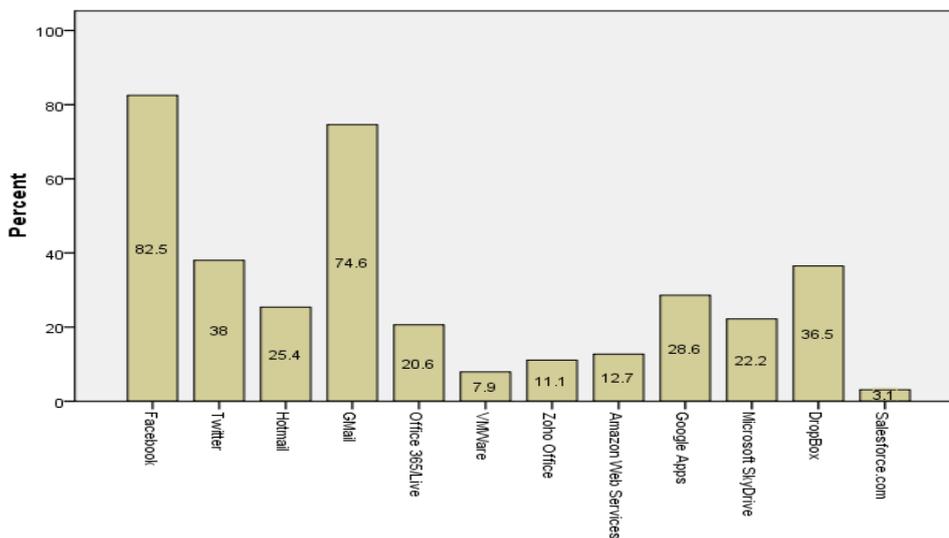


Fig 3: popular cloud services and applications in use

Another important observation realised indicated that majority of respondents were using popular cloud services and applications in their business operations unknowingly because they were free-of-charge. As illustrated by Fig. 3, approximately 83% and 75% of surveyed respondents specified that their enterprises used Face book and Gmail.

## 5. CONCLUSION

### 5.1 Implications & Recommendations

An increase in the awareness and familiarity with cloud computing amongst SMEs serves as the perfect recipe for increased adoption. There is therefore the need to focus and raise awareness on its benefits and importance in the current digitized knowledge-based economy amongst small businesses particularly technology-driven ones. This would

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encourage the understanding and acceptance of cloud services within the SME sector and make them more productive and competitive. In this regard, cloud computing can form an integral part of the National Policy on Information and Communication Technology for Development (ICT4D) passed by the Government of Ghana[54], for example. Accordingly, affordable cloud solutions and free cloud-based applications on the web can serve as the foundation for increasing awareness, availability and usage of cloud services amongst SMEs. SMEs must also place emphasis on the provision of training facilities in ICT for their employees to increase knowledge.

## 5.2 Concluding Remarks

The activities of SMEs are showing great promise in Ghana, a developing economy, but still faced with challenges like technology use. The identification of the issues associated with the level of awareness of cloud computing cannot be overemphasized. Although the majority of respondents sampled especially IT staff and officers had an appreciable knowledge in cloud computing, the main employees and the SMEs concerned were believed to have low awareness of the new technology and its prospects for the businesses. This study would benefit technology policy makers, cloud service providers and owners, managers and IT professionals of SMEs in developing and emerging economies. It seeks to intensify and educate CSPs and SMEs about the current state level of understanding of cloud computing and the benefits associated with deploying cloud services effectively.

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