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Abstract

Purpose – The purpose of this paper is to investigate the determinants of cloud computing adoption (CCA) in a developing country context through the lens of the technology, organisation and environment (TOE) framework.

Design/methodology/approach – The study was carried out using the quantitative research methodology based on a survey of 305 organisations from different industries in Ghana. Based on the TOE framework, a conceptual model consisting of ten hypotheses were proposed and tested through a confirmatory factor analysis and logistic regression analysis.

Findings – The findings indicate that relative advantage, security concern, top management support, technology readiness, competitive pressure and trading partners' pressure were the TOE factors found to be significant in CCA in a developing country context. Conversely, firm size, scope, compatibility and regulatory support were found to be insignificant.

Originality/value – This study provides insights into CCA across different industries in a developing country environment. The study is arguably the first kind of empirical research into CCA in a developing country context, specifically in Ghana. The findings from this study provide a foundation for other studies as well as constructive insights for the development of cloud computing, due to its infancy in the developing world.

Keywords Determinants, TOE, Ghana, Cloud computing, Developing countries, Adoption

Paper type Research paper

1. Introduction

Cloud computing has been described as a new development in the field of information technology (IT) (Armbrust *et al.*, 2009). With this advancement comes a huge potential which businesses and governments in the developed world are already utilising to improve service delivery and performance. Cloud computing basically entails the provision of IT as a service rather than as a product. Cloud computing has been adopted in private, public and non-profit sectors in both industrialised and developing countries. However, the developed economies are far ahead of the developing world in terms of adoption and use. In spite of the multitudinous benefits associated with the cloud technology, its potential is yet to be realized in developing countries.

Extant research into cloud computing adoption (CCA) in developing countries remains limited. Conversely, determinants of CCA in the developed world is well established in information systems literature. To large extent, the technological, organisational and environmental (TOE) contexts of cloud computing between the

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developed and the developing world differ. For example, the technological infrastructure in the UK, as a developed country is far more advanced than that of Ghana, as a developing country. Moreover, it is well noted in the general information systems literature that research findings from the developed world do not directly apply to the developing world due to contextual differences (Avgerou, 2001; Effah, 2014; Heeks, 2002). Therefore given that CCA is well established in the developed world but not in the developing world, this paper investigates the determinants of CCA in the developing country context of Ghana.

The rest of the paper is set out as follows. Section 2 reviews relevant literature on trend in and adoption of cloud computing, as well as presents a conceptual model based on the TOE framework and ten hypotheses for testing. Section 3 presents the research methodology detailing how data were gathered and analysed. Section 4 presents the findings while Section 5 discusses the findings. Finally, Section 6 concludes the study and provides contribution as well as implications for future research directions.

2. Literature review

IT has long been regarded as a product. However, this notion seems to be dwindling as many IT providers are striving to offer IT as a service and at reduced cost. Cloud computing as an innovation provides opportunity for IT to be delivered as a service rather than as a product. Cloud computing innovation has been with the IT industry for a while. However, it was not initially commercialised. The genesis of cloud computing is found in other technologies such as grid and parallel computing, distributed systems, hardware and software virtualization, multi-core chips, and internet-based technologies (Buyya *et al.*, 2009). There is still not a standard definition of what cloud computing entails (Sultan, 2010). In this paper cloud computing is defined as the delivery of IT infrastructure and applications as a service on demand to individuals and organisations via internet platforms.

2.1 Cloud service deployment and delivery models

Cloud services are offered through four deployment models, namely, private, public, community and hybrid (Mell and Grance, 2010). First, the private cloud deployment offers internal utilisation of technologies that are maintained in house (Yang and Tate, 2012). Private cloud deployment is exclusive to an organisation and sometimes managed by the organisation itself (Wai-Ming *et al.*, 2013). Second, the public cloud deployment provides services to the general public including organisations and individuals. Public cloud infrastructure is often owned, hosted and managed by third-party service providers (Marston *et al.*, 2011). Some popular public cloud services are Amazon EC2 (Elastic Cloud), S3 (Simple Storage Service), Google AppEngine and SalesForce.com.

Third, the community cloud deployment offers cloud services to a group of organisations with similar business missions, security and compliance requirements. The membership of the group is likened to a community where common interest is shared by members. Cloud services that the community deploy are exclusive to members. Community cloud deployment may be managed by member organisations or a third party and may exist on or off premise of members (Marinos and Briscoe, 2009). Lastly, the hybrid cloud deployment provides a combination of private, public or community deployment enabled by a standardized technology that ensures data and application portability (Jula *et al.*, 2014). The hybrid deployment provides an alternative means to balance the advantages and disadvantages in the other deployment models (Mateescu *et al.*, 2011).

There are three-main cloud service delivery models: software-as-a-service (SaaS), platform-as-a-service (PaaS) and infrastructure-as-a-service (IaaS) (Mell and Grance, 2010). The SaaS delivery model is based on servers, bandwidth and software that are offered and managed by a service provider. For SaaS, the client organisation looks for services that meet or can be tailored to meet specific needs. The responsibility is on the service provider to ensure continuous availability of the services to the client organisation (Siamak, 2010). SaaS is the popular delivery model of cloud computing and has been adopted by large companies such as IBM, Salesforce and so on.

The IaaS delivers hardware components consisting of servers, storage and network infrastructure as well as associated software as a service through the internet. IaaS users do not have to buy computing infrastructure; rather, the infrastructure is provisioned to users on demand (Heinle and Strebel, 2010). Instead of traditionally buying and installing computing infrastructure, IaaS provides these infrastructure via the internet. Thus, there is no need for an individual organisation to purchase, install and manage its own computing infrastructure under IaaS. The PaaS delivery model consists of hardware, operating system and software framework which offers a hosted web-based application development platforms for other applications to be developed (Buyya *et al.*, 2009). PaaS is built on IaaS to provide operating systems and other application services over the internet, eliminating the need to download and install applications on end-users' computers. The internet-based development of PaaS offers developers a method to build applications online (Giessmann and Stanoevska-Slabeva, 2013).

Beyond, these main service delivery models, a number of variations are currently found in the literature. These include concepts such as security-as-a-service, data-as-a-service, communication-as-a-service, business process-as-a-service and IT-as-a-service (Mujinga, 2012). The coinage of everything as a service or X as a service has therefore come to stay. However, it is worth noting that all these are off-shoots from the three-main service delivery models.

2.2 CCA

Generally, CCA has been studied from two contexts, namely developed and developing. Some studies (e.g. Alshamaila *et al.*, 2013; Sultan, 2014) have made significant contributions to CCA from the perspective of developed countries. For example, Alshamaila *et al.* (2013) studied CCA among small and medium sized (SMEs) organisations in North-East England using the TOE framework. The findings from the study indicated the determinants of CCA as relative advantage (RA), uncertainty, geo-restriction, compatibility, trialability, firm size (FS), top management support (TMS), prior experience, innovativeness, industry, market scope, supplier efforts and external computing support. Also, the study found competitive pressure (CP) to be an insignificant determinant of cloud computing. These findings are enlightening. However, adoption decision by SMEs might be different from large organisations. Additionally, CCA from the perspective of developed countries might be different from the perspective of developing countries. Therefore, there is a need to investigate determinants of CCA across different organisation as well as from developing country perspective. Considering the focus of this study, attention is turned to CCA in developing countries.

CCA in developing countries has had a fair share of literature (e.g. Low *et al.*, 2011; Makena, 2013; Rawal, 2011) and relevant contributions have also been made.

For example, Rawal (2011) investigated the adoption of cloud computing in relation to e-Government in India and revealed that there is a low level of awareness, trust, and adoption of cloud computing among government officials. Lian *et al.* (2014) combined TOE and HOT-fit frameworks to investigate the factors that affect the decision to adopt cloud computing in Taiwanese hospitals. The findings pointed out data security, perceived technical competence, cost, TMS and complexity as significant adoption factors. The study however had some limitations: first, it solely focused on the health sector. The results from the health sector may not be applicable to other sectors. Second, the sample size of 60 is less representative making it difficult to apply the findings to other health sectors. Lastly, the study was also silent on the determinants of CCA in the developing country context. Even though some studies (e.g. Cegielski *et al.*, 2012; Cheol *et al.*, 2013; Wu *et al.*, 2011) have attempted to point out respective factors that influence CCA from individual, organisational and even national perspectives, their findings are constrained to the context of developed countries. These limitations in literature calls for more research to highlight context specific determinants of cloud computing in developing countries.

In a closer look into Africa, some studies (e.g. Dahiru *et al.*, 2014; Makena, 2013; Le Roux and Evans, 2011) have also been conducted on cloud computing. For instance, Le Roux and Evans (2011) investigated how cloud computing can help South Africa bridge the digital divide in secondary and basic education. The authors believed, South Africa has the required skills and technology to reduce the digital divide gap and set the pace for other developing countries. However, their findings identified lack of political will and determination as key factors responsible for widening the digital divide. Nonetheless, their study only reviewed cloud computing applications and services that were in use by some developed country schools but did not address the actual adoption issues faced by these institutions. Like others, their study also did not highlight the determinants of CCA from the context of a developing country. Their study is viewed to consider readiness factors instead of highlighting the determinants of CCA. Makena (2013) investigated the factors affecting CCA by SMEs in Kenya and found some TOE factors to be significant. However, the study did not cover a broader spectrum of organisations to provide a holistic view on the adoption of cloud computing. Thus, a study that involves a large number of organisations is welcoming to provide more understanding and generalisation power to factors that determine the adoption of cloud computing from a developing country perspective.

2.3 Research framework, model and hypotheses

Extant cloud computing literature has used prominent adoption frameworks and theories such as technology adoption model (TAM), diffusion of innovation (DOI), grounded theory, migration theory, theory of reasoned action (TRA), TOE framework and so on. It has also been observed that two groups of frameworks are used in CCA research, namely, individual adoption (micro-level adoption) and organisational adoption (meso-level adoption) frameworks. Models such as TAM, TRA and DOI are prominent in innovation adoption. However, such models are suitable for individual level adoption and tend to consider only the technological dimension of innovation adoption and not the organisational and environmental perspectives. Since this paper investigates the determinants of CCA among organisations, the TOE framework which accounts for the TOE factors is considered as the appropriate theoretical framework. The TOE framework was developed to investigate firms' decision to adopt and implement an innovative technology taking into consideration the TOE contexts

(Tornatzky and Klein, 1982). The three contexts are seen as both enablers and inhibitors of a technological innovation adoption. These contexts have great influence on how firms perceive the need for, search for and adopt new technologies.

Table I illustrates selected CCA studies, factors they studied and their definitions. The table also provides a snapshot of factors that are posited in extant literature as determinants of cloud computing.

Technological context (TC). Cloud computing has attributes that favour or disfavour its attractiveness and intention towards adoption. Rogers (2003) posits that any

Contexts	Factor	Definitions in this study	Sources
Technological	Relative advantage	The degree to which an innovation is perceived as being better than the idea it supersedes	Low *et al.* (2011), Alshamaila *et al.* (2013), Tan *et al.* (2009), To and Ngai (2006), Wang *et al.* (2010), and Rogers (2003)
	Security concern	The fear of vulnerabilities in cloud computing systems	Chebrolu (2011), Zissis and Lekkas (2012), and Sultan (2014)
	Compatibility	The degree to which an innovation is perceived as being consistent with the existing value, past experiences and needs of receivers	Hong and Zhu (2006), Tan *et al.* (2009), Rogers (2003), To and Ngai (2006), Oliveira and Martins (2010), and Wang *et al.* (2010)
Organisational	Firm size	Refers to the magnitude of an organisation in terms of number of employees, target market size and capital investment	Dholakia and Kshetri (2004), Hong and Zhu (2006), Oliveira and Martins (2010), Pan and Jang (2008), Wang *et al.* (2010), Zhu *et al.* (2003), and Alshamaila *et al.* (2013)
	Top management support	The backing important members in management positions accord an innovation and thus result in the amount of resource allocated to that innovation	Lee and Kim (2007), Wang *et al.* (2010), Low *et al.* (2011), Oliveira and Martins (2010), and Alshamaila *et al.* (2013)
	Technological readiness	Refers to the degree to which technological infrastructure and human resources are needed to support cloud computing adoption	Kuan and Chau (2001), Oliveira and Martins (2010), Pan and Jang (2008), To and Ngai (2006), Wang *et al.* (2010), and Zhu *et al.* (2006)
	Firm scope	The scope represents the area of operation of the firm	Dewan *et al.* (1998), and Hitt (1999)
Environmental	Competitive pressure	The intensity of competition among firms in an industry	Lin and Lin (2008), Oliveira and Martins (2010), Pan and Jang (2008), To and Ngai (2006), and Wang *et al.* (2010)
	Trading partner's pressure	Pressure from upstream and downstream business partners with whom an organisation conduct business transactions	Chong and Ooi (2008), Lai *et al.* (2007), Lin and Lin (2008), Oliveira and Martins (2010), Pan and Jang (2008), Wang *et al.* (2010), and Zhu *et al.* (2003)
	Regulatory support	Refers to support given by government to encourage the assimilation of IT innovation by firms	Nkhoma and Dang (2013), Zhu *et al.* (2006), and Makena (2013)

Table I. Factors for cloud computing adoption and sources innovation that exhibits favourable, appealing and easy-of-use characteristics diffuses more quickly than those that exhibit less of these attributes. Significant factors identified from prior adoption studies (e.g. Alshamaila *et al.*, 2013; Premkumar *et al.*, 1997; Thong, 1999) as components of the TC are RA, compatibility and complexity. RA is defined as "the degree to which an innovation is perceived as being better than the idea it supersedes" (Rogers, 2003, p. 299). RA of cloud computing is expressed in terms of cost flexibility, increased productivity and scalability (Armbrust *et al.*, 2009) to meet growing demand of businesses. The scalability advantage also propagates the green IT agenda as scaled infrastructure result in less power consumption (Marston *et al.*, 2011; Sultan, 2010). The "pay as you go" or pay-per-use feature of cloud computing helps businesses to control cost. Therefore, pay-per-use motivates CCA. This study adopts RA to measure CCA from the TC as depicted in the conceptual model in Figure 1. Accordingly, the study proposes the following hypothesis:

H1. RA has an influence on CCA.

Cloud security remains a concern as many organisations feel unease to put their data and resources on systems in the cloud for which they have limited control (Sultan, 2014; Zissis and Lekkas, 2012). Surprisingly, prior adoption studies (e.g. Premkumar and

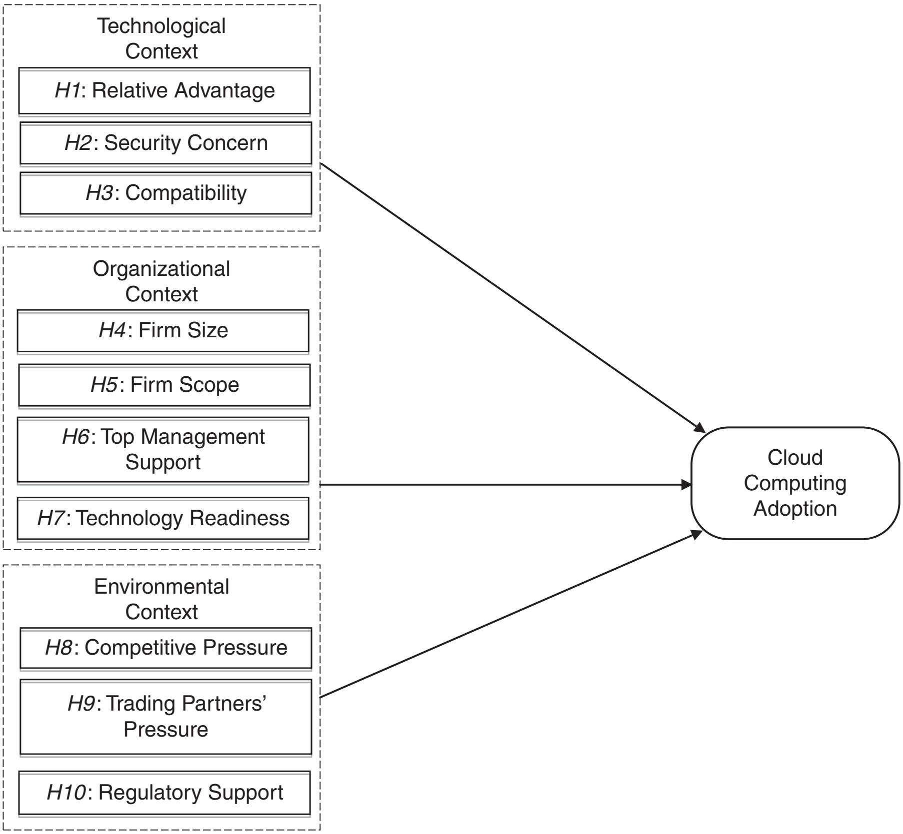


Figure 1.
Conceptual model for cloud computing adoption

Ramamurthy, 1995; Thong, 1999; Zhu *et al.*, 2003) have not stressed on security as an important determinant. To fill this knowledge gap, this study includes security concern (SC) as a determinant of CCA. SC is examined in this study in terms of how organisations feel about security systems in cloud services and whether they are willing to store their data in these systems irrespective of concerns. As an outcome, the study proposes that:

H2. SC influences the adoption of cloud computing.

The "degree to which an innovation is perceived as being consistent with existing value, past experiences and needs of receivers" (Rogers, 2003, p. 240) is referred to as compatibility. Even though system compatibility has improved over the years, the ability of a technology to fit and work perfectly with existing systems of an organisation is seen as a crucial attribute worth considering in any technology adoption (Lian *et al.*, 2014; Premkumar *et al.*, 1997). Compatibility of existing application is another factor that deters firms from adopting a technological innovation (Heinle and Strebel, 2010). Cloud service providers mostly have proprietary software that are not always compatible with existing systems of their clients. As a result, client of a cloud service provider needs to change their existing systems in order to deploy cloud systems. For example, if the existing data encryption method of an organisation varies from that of a cloud service provider, issues of compatibility will arise. Thus:

H3. Compatibility has an impact on the adoption of cloud computing.

Organisational context (OC). The second construct of the TOE framework is the OC. For a technology to be fully utilised, it should fit well within an organisational setting. Earlier information systems studies (e.g. Damanpour, 1987; Moch and Morse, 1977) identified factors such as formalization, centralisation and integration as organisational factors that determine the adoption of an innovation, but recent studies have accorded less support to these variables (Segars and Grover, 1993). The earlier variables are regarded to treat organisational features as objective realities whose factual character is unchallenged (Slappendel, 1996) and too simplistic to explain the complexity in adoption decision of an innovation (Premkumar *et al.*, 1997). On the contrary, current studies (e.g. Alshamaila *et al.*, 2013; Low *et al.*, 2011; Makena, 2013; Oliveira and Martins, 2010; Tornatzky and Klein, 1982) identify TMS, FS, scope and technological readiness (TR) as organisational factors that need to be considered in technology adoption. Anand and Kulshreshtha (2007) pointed out that FS is determined by number of employees, target market size and capital investment made in an organisation. As such, larger firms have the propensity to invest in innovations and stand to benefit greatly from the technology adoption decision. Similarly, other studies (e.g. Pan and Jang, 2008; Zhu *et al.*, 2003) have also asserted that large organisations tend to adopt an innovation due to the tendency to adjust to risk as compared to smaller once. However, the "pay-per-use" feature of cloud computing makes it easier for smaller firms to also adopt cloud computing. Thus, the hypothesis:

H4. The size of a firm influences adoption of cloud computing.

FS is closely juxtaposed with firm scope (FSC). The scope represents the area of operation of a firm. Cloud computing defies geographical restriction. Therefore, organisations with branches around the world are best suited to adopt cloud computing. Dewan *et al.* (1998) found that the greater the FSC the greater the demand for IT investment. Previous studies (e.g. Oliveira and Martins, 2010; Zhu *et al.*, 2003) have shown a positive relationship between IT adoption and FSC. This leads to the following hypothesis:

H5. The scope of a firm influences adoption of cloud computing.

TMS refers to the level of importance placed on an innovation by senior management. As such, the level of support results in the amount of resources allocated to that innovation (Oliveira and Martins, 2010). TMS is regarded as an important organisational factor to be considered in CCA since, it either advances or constraints the adoption decision. Prior studies (e.g. Alshamaila *et al.*, 2013; Pan and Jang, 2008; Premkumar *et al.*, 1997; Zhu *et al.*, 2003) indicate that TMS positively relates to adoption of an innovation. TMS is essential for providing adequate resources towards adoption. Additionally, if the adoption of cloud computing requires business process reengineering, the power of top management will be a significant organisational factor. This importance of TMS leads to the proffer of the hypothesis:

H6. TMS influences CCA.

TR refers to the degree to which technological infrastructure and human resources are needed to support adoption of an innovation (Oliveira and Martins, 2010). Technological infrastructure consist of hardware, software, network resources and services required for the existence, operation and management of cloud computing in an organisation. The human resource readiness on the other hand is the knowledge and skills of people required to implement and manage cloud computing services in organisations (Lian *et al.*, 2014). Most cloud service providers are far away from their users. Hence, user organisation requires reliable internet connection to access cloud based resources. Also, IT skills of the human resource in organisations is another factor that may influence that adoption of cloud computing (Oliveira and Martins, 2010; Pan and Jang, 2008; Wang *et al.*, 2010; Zhu *et al.*, 2003). As people will implement, operate and manage cloud services if adopted. Therefore, the availability of technological infrastructure and IT skills of human resource constitute the TR of a firm. As a result, TR is essential in the adoption of cloud computing. Thus, the proposition of the hypothesis:

H7. TR influences CCA.

Environmental context (EC). Businesses do not operate in a vacuum but rather in an environment characterised by conditions that constrain or promote their operations. It is important to consider environmental issues pertaining to technological adoption decision of organisations. The EC examines how industry characteristics and structure such as CP, infrastructure support and regulatory factors affect the adoption of an innovation. Earlier studies (Chong and Ooi, 2008; Low *et al.*, 2011; Oliveira and Martins, 2010; Wu and Subramaniam, 2009; Zhu *et al.*, 2003) have identified factors such as industry pressure, competitors, access to resources supplied by others and dealings with government as significant factors of adoption. These factors are considered important because they have substantial effect on the success of organisations. CP according to Oliveira and Martins (2010) refers to the intensity of competition among firms in an industry. CP in an industry sometimes precipitate adoption of a technology as firm can derive competitive advantage through adoption of an innovation. Thus, CP is identified as a motivator of adoption. In another strand, Porter and Millar (2010) posits that CP leads to IT adoption as it may alter the rules of competition. The resulting IT can give new ways to organisations to outperform their competitors. Therefore, this study adopts CP as a determinant of CCA. Thus, the hypothesis:

H8. CP influences CCA.

Some studies (e.g. Chong and Ooi, 2008; Pan and Jang, 2008) have asserted that trading partner pressure (TPP) is significant in the adoption of an innovation. Therefore, it is worth considering the significance of TPP in the adoption of cloud computing among organisations. Trade partners are individuals or organisations with whom an organisation conducts business (Anand and Kulshreshtha, 2007). Pressure from trading partners could occur from down or upward streams of a firm. As most firms rely on inputs and collaboration from partners to satisfy their customers, pressure from these partners will push an organisation to adopt an innovation in order to maintain their working relationship. Hence, it is hypothesised that:

H9. TPP influences CCA.

The last factor considered under the EC of the TOE framework is government regulations. Government regulations come in the form of laws that seek to promote and protect firms that adopt an innovation (Makena, 2013; Nkhoma and Dang, 2013). Cloud computing defies geographical boundaries and is accessible in different countries. Therefore, a legal support is deemed important to protect firms that adopt cloud computing as laws vary from country to country. For example, if an existing law prohibits the storage of health data outside the jurisdiction of a country, this will hinder the adoption of cloud storage because some cloud service providers exist outside the geographical boundaries of their users. Most cloud computing studies (e.g. Alshamaila *et al.*, 2013; Low *et al.*, 2011) have ignored this construct. However, a few (Makena, 2013; Nkhoma and Dang, 2013) have pointed out that it is important to consider the legal regulations that support and protect CCA. Some firms may feel reluctant to adopt cloud computing if they are not confident of a legal regulation that protect their data and privacy (Marston *et al.*, 2011). After consideration of this factor in the EC, the following hypothesis is proposed:

H10. Regulatory support influences CCA.

3. Research methodology

As noted above, the aim of this study is to investigate determinants of CCA among organisations from different industries in a developing country context. Data was collected using questionnaires designed in line with Churchill (1979) and Straub (1989) proposal for designing a survey instrument in order to ensure reliability and validity. The target population was organisations operating in Ghana and the sampling technique adopted was a stratified random sampling since it allows selection of a balance sample of the population from the subpopulation (Hair *et al.*, 2010). The subpopulations were Ghanaian and foreign-owned businesses operating in Ghana. For a respondent to be selected, it must first belong to one of these strata.

The list of companies in Ghana Club 100, firms registered on the Ghana Stock Exchange, and multinational companies operating in Ghana were consulted for targeted respondents. Participants were selected from the strata through a simple random method so that they may all have an equal chance of being selected. Data collection was carried out from January to March 2014. In terms of positions, the respondents from the selected organisations were IT staff and managers who have IT knowledge of the current and future operations of their respective organisations. After data entry and examination, 305 responses were deemed valid for further analysis. The valid responses represented 87.7 per cent of the targeted sample.

The data analysis technique adopted is structural equation modelling (SEM) and logistic regression. The data analysis was carried out in four phases, namely data examination, demographic analysis, confirmatory factor analysis (CFA) under SEM and logistic regression analysis. The data examination was undertaken to check for missing data, outliers and test of normality to enable further statistical analysis of the data set (Byrne, 2010). The demographics of participants was analysed and the results are present in the findings below. CFA was performed to test and validate the initial conceptual model. The CFA was conducted using AMOS version 22 on the data set to measure the model results since CFA helps to determine if a test of validity on a hypothesised model can be reproduced (Hair *et al.*, 2010; Byrne, 2010). Finally, logistic regression analysis was also performed to test the hypotheses in Section 2. The logistic regression technique was selected among other statistical methods because the dependent variable, CCA, was measured dichotomously.

4. Findings

4.1 Demographics of surveyed organisations

The distribution of respondents based on the industry they operate in are as follows. The IT services sector recorded the highest percentage of participants with a percentage of 13.4 per cent followed by educational with a percentage of 11.8 per cent and financial and banking services with a percentage of 10.8 per cent. The rest are government sector 9.5 per cent, media and communication 9.4 per cent, electricity, water supply, oil and gas 7.2 per cent, travel/leisure and hospitality 6.9 per cent, construction 6.2 per cent, real estate 5.6 per cent, manufacturing 5.2 per cent, health care 4.3 per cent, telecommunication 3.6, mining and quarrying 3.3 per cent and other industries 3.0 per cent. The coverage of industries shows that the data was representative of the population.

4.2 Assessment of the overall measurement model

The analysis on the determinants of CCA in this study is organised in twofolds. First, analysis of the measurement model validation through CFA and second, test of the hypotheses through logistic regression analysis. According to Hair *et al.* (2010), a method for examining a good representation of constructs in a conceptual model is through validation of the measurement model. From the CFA analysis, the second-order latent variable, TC was measured by combination of first-order latent variables RA, SC and compatibility (C). All the three variables RA, SC and C demonstrated strong convergent validity with standardized factor loading (FL) above 0.70 thus, were considered statistically valid to measure the TC.

In relation to the second-order latent variable, OC, two of the first-order latent variables were found not to satisfy convergent validity. OC was measured by latent variables, namely, FS, FSC, TMS and TR. Latent variables FS and FSC recorded standardized FL of 0.30 and 0.37, respectively. Their FL are lower than the recommended threshold of 0.70 hence, they were dropped from the measurement model.

On the other hand, TMS and TS had valid FL above the recommended threshold thus, they were maintain during the model modification process.

The last second-order factor in the measurement model is the latent variable EC, which is measured by first-order variables: CP, TPP and regulatory support (RS). All the first-order latent variables CP, TTP and RS measuring EC recorded significant FL of 0.91, 0.97 and 0.90, respectively, which are above the recommended threshold. Thus, these constructs are valid for further analysis and retention in the modified measurement model.

The *p*-value of the final measurement model was still significant despite the modification. However, it has been argued that the significance of the *p*-value is as a result of large sample size (Hair *et al.*, 2010). Therefore, a better criterion is the ratio of χ^2 to the degrees of freedom which is 1.73 and less than the threshold of 2 in Table II (Carmines and McIver, 1981). In terms of root mean square error of approximation, the final model had a value of 0.05, which is in agreement with the benchmark. Therefore, the measurement model fits the data set. The incremental fit indices obtained in the final measurement model are greater than the threshold of 0.90 ranging from 0.97 to 0.96 while the parsimonious fit indices also recorded values of 0.82 and 0.78, which are above the recommended value of 0.50. In relation to the test of discriminant validity, the average variance estimate (AVE) recorded by the second-order latent variables ranges from 0.89 to 0.92 as shown in Table III. These values are above the validity threshold of 0.50, an indication of acceptable convergent validity of the measuring scales (Hair *et al.*, 2010). Also, the AVE for each latent variable is higher than the square of the correlation between that construct and any other constructs, an indication of adequate discriminant validity between the constructs (Cable and DeRue, 2002).

Goodness-of-fit Indices	Benchmark	Initial model
Absolute goodness-of-fit measure		
χ^2 (CMIN)	$p \geqslant 0.05$	0.00
χ^2/degree of freedom	$\leqslant 2$	1.73
Absolute badness of fit measure		
Root mean square error of approximation (RMSEA)	$\leqslant 0.08$	0.05
Incremental fit measure		
Comparative fit index (CFI)	$\geqslant 0.90$	0.97
Incremental fit index (IFI)	$\geqslant 0.90$	0.97
Turker-Lewis index (TLI)	$\geqslant 0.90$	0.96
Parsimony fit measure		
Parsimony comparative of fit index (PCFI)	$\geqslant 0.50$	0.82
Parsimony normed of fit index (PNFI)	$\geqslant 0.50$	0.78

Table II. Goodness-of-fit indices for final measurement model

Constructs	CR	AVE	Shared variance EC	TC	OC
EC	0.963	0.898	*0.948*		
TC	0.941	0.841	0.542	*0.917*	
OC	0.956	0.915	0.539	0.331	*0.957*

Table III. Construct, AVE and shared variance

In conclusion, the final measurement model supported the data set with eight latent variables out of the initial ten proposed in the conceptual framework. The factors supported based on the TOE framework among Ghanaian organisations are RA, SC, compatibility, TMS, TR, CP, TPP and RS.

4.3 Hypotheses confirmation

The steps adopted in testing the hypotheses using logistic regression are: a χ^2 test for the change in −2LL value from the base model, Hosmer and Lemeshow test of model fit, and Wald statistic estimation. The χ^2 test is used to conduct an assessment of how the independent variables have significantly improved the model fit. According to Hair *et al.* (2010), logistic regression uses the value of −2L times the log to predict the model. The −2LL, and the R^2 values of the base model are shown in Table IV. Nagelkerke R^2 value of 13.2 per cent indicates the variation in the data that is explained by the logistic regression model.

Hosmer and Lemeshow test is another means of comparing the conceptual model with the base model (Lemeshow and Hosmer, 1982). From Table V, the Hosmer-Lemeshow test was insignificant indicating that the conceptual model is not much different from the base model hence, possesses a good explanatory capability.

Lastly, the level of significance and hypotheses testing of individual independent variable is performed using the Wald test and significant values, respectively (Hair *et al.*, 2010). The significant values indicate that out of the ten independent variables, six were significant in determining CCA. The result of the logistic regression in Table VI indicates that out of the ten hypotheses proposed at the beginning of the

Table IV. Model summary

Step	−2 Log likelihood	Cox and Snell R^2	Nagelkerke R^2
1	364.032	0.097	0.132

Table V. Hosmer and Lemeshow test

Step	χ^2	df	Sig.
1	10.538	8	0.229

Table VI. Hypotheses confirmation in logistic regression

Factors	Coefficient (β)	SE	Wald	p-value	Support for model
Relative advantage (RA)	−0.534	0.261	4.176	0.041	*H1*: supported
Security concern (SC)	0.602	0.257	5.466	0.019	*H2*: supported
Compatibility (C)	0.244	0.175	1.943	0.163	*H3*: rejected
Firm size (FS)	0.159	0.147	1.173	0.279	*H4*: rejected
Firm scope (FSC)	0.055	0.195	0.080	0.777	*H5*: rejected
Top management support (TMS)	−0.417	0.163	6.543	0.011	*H6*: supported
Technology readiness (TR)	0.665	0.300	4.933	0.026	*H7*: supported
Competitive pressure (CP)	0.423	0.208	4.139	0.042	*H8*: supported
Trading partners pressure (TPP)	−0.780	0.301	6.697	0.010	*H9*: supported
Regulatory support (TS)	0.150	0.203	0.549	0.459	*H10*: rejected
Constant	−1.020	0.845	1.457	0.227	

Notes: $^*p < 0.05$; $^{**}p < 0.01$

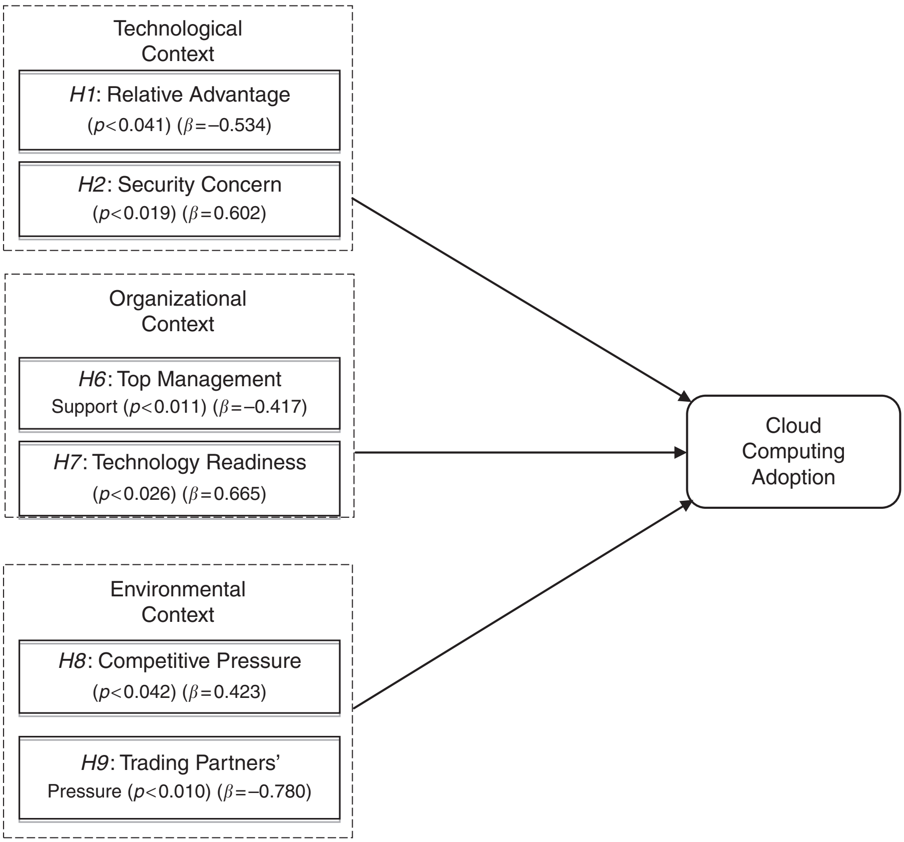
study, six of them were significant. The six supported factors with *p*-values less than the threshold of 0.05 are RA, SC, TMS, CP, TPP and TR. The factors with *p*-values greater than 0.05 and subsequently rejected by the model are FSC, FS, compatibility and RS.

Figure 2 shows the final research model with the respective significant and coefficient values of the determinant of CCA. Among the factors with significant *p*-values, TPP recorded the highest Wald value, respectively, followed by TMS, SC, TR, RA and CP, an indication that the most important determinant of CCA in a developing country context is TPP. Table VII also provides inter-item correlation of the variables used in the study.

5. Discussion

5.1 TC

The TC initially consisted of RA, SC and compatibility. However, after the data analysis, only two factors, RA and SC, were supported. The significance of RA in the adoption of cloud computing is consistent with some studies (e.g. Low *et al.*, 2011; To and Ngai, 2006; Wang *et al.*, 2010). However, its negative relation to the adoption of cloud computing is inconsistent with the studies above except the findings of



Notes: $^{*}p<0.05$; $^{**}p<0.01$

Figure 2. Cloud computing adoption model

Table VII. Items inter-correlation matrix

	RA	C	SC	TMS	FS	FSC	TR	TPP	CP	RS	CCA
RA	1.00										
C	0.28	1.00									
SC	0.81	0.28	1.00								
TMS	0.25	0.24	0.26	1.00							
FS	0.27	0.28	0.25	0.49	1.00						
FSC	0.26	0.19	0.26	0.20	0.18	1.00					
TR	0.28	0.16	0.34	0.20	0.19	0.36	1.00				
TPP	0.36	0.17	0.43	0.19	0.21	0.35	0.83	1.00			
CP	0.39	0.21	0.38	0.22	0.20	0.39	0.70	0.68	1.00		
RS	0.67	0.23	0.67	0.30	0.28	0.27	0.33	0.43	0.41	1.00	
CCA	0.06	0.11	0.14	−0.05	0.06	0.09	0.17	0.09	0.19	0.10	1.00

Low *et al.* (2011). This negative relationship could be attributed to the technical knowledge required to understand cloud computing, a relatively new technology, and its complex billing mechanisms. SC also had significant impact on the adoption of cloud computing and this is also in agreement with extant studies (e.g. Chebrolu, 2011; Sultan, 2014; Zissis and Lekkas, 2012). These prior studies emphasised the importance of security in the adoption of an innovation. The nature of cloud computing dictates a critical look at security of data, systems and service providers because, a breach could result in serious problems for adopters. Therefore, its significance as a determinant is in the right direction. Prior studies (e.g. Oliveira and Martins, 2010; Wang *et al.*, 2010) pointed out compatibility as a significant determinant of cloud adoption. Conversely, it was found to be insignificant in the adoption of cloud computing in a developing country context. Nonetheless, the non-significance of compatibility in this study is consistent with Low *et al.* (2011). The non-significance of compatibility is explained by successful implementation of similar information systems in the past. Thus, an organisation will then perceive cloud computing to be compatible with existing systems.

5.2 OC

FS, FSC, TMS and TR were determinants that constituted the OC for CCA. After the data analysis, TMS and TR were the factors found to have significant impact on the adoption of cloud computing. The significance of TMS is consistent with other studies (e.g. Dholakia and Kshetri, 2004; Low *et al.*, 2011; Pan and Jang, 2008; Alshamaila *et al.*, 2013) as it is regarded a very important determinant in the adoption of a technology. Business process reengineering and allocation of resources may be required as a result of a technology adoption, thus, the backing of top management is needed. Therefore, TMS is vital in the adoption of cloud computing. TR is another factor that had significant impact on the adoption of cloud computing in a developing country perspective. Its significance is in line with previous studies (e.g. Oliveira and Martins, 2010; Zhu *et al.*, 2003). The significance of TR reiterates the point that technological infrastructure and human resources are necessary for technology adoption. Conversely, FS, and FSC were insignificant. This result is contrary to some extant studies (e.g. Dholakia and Kshetri, 2004; Low *et al.*, 2011; Pan and Jang, 2008). However, this situation could be explained by the unique feature of "pay-per-use" in cloud systems. Thus, providing a better alternative to monitor and control cost. Rendering the size and scope of the firm less significant in the adoption of cloud computing.

5.3 EC

The EC is constituted by CP, TPP and RS. Competitive and TPPs were the significant determinants of CCA while RS was insignificant. Prior studies (e.g. Oliveira and Martins, 2010; Pan and Jang, 2008; Wang *et al.*, 2010) also point out that competitors and trading partners are significant determinants in technology adoption. The findings in this study also confirm this position. However, this finding is converse to the findings of Alshamaila *et al.* (2013) in which CP was found to be insignificant in CCA from a developed country context. This indicates that organisations from developed and developing contexts respond differently to CCA. IT adoption may alter the rules of competition and give an organisation new ways to operate and outperform their competitors. On the other hand, pressure from trading partners may force a business to adopt an innovation in order to maintain cooperative relationship with these partners.

The finding on RS is not consistent with results from previous studies (e.g. Makena, 2013; Nkhoma and Dang, 2013; Zhu *et al.*, 2003). However, this may be attributed to many reasons. The first being the rate at which technological development and growth surpasses legislation. As a result, organisations may decide that RS is not that important in adoption. Also, cloud computing is in its infancy and yet to gain significant consideration for policy regulation especially in developing countries. Again, government regulations are also seen to be playing catch-up with technological innovations in developing countries. Therefore, if organisations decide to wait for complete legislation from governments, adoption of a new technology will become a problem. Nonetheless, the non-significant nature of RS does not make it less important.

6. Conclusion

This study investigated the determinants of CCA among organisations from different industries in a developing country. The study adopted the TOE framework as a guiding lens to tackle adoption from multiple contexts. The constructs employed in the study were tested and validated using CFA while the hypotheses were tested using logistic regression. Given the dichotomous nature of the dependent variable (CCA), logistic regression was chosen among other multivariate techniques to test and validate the hypotheses proposed in relation to the ten factors. The initial conceptual model consisted of ten variables. The results from the CFA analysis and the logistic regression provided support for six variables out of the initial ten. The confirmed variables are: RA, SC, TMS, TR, CP and TPP. The other four factors, namely FS, FSC, compatibility and RS were insignificant to the model and were therefore rejected as determinants of CCA from a developing country context.

The findings in this study once again emphases the point that technological adoption cannot be studied from one context. Rather, TOE contexts should be considered as they may promote or inhibit adoption. Also, the mix results in terms of determinants of CCA in developed and developing country context points out the importance of geographical context in technology adoption. Considering the clarifications provided by this study, it is therefore important for organisations to pay more attention to the significant factors especially in developing country context, particularly to a new construct security, which most cloud computing studies have ignored.

6.1 Contribution to research, practice and policy

This study has made significant contributions to research, practice and policy. In regards to research, this study contributes to the body of knowledge on cloud computing by testing and validating the TOE framework in a developing country perspective. This is an important contribution given the existence of cultural and societal idiosyncrasies in different countries. The study also provides empirical support that, the adoption of cloud computing cannot be studied from just the technological or OCs since the findings indicate the importance of environmental factors in the adoption of cloud computing. Lastly, the study bridges the ostensible literature gap on cloud computing between the developed and developing countries.

This study contributes to practice by drawing attention of practitioners to important factors in CCA. Thus, organisations venturing into cloud computing have a fundamental understanding of the determinants, a knowledge arguably not previously available to developing country organisations. Therefore, firms planning to adopt cloud computing in developing countries need to take critical look at TPP, TMS, SC, TR, RA and CP.

With regards to policy, it is noted that creating a favourable ICT environment will positively influence the adoption of cloud computing. The enabling environment in the form of legislation, ICT infrastructure and policies will propagate the cloud computing agenda. This study reiterates the importance of adequate RS in the form of policies to support cloud computing as current laws are seen as playing catch-up with technological developments especially in developing countries.

6.2 Limitations and future research directions

Some limitations have been identified in this study therefore, future research directions have been suggested. First, the study focused on organisations in one developing country. Therefore, similar studies should be conducted in other developing countries to consolidate the findings. Second, this quantitative study might not provide deep explanation thus, future studies should consider testing the determinants in a qualitative setting. Also, a challenge is made to both researchers and practitioners to go beyond developing cloud applications for financial and ICT sectors and consider other sectors with less CCA such as agriculture and manufacturing.

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