# Cloud Computing Adoption for Business Development: A TOE Perspective

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## Abstract
This paper explores the factors impacting cloud computing adoption in the South African financial services sector. Through a literature review the merits and relevance of the Technology Organization Environment (TOE) model is shown. Using the three contexts of the TOE model eight variables influencing the intention to adopt cloud computing is examined. An online survey of IT and business managers working within the South African financial services sectors was conducted. The results of a PLS-SEM analysis of the data shows that top-management support and compatibility are significant predictors within the sample and context of the research. The research builds upon previous technology adoption studies and adds new findings in a developing country context. The growing relevance and adoption of cloud computing makes the results relevant to a broader organizational audience within similar contexts.

***Keywords***
Cloud computing, adoption, Technology Organization Environment (TOE), financial services, South Africa

## Introduction
The financial services sector plays a significant role in the South African economy, with information systems and technology playing a significant role in these institutions. Information technology (IT) has evolved to becoming increasingly Internet-based, with cloud computing as its natural progression. Advances in IT have facilitated novel ways of delivering financial services and products. Innovative institutions are continuing to explore

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avenues such as mobile and Internet service delivery to gain competitive advantage. Financial institutions are no longer sheltered by protective laws, but compete in a global market.

Research estimates that cloud computing would create nearly 14 million jobs globally by 2015; of those nearly 145,000 will be in South Africa (IDC, 2012). It is suggested that job creation would predominantly take place in the financial services, discrete manufacturing, and communication and media sectors. Furthermore, predicted revenues from cloud innovations will reach $1.1 trillion per year by 2015 which, combined with efficiencies due to cloud usage, is anticipated to significantly drive institutional reinvestment and job growth (IDC, 2012). Driving productivity, reducing costs and freeing IT staff to focus on mission-critical work are amongst the identified institutional benefits of cloud computing.

As cloud computing is relatively new to South Africa codes of conduct, best practices, guidelines, and standards (already available in other geographies) are still developing. One prominent area of concern is the development and implementation of data protection and privacy laws – institutions need to understand and ensure that their customers' personal data is securely stored and transmitted (Bortz, 2011). A sound infrastructure is also essential for effective delivery. Over the past five years improvements have been made to South Africa's communications infrastructure, which in turn has improved the environment of cloud technology and delivery.

Within the ICT4D community, the surge of cloud computing is observed with great interest where parallel are being drawn between cloud computing and the rise of other emerging technologies such as social media and mobile phones (Prasad & Murti, 2012; Sultan, 2013). Questions are being asked whether cloud computing technologies carry the potential of creating a similar paradigm shift in the way IT resources and services can be used and distributed specifically in developing countries and the potential impact to the public as well as private sector (Greengard, 2010).

This research focuses on the key factors influencing the adoption of cloud computing in the South African financial service sector. The objective is to assist institutions to understand the factors influencing cloud computing adoption, the associated benefits, and drawbacks. The South African financial services sector is globally competitive and relatively well positioned internationally. This makes it an important sector to evaluate and could possibly provide valuable insight for others sectors.

This paper is structured as follows. First a brief background discussion of cloud computing introduces the domain. Thereafter the research model for this study is presented, followed by the research methodology. Then the results of a PLS-SEM analysis and the findings are presented. Finally, the limitations and potential for future work concludes the paper.

# Background

Financial services institutions that utilize a great deal of IT enabled services would benefit from cloud computing (Garg, 2011). This section first defines cloud computing, the benefits and drawbacks, before looking at adoption studies in this domain.

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## The Cloud Computing Domain

Garg (2011) describes cloud computing as a powerful combination of autonomic computing and public utility, such as the telephone network or electricity grid. Like public utilities it possesses elasticity for upward or downward scaling and is accessed through pooled computing resources using a multi-tenant model. Cloud computing combines the advances in dynamic fields such as utility, distributed and grid computing, web services and service orientated architecture (Weiss, 2007). It uses the Internet to offer software and hardware services for personal or professional (business) use. Resource usage is metered and billing is done using a utility computing model.

Extensive monitoring capabilities forms a key part of the cloud computing service offering. Service Level Agreements (SLAs) between the cloud service provider and the consumer will set out who is responsible for monitoring and reporting on any changes to the institution's IT network or software as a service (SaaS). This may extend to allow for management too – where the third party is allowed to respond to changes (in a predetermined manner) as they occur. Integration services provide clients with tools to develop adapters and mappings that will allow the use of various data formats and services.

## Benefits of Cloud Computing

Cloud Computing offers reduced capital costs, as the startup costs are borne by the cloud provider. Cloud users' savings span areas such as IT infrastructure, computer hardware, and software. When utilizing cloud computing users have access to increased computing power, storage capacity, and performance, with the option of upgrading or downgrading in response to cyclical or periodic fluctuations in demand. As cloud providers are responsible for maintenance of the cloud, and security of their users' data, users benefit from enhanced services such as reliability and increased data safety without having to deal with maintenance issues (Miller, 2008).

The most important benefit of cloud computing to business is the cost savings. Grossman (2009) explains that this is due to usage-based pricing model which helps reduce initial capital outlay and overcome barriers to entry. Research shows that institutions owning their in-house IT infrastructure use less than 50 percent of their IT resources optimally (Leavitt, 2009). Cloud data centers on the other hand are able to offer their users increased availability without the upfront financial outlay or associated risk. By using cloud computing these institutions can increase their operational efficiency and promote business continuity, whilst still reducing costs. Internet providers encourage institutions to scale up within clouds, thus enjoying increased capacity on demand without the heavy capital outlay (Grossman, 2009).

Another key benefit of using cloud computing is its implementation agility – IT professionals can quickly develop and deploy cloud applications. Applications developed or amended in the cloud have the benefit of being accessible to users across the globe without restricting the number of users (Melvin & Greer, 2009). As institutions are not managing the process themselves they are spared the red tape and time delay of software and hardware sign-off and deployment. Thus the institution's products or services reach the market more swiftly (Vile & Liddle, 2009).

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As applications hosted in the cloud generally use interfaces similar to that of web based browsers or windows based applications, users find them familiar and take to them with ease. This promotes adoption and user satisfaction while reducing the duration of the initial learning curve (Melvin & Greer, 2009). Also, as cloud providers tend to not use contracts to lock their customers in, an initial trial of services is encouraged and may lead to expanded usage. This flexibility is a strong motivator for cloud adoption and particularly the software as a service (SaaS) model.

## Drawbacks of Cloud Computing

The need for a strong and reliable Internet connection is critical for efficient usage of cloud computing. Without reliable connectivity cloud services become inaccessible to the user. The speed of the connection also plays an important role in facilitating smooth usage of various services. Slow connections can cause frustration to users and reduce customer satisfaction (Miller, 2008; Leavitt, 2009). In cases where the user needs an increase in bandwidth and speed of broadband, in order to make better use of cloud computing, this financial outlay may offset part of the savings previously made from not purchasing software and hardware (Leavitt, 2009).

A possible drawback of SaaS is that applications which run remotely are slower than if these applications were run from the institution's premises. To reduce this risk implementations often limit features offered by the applications (Miller, 2008; Melvin & Greer, 2009).

Further concerns for users when considering cloud usage, particularly for larger institutions handling confidential information or customer data, includes legal restrictions (which may differ across geographies) and security standards maintained by the cloud providers (Grossman, 2009). A thorough understanding of legal and privacy issues is important to protect information and it has been shown that (South African) companies are not always aware of the legal frameworks that are in place (Gebers & Ophoff, 2013).

## Related work on Cloud Computing Adoption

As the remote access offered by cloud computing opens doors to innovative new ways of doing business, various studies have investigated cloud computing as far as security requirements, new technologies and future expectations are concerned (Tuncay, 2010). Such studies include:

- In response to these innovations Misra and Mondal (2010) developed two financial models for cloud users, one for new businesses and another for businesses with existing IT infrastructure. Their research found that small to medium institutions, who may not have much capital to invest upfront, were attracted by the pay-per-use billing model of clouds.
- The size of an institution was found to have a material impact on perceived importance of cloud services and technological developments within the institution. Pyke (2009) found that larger institutions preferred managing their core processes locally.
- Banerjee (2009) conducted research on technology at HP labs, where cloud based smart environments were developed based on utility computing data centers. Grossman (2009) researched the development of hardware geared towards optimizing networks in

support of data mining software.

The potential contribution of cloud computing technology to national development especially in developing countries is increasingly becoming a subject of discussion within the ICT4D community. Primarily, cloud computing is seen to present opportunities in the public sector especially on improving service delivery in areas such as education, health as well as governance (Kshetri, 2010; Goundar, 2010). Within the private sector cloud computing is seen to open up new markets as well as possibilities for new business and business models (Greengard, 2010). Perhaps the one aspect that seem to stand out in ICT4D research community is interest on how cloud computing will affect the access to content and services via mobile phones which have seen significant interest and usage in developing countries (Goundar, 2010; Prasad & Murti, 2012; Sultan, 2013). Looking specifically into the financial sector, cloud computing is seen as an opportunity for companies to lower their IT costs but it also offers opportunities for new business models and new markets that are more suitable to consumers in developing countries (Dogo, Salami, & Salman, 2013; Ghosh, Joyee, & Mahanti, 2014; Ksheri, 2011).

However, as pointed out by Ksheri (2011), there are many inconsistencies on findings and conclusions drawn from research as well as experiences regarding impact and potential of cloud computing in developing countries. Furthermore, concerns have being raised with regard to the viability and sustainability of cloud computing technology in developing countries citing challenges such as limited bandwidth as well as unreliable electricity supply (Greengard, 2010; Ksheri, 2010). These challenges are additional to the well documented challenges of data security and privacy that have so far impacted the adoption of cloud computing technologies globally.

# Theoretical Framework

The model for this research was compiled and adapted from the Technology Organization Environment (TOE) model developed by Tornatzky and Fleischer (1990). This section reviews organizational adoption of innovations and potential factors affecting institutional adoption of cloud computing. This provides context to the methodology and results from this research.

## Innovation Diffusion Theory

Cloud computing is an innovation in the evolution of IT. Innovation Diffusion Theory (IDT), as developed by Rogers (1995), is a leading theory in studying organizational adoption of IT. In IDT innovation is defined as “an idea, practice or object that is perceived as new by an individual or unit of adoption” (Rogers, 1995, p. 2).

IDT facilitates the study of how, why, and at what rate innovations are adopted by individuals or other adopting units (Rogers, 1995). IDT postulates that innovations possess attributes which adopters perceive, and that these attributes affect the innovation’s adoption. The attributes identified by Rogers (1995) include trial-ability, relative advantage, observability, compatibility, and complexity. Each attribute is believed to reduce the potential adopter’s uncertainty regarding the perceived benefits of adopting the relevant innovation.

Rogers (1995) identifies leader characteristics (leader's attitude towards change), internal organizational characteristics (centralization, complexity, formalization, interconnectedness, organizational slack, size) and external characteristics of the organization (system openness), as adoption predictors known as the organizational innovation adoption model. These characteristics were also found to influence organizational adoption of technology innovations.

IDT also brings to the fore the innovation adoption decision process which is defined as the process by which individuals or decision making units progress in order to move from gaining initial knowledge of an innovation to the adoption or rejection decision (Rogers, 1995). The decision making unit progresses through five stages during this process: the knowledge stage, persuasion stage, decision stage, implementation stage, and confirmation stage. This research will focus on the first three stages of this process.

## Technology Organization Environment Model

The five technology attributes of IDT is congruent with the Technology Organization Environment (TOE) model (Pan & Jang, 2008; Shirish & Teo, 2010; Wang et al., 2010). The TOE model, as developed by Tornatzky and Fleischer (1990), establishes a framework that focuses on the three key areas (namely technology, organization, and environment) affecting the adoption and implementation of new technologies and innovations.

The first area, technology, refers to the organization's external and internal technologies. The second, organization, refers to the various indices relating to the origin of the organization, for instance its scope, size, level of formalization, whether it is centralized or decentralized, complexity of management structures and organizational structures, and the efficiency and effectiveness of the organization's human resources component. Lastly, the environment refers to the organizations external and uncontrollable factors such as the legal environment (government policies, laws), the industry, as well as competition (Tornatzky & Fleischer, 1990).

Further to this, Swanson (1995) asserts that for complex IT innovations to be adopted, an advantageous organizational structure, technology portfolio, and environmental strategy were needed. Similarly, numerous other researchers have examined, adopted, and adapted the TOE model, reinforcing the value of the model as an effective and adaptive research tool (e.g. Pan & Jang, 2008; Shirish & Teo, 2010).

## Research Model

This research uses the TOE model as a foundation, extending prior work by Yoon (2009) and Low, Chen, and Wu (2011). The dependent variable for this research is the intention to adopt cloud computing. Figure 1 presents the model used in this research.

In the technology context the following contexts are investigated. Relative advantage, where relative advantage was identified as the perceived benefits of cloud computing adoption. Compatibility which encapsulating both organization and technical compatibility. Security concern where security concern was measured in terms of the perception of the security of cloud computing. The above leads to the following hypotheses:

*Hypothesis 1: Relative advantage will have a positive influence on the intention to adopt cloud computing.*
*Hypothesis 2: Compatibility will have a positive influence on the intention to adopt cloud computing.*
*Hypothesis 3: Security concerns will have a negative influence on the intention to adopt cloud computing.*

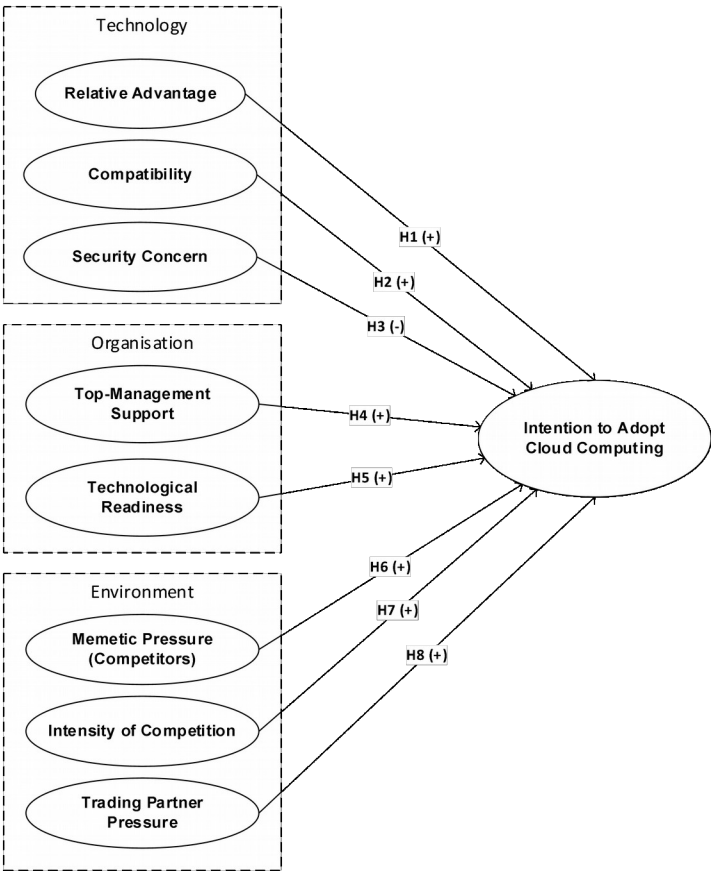


*Figure 1: Research Model*

In the organization context the following constructs are investigated. Top management support evaluates top managements interest in adopting cloud computing, the importance they ascribe to cloud computing, and the support shown to adoption. Organizational readiness is defined in terms of technical readiness which refers to the organization's IT sophistication. This includes technical expertise and level of management understanding and support of IT to achieve the organization's objectives. This leads to the following hypotheses:

*Hypothesis 4: Top management support will have a positive influence on the intention to adopt cloud computing.*
*Hypothesis 5: Technology readiness will have a positive influence on the intention to adopt cloud computing.*

In the environment context the following constructs are investigated. Mimetic pressure (competitors) relates to the perceived extent to which competitors are adopting cloud computing and the perceived success of competitors who have adopted. Intensity of

competition relates to the ease with which customers can switch to a competitor, level of rivalry in the industry and the availability of substitute products and services. Trading partner pressure is a normative pressure, which relates to suppliers and professional/trade association's perceived adoption of cloud computing. The above leads to the following hypotheses:

*Hypothesis 6: Competitive (mimetic) pressure will have a positive influence on the intention to adopt cloud computing.*

*Hypothesis 7: Intensity of competition will have a positive influence on the intention to adopt cloud computing.*

*Hypothesis 8: Trading partner pressure will have a positive influence on the intention to adopt cloud computing.*

# Methodology

The research was conducted from a positivistic perspective, following a deductive approach. The target population for this research was IT and business managers at South African financial services institutions, such as banks, investments houses, and institutions offering long and short term insurance.

An anonymous online questionnaire was used to collect data. Due to limited funding and short timeframe non-probability convenience sampling was used. A sample frame was compiled from publicly listed companies, such as that of the JSE, the Financial Services Board, other third party sources, and interest groups such as LinkedIn. A survey invitation was sent via email or fax to 350 IT and business managers working within the South African financial services sector. Managers who did not complete the questionnaire within the first two weeks were sent an electronic reminder. A further reminder was sent a week later. Thereafter, if no response was received, it was recorded as a non-response.

The questionnaire was compiled and adapted from the concepts and questions found in the research of Yoon (2009) and Low, Chen, and Wu (2011). Constructs were measured on a 7-point Likert scale. The use of items in previous studies promote their validity and reliability.

# Results and Analysis

The PLS approach to structural equation modeling (SEM) was used for data analysis due to its predictive nature. It has a secondary benefit of working efficiently with small sample sizes. PLS-SEM is "an ordinary least squares (OLS) regression-based method… [which] uses available data to estimate the path relationships in the model" (Hair, Hult, Ringle, & Sarstedt, 2014, p. 14). For the data analysis a popular implementation of PLS, SmartPLS 3 (Ringle, Wende, & Becker, 2015), was used.

The final data set contained 44 responses, each representing a different organization. Two missing values were present and dealt with using the mean replacement method. Basic demographics for the data set is reported in Table 1. The following subsections discuss the key aspects of the analysis.

| Demography | Category | Frequency | Percent (%) |
|---|---|---|---|
| Area of expertise | Business | 12 | 27 |

| | | | |
|---|---|---|---|
| | IT | 32 | 73 |
| Sector | Banking | 6 | 14 |
| | Investments | 10 | 23 |
| | Insurance | 25 | 57 |
| | Other | 3 | 7 |
| Organization size | 0-100 | 8 | 18 |
| | 101-1000 | 14 | 32 |
| | 1000 < | 22 | 50 |
| Approx. annual sales/revenue | R0-500 million | 15 | 34 |
| | R501 million – 1 billion | 7 | 16 |
| | R1 billion < | 22 | 50 |

*Table 1: Participant Demography*

## Evaluating the Reflective Measurement Model

An assessment of the reflective measurement model included examining composite reliability to evaluate internal consistency, individual indicator reliability, and average variance extracted (AVE) to evaluate convergent validity. In addition, cross loadings was used to assess discriminant validity. The initial path modeling procedure was performed using the default settings in SmartPLS.

As per the recommendation of (Hair et al., 2014, p. 103) indicators with weak outer loadings (< .4) were removed. This eliminated two indicators (one for technology readiness and another for intensity of competition). Subsequently indicators with outer loadings between .4 and .7 were considered for removal if the impact on composite reliability and AVE was substantial. In this process five indicators were eliminated (all related to technology readiness). The remaining indicators were considered to show sufficient indicator reliability. Following this process, the resulting values for composite reliability and AVE are shown in Table 2.

| Latent Variable | Indicators | Loadings | Composite Reliability | AVE |
|---|---|---|---|---|
| Relative Advantage | ra_1 | .613 | .882 | .558 |
| | ra_2 | .780 | | |
| | ra_3 | .720 | | |
| | ra_4 | .807 | | |
| | ra_5 | .830 | | |
| | ra_6 | .711 | | |
| Compatibility | comp_1 | .870 | .902 | .697 |
| | comp_2 | .803 | | |
| | comp_3 | .771 | | |
| | comp_4 | .889 | | |
| Security Concern | sec_1 | .975 | .976 | .932 |
| | sec_2 | .980 | | |
| | sec_3 | .940 | | |
| Top-Management Support | tms_1 | .957 | .943 | .847 |
| | tms_2 | .851 | | |
| | tms_3 | .949 | | |
| Technology Readiness | tr_1 | .973 | .802 | .678 |
| | tr_2 | .640 | | |
| Mimetic Pressure (Competitors) | mp_1 | .895 | .935 | .708 |
| | mp_2 | .881 | | |
| | mp_3 | .918 | | |
| | mp_4 | .846 | | |

| | | | | |
|---|---|---|---|---|
| | mp_5 | .751 | | |
| | mp_6 | .740 | | |
| Intensity of Competition | ic_1 | .999 | .761 | .636 |
| | ic_2 | .524 | | |
| Trading Partner Pressure | tpp_1 | .842 | .938 | .751 |
| | tpp_2 | .886 | | |
| | tpp_3 | .936 | | |
| | tpp_4 | .869 | | |
| | tpp_5 | .795 | | |
| Intention to Adopt Cloud Computing | intent_1 | .950 | .946 | .898 |
| | intent_2 | .945 | | |

*Table 2: Latent Variable Parameters*

Composite reliability is a more appropriate measure to Cronbach's alpha in PLS-SEM (Hair et al., 2014, p. 101). All composite reliability measures are above 0.7, which is a common cut-off point (Nunnally & Bernstein, 1994). Thus internal consistency reliability is shown. Each AVE is above 0.5, indicating that the construct explains more than half of the variance of its indicators, establishing sufficient convergent validity. To assess discriminant validity cross loadings were examined. All indicator's outer loadings on their construct were higher than cross loadings with other constructs, showing discriminant validity.

## Findings for the Structural Model

Findings from the PLS analysis of the structural model are shown in Figure 2. The coefficient of determination, $R^2$, is .843 for the dependent variable. Thus the eight latent variables explain a substantial 84.3% of the variance for the intention to adopt cloud computing variable. The inner model suggests that (organization) top-management support and (technology) compatibility has the strongest effect on intention to adopt cloud computing, with the path coefficients being .452 and .355 respectively.

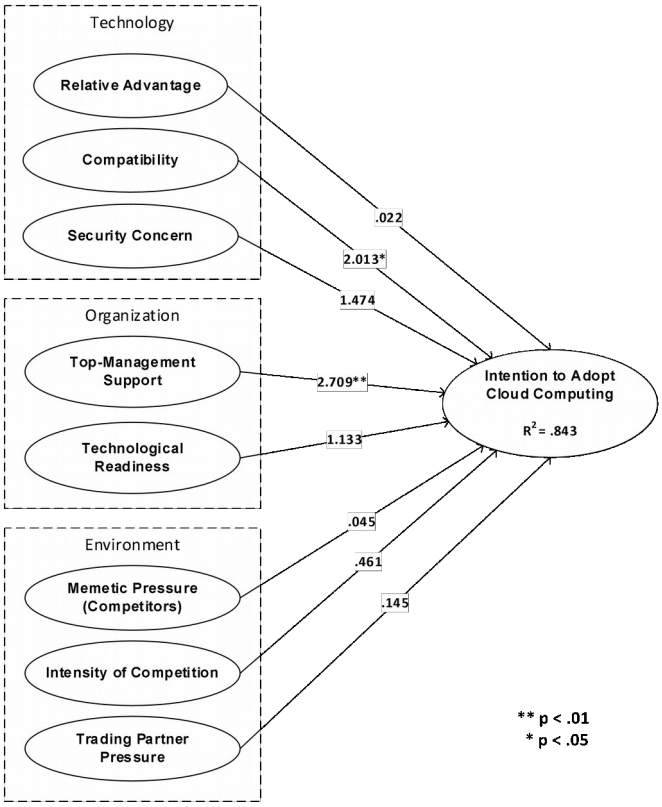


*Figure 2: PLS Analysis of Results*

A bootstrapping procedure using 5,000 samples, and the default settings in SmartPLS, was used to test the significance of the structural paths using T-statistics. The resulting values are indicated in Figure 2. Overall the research model found evidence to support H4 ($p < .01$) and H2 ($p < .05$). Therefore, for the sample of organizations: a) top-management support; and b) compatibility, will positively influence the organization's intention to adopt cloud computing.

Positive top-management attitude is shown to be a key contributing factor, making it important for such employees to have sufficient understanding of cloud computing to reduce resistance to change. The results also imply that compatibility is not a strong barrier to the adoption of cloud computing, indicating the technical feasibility of integrating such applications and services. This finding supports the proposition put forward by Kshetri (2011) that technological capabilities of local companies combined with experiences in serving the local market can positively facilitate the adoption of cloud computing in developing countries. Furthermore, while the study did not find the construct of relative advantage as a significant factor, this is inconsistent with the study by Low et al. (2011) on cloud computing adoption in the Taiwanese high-tech industry which found the construct of relative advantage to be a barrier to cloud computing adoption.

# Conclusion

While limited by a small sample size the results of this study indicate two key factors for the adoption of cloud computing in organizations: top-management support and compatibility within the organization. This study focused on a developing country (South

African) context and only within the financial services sector. As such, the targeted nature of products/services and strict regulatory requirements may influence the hypothesized constructs.

The findings should be explored in other developing country contexts to confirm and discover additional issues in such environments as well as address the various inconsistencies. Future research directions could focus qualitative data in order to gain an in-depth understanding of the constructs tested in this research and how they influence adoption. Comparative research into the differences between early adopters and non-adopters, focusing on their motivators, should also prove to be insightful.

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