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AN INTEGRATED THEORETICAL FRAMEWORK FOR CLOUD COMPUTING ADOPTION BY UNIVERSITIES TECHNOLOGY TRANSFER OFFICEs (TTOs)

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ABSTRACT

Cloud Computing (CC) as a new phenomenon technology has become a significant term in the world of information systems (IS). Adopting new technologies and developing new systems as new strategies help organizations to gain competitive advantage and become more efficient and productive. As cloud-based solutions have many advantages for organizations it is valuable for them to understand the determinants of cloud computing adoption. Organizations including Technology-Transfer-Offices (TTOs) need to improve their business methods by adopting CC. Despite the advantages of Cloud Computing, only a few studies have examined CC adoption in the IS field and in particular there is no study in the context of TTO. This paper aims to fill this gap by analyzing the determinants of CC adoption by Malaysian TTOs. Many factors influence CC adoption. The aim of this paper is to identify the factors and barriers which influence the adoption of CC by TTOs. To assess the determinants of CC adoption by TTOs, researcher proposed an integrated theoretical framework based on two theories of adoption: the Diffusion of Innovations (DOI) theory and Technology-Organization-Environment (TOE).

Keywords: *Cloud Computing, Adoption, Technology Transfer Office (TTO), Diffusion of Innovations (DOI), Technology-Organization-Environment (TOE)*

1. INTRODUCTION

In recent years, Information Technology (IT) is globally regarded as an essential tool that can improve business competitiveness and provide enormous advantages for organizations. Adopting new technologies and developing new systems as new IT strategies help organizations to gain competitive advantage and become more efficient and productive. Therefore, due to severe market competition and obviously changing business environment, organizations remain motivated to adopt new IT and to rapidly reorient their IT strategies including Cloud Computing to improve their business operations (Pan and Jang, 2008; Sultan, 2010; Low et al., 2011). Cloud Computing provides many advantages for all organizations, including TTOs. Despite the advantages of Cloud Computing, study on CC adoption seems to be one of the less examined research in the IS field (Wu et al., 2011) and particularly there is no study in the context of TTO. Therefore TTOs same as other organizations need to consider both the benefits and risks of CC to make better decision to adoption. Consequently, Technology Transfer Offices of Malaysian universities have been selected for this study as they are lagging behind Cloud Computing adoption.

1.1. Cloud Computing

Cloud Computing has become a critical player in the world of information technology (Sultan, 2010; Low et al., 2011, Buyya et al., 2009). According to (Saedi & Iahad, 2013) the term Cloud Computing (CC) "can be explained in two parts: First, using a web browser on the internet to dynamically allocate or de allocate the access of the remote computing resources based on the users' demands (Naone, 2007) and the second part refers to paying for the real use of the computing resources and facilities" (Hoover & Martin 2008; Kim et al. 2009).

Cloud Computing includes three different types of services: Software as a Service (SaaS), platform as a Service (PaaS), and Infrastructure as a Service (IaaS) Goscinski and Brock, 2010, Low et al., 2011, Wu, 2011). In SaaS, customers rent software applications from cloud service providers via the internet (Sultan, 2010) instead of installing them on their own computer (Salesforce.com, Customer Resource Management (CRM), and Google Apps). PaaS provides a virtualized platform in the cloud over the internet, upon which applications can be developed

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and executed (Salesforce.com, Microsoft Azure, and Google App Engine). The last category, which is the delivery of computer infrastructure as a service (IaaS), offers computing power and storage space. In this category clients pay on a per-use basis and services are presented by Amazon.com AWS, IBM Blue Cloud, SUN Network.com, Rackspace, and GoGrid.

Therefore Cloud Computing is defined as the ability of businesses and individual users to access applications from anywhere in the world on demand (Low et al., 2011; Misra & Mondal, 2010; Sultan, 2010).

According to NIST (National Institute of Standards and Technology) there are 4 types of deployment models of cloud computing (Mell & Grance, 2009; Das et al. 2011; Marston et al., 2011). The first is Private Cloud, where "the cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third party and may exist on premise or off premise". The second is Community Cloud where "the cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns. It may be managed by the organizations or a third party and may exist on premise or off premise". The third is Public Cloud. This is when "the cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services". And finally Hybrid Cloud, which is a combination of two or more types of cloud computing as previously described. (Khajeh-Hosseini et al., 2010)

1.2. Technology Transfer Office

Universities are definitely an important source of new knowledge in the area of science and technology. It is very important to identify mechanisms by which the results of university researchers can be transferred into industry (Yazdani et al., 2011; Siegel et al., 2005). In this process, a Technology Transfer Office (TTO) has the important role (Siegel et al., 2003). Many universities established technology transfer offices to manage and protect their intellectual property (Siegel et al., 2003). TTO were established at most universities with the mission of supporting and helping professors, students and administration to develop and commercialize their inventions Apple, 2008; Yazdani et al., 2011).

TTO should present a link between university researchers and entrepreneurship, or in one word, economy. However in both developed and developing countries there is still a gap between university and industry (Siegel et al., 2007). TTOs are important players of each market and they significantly contribute to each economy's GDP. Although TTOs are not powerful enough to influence the economy individually, overall they have a great impact. Therefore proposing new strategies and technologies that help TTOs become more efficient and effective also have a positive impact on the economy's growth as a whole (Siegel et al., 2004; Sharif et al., 2008) One strategy that helps organizations including TTOs to gain competitive advantage among competitors is investing in ICT (Siegel et al., 2007; Yazdani et al., 2011; Sharif et al., 2008).

Table 1: Previous Research Combined TOE and DOI

2. BACKGROUND OF STUDY

2.1. Cloud Computing Adoption

Cloud Computing is defined by the National Institute of Standards and Technology (NIST) as "a model for enabling 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" (Khajeh-Hosseini et al., 2010). Cloud computing is a kind of computing application service that is like e-mail, office software, and enterprise resource planning (ERP) and uses ubiquitous resources that can be shared by the business employee or trading partners. Thus, a user on the internet can communicate with many servers at the same time, and these servers exchange information among themselves (Hayes, 2008). Moreover, telecommunication and network technology have been progressing fast; Cloud computing services can provide the user seamless, convenient, and qualified technological support that can develop the enormous potential demand (Buyya et al., 2009; Pyke, 2009). Thus, cloud computing provides the opportunity of flexibility and adaptability to attract the market on demand. From a business point of view, firms are increasingly attempting to integrate business processes into their existing IS applications and build internet-based technologies for transacting business with trading partners (Tuncay, 2010). Cloud computing, as a new computing paradigm, offers many advantages to organizations (Saya et al., 2010) such as: flexibility, scalability, and reduced cost etc. Cloud computing enhances companies' competitive advantage (Throng, 2010). These advantages help companies grow larger

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and become more efficient, productive and innovative by allowing firms to focus on their core business. Cloud offers efficient communication, and improves collaboration which leads to work efficiency and coordination among organizations and enhances the ability to respond more quickly to changing market needs (Armbruat et al., 2010; Marston et al., 2011; Olivia et al., 2014). Therefore acceptance and usage of any beneficial technology such as CC by TTOs have a positive influence on the economy as a whole. Cloud Computing can provide several advantages for all organizations (Saya et al., 2010), both strategic and operational. Despite the advantages of Cloud Computing for organizations, only a few studies have examined the CC adoption in the IS field (Wu et al., 2011) and in particular there is no study in the TTO context. Moreover the cloud computing adoption rate is not growing as fast as expected (Banerjee, 2009). According to (Saya et al., 2010) most of the previous literature focused on Cloud computing's architecture (Rochwerger et al., 2009), potential applications (Liu & Orban 2008), and Cloud Computing costs and benefits (Assuncao et al., 2009). Besides developing a theoretical framework few have examined cloud computing adoption. While Cloud Computing provides many advantages to all enterprises it seems that the adoption of CC is still in early stages of diffusion (Saya et al., 2010; Khajeh-Hosseini et al. 2010; Saedi & Ihad, 2013) hence study on CC adoption is very important and useful. As a result it is important to identify the factors influencing the decision to adopt cloud computing.

2.2. Theories of Adoption

Many different theories and models have been proposed to study the process of adopting new technologies. Review of literature on Information Technology (IT) adoption shows that there are several studies at the individual level. There are many theories and models used for IT adoption at the individual level such as Technology Acceptance Model (TAM) (Davis, 1986; Davis, 1989; Davis et al., 1989), Theory of Planned Behavior (TPB) (Ajzen, 1985; Ajzen, 1991), TAM 2 (Venkatesh & Davis, 2000), Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). However, there are fewer studies at the organization level. This article mainly focused on well-known and most relevant theories for this study, Diffusion of Innovation (DOI), Technology-Organization-Environment (TOE).

2.2.1. Diffusion of Innovation (DOI)

Diffusion of Innovation Theory (DOI) is a theory developed by Everett Rogers (1962). DOI is a theory of how, why, and at what rate new ideas and technology spread through cultures (Rogers, 2003). DOI is mostly based on the innovation's characteristics and the perceptions of the users about the technology (Olivia, 2014). Rogers (1983) defined diffusion of innovation as "the process in which an innovation is communicated through certain channels over time within a particular social system". Rogers (2003) identified five important attributes of innovation that influence the decision whether to adopt or reject a particular innovation. These five attributes are valid for both individual and organizational adoption of technology. Rogers suggested the characteristics which influence the adoption of innovation as relative advantage, compatibility, complexity, observability, and trialability. Relative advantage is the degree to which an innovation can bring benefits to an organization. Compatibility refers to the degree to which an innovation is consistent with existing business processes, practices and value systems. Complexity considers the degree to which an innovation is difficult to use. Observability is the degree to which the results of an innovation are visible to others and trialability is the degree to which an innovation may be experimented with on a limited basis (Rogers, 2003).

2.2.2. Technology-organization-environment framework

TOE framework was developed by Tornatzky and Fleischer (1990) to analyze the adoption of technological innovation by firms and organizations. According to TOE framework there are three context groups: technological, organizational and environmental which influence the adoption an innovation at firm level (DePietro et al., 1990; Melville & Ramirez 2008; Low et al., 2011).

The technological context refers to the technologies available to an organization and the current state of technology in the organization. Technological context also refers to the characteristics of the innovation, for instance availability, compatibility and complexities which have a significant influence on adoption of innovation (Low et al., 2011). The organizational context describes the characteristics of an organization. Organizational characteristics consist of firm size, degree of centralization, formalization, complexity of its managerial structure, the quality of its human

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resources, and the amount of slack resources available internally. The environmental context refers to organization's environment (DePietro et al., 1990, Low et al., 2011) such as industry, competitors, regulations, and relationships with the government. These are external factors that present constraints and opportunities for technological innovations (DePietro et al., 1990).

The majority of these theories explains and predicts the adoption decision based on factors that are related to the technology itself (such as the characteristics of the technology, or users' perception about the technology). However, technology-related constructs are not the only factors that influence the adoption of technologies. There are other factors (such as environmental and organizational factors) that influence the decision to adopt an innovation. These factors, specifically environmental factors, are not taken into account in DOI. Technology-Organization-Environment (TOE) is another theoretical framework that overcomes this drawback. This framework not only uses technological aspects of the diffusion process, but also non-technological aspects such as environmental and organizational factors. Table 1 shows previous research that combined two theories in different context of IT adoption.

3. RESEARCH METHODOLOGY

The main aim of this research is to identify factors which influence the adoption of cloud computing by TTOs. This study proposed an integrated theoretical framework based on two theories including the DOI and TOE framework. An in-depth literature review was conducted by researcher to determine and identify factors and barriers which influence CC adoption. Quantitative method will be used in this research. Questionnaires will be used to collect data from case studies. After that a pilot study will be conducted to confirm the structure and content of the survey before conducting the main study; therefore, researcher will use a pilot study among TTOs in order to improve the variables. Online survey and paper based survey will be used for the collection of quantitative data. Intended data will be collected from Technology Transfer Offices of five public Malaysian research universities. Online questionnaires will be set up using Google Survey, and this online survey will be sent via e-mail to the TTOs managers. To analyze data Smart PLS software will be used.

4. RESEARCH FRAMEWORK AND HYPOTHESIS

In this study, an integrated theoretical framework for cloud computing adoption at technology transfer offices based on DOI and TOE that are used widely in IT adoption studies (Chong et al., 2009, Olivia et al., 2014) has been proposed. These two theoretical frameworks complement each other. DOI is mostly focused on characteristics of the technology and does not recognize environmental factors while TOE is a multiple perspective framework including environmental context influence the decision to adopt an innovation. When using the TOE framework in comparison with other adoption and diffusion theories it is much more relevant to arrange every determinant of CC adoption into three categories: technological, organizational, and environmental contexts. Moreover, the TOE theory is a very useful analytical tool to explain the adoption of innovation by firms (DePietro et al., 1990). Table 2 shows the list of variables included in this study.

Table 2: Variables used in this research

4.1. Research Theoretical Framework

Figure 1 demonstrates the initial integrated theoretical framework for adoption of cloud computing by TTOs. Research framework is founded based on two theories, TOE and DOI. In order to develop this integrated framework, factors of and barriers to CC adoption are categorized into four groups: Technology, Organization, Environment and Human characteristics.

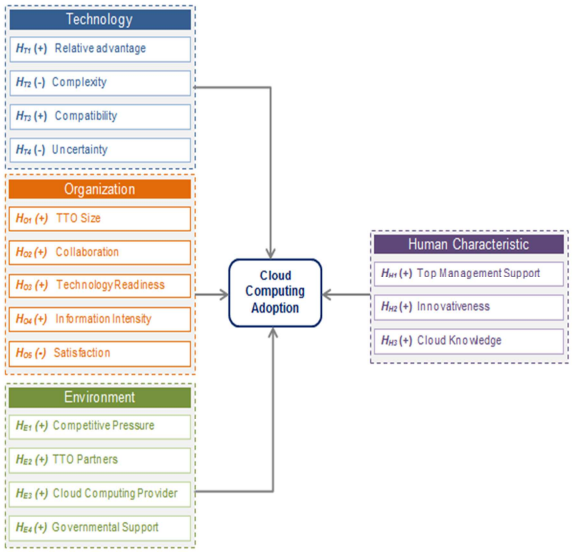

Figure1: Initial Integrated Theoretical Framework for Adoption of Cloud Computing by TTOs

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4.2. Research Hypothesis

In this section of the research, each construct is explained in more detail. The related hypothesis for each construct is then presented.

T.1 Relative Advantage: Rogers (2003) defined relative advantage as "the degree to which an innovation is perceived as providing better and greater benefit for firms". In this study relative advantage is defined as "the degree to which TTO managers perceive cloud computing as being better than other computing paradigms". Many previous studies in innovation adoption process identified that relative advantage is a significant determinant (Wang et al., 2010; Low et al., 2011; Olivia et al., 2014) therefore it is important to study the concept of relative advantage in the context of cloud computing.

According to (Saedi & Ihad, 2013), CC provides enormous advantages for all organizations. An advantageous technology is one that enables an organization to perform tasks quicker, easier and more efficiently. In addition, it can improve the quality, productivity and performance of the organization (Low et al., 2011; Armbrust et al., 2010; Hayes, 2008). For these reasons, relative advantage has a positive influence on adoption of cloud computing by TTOs; therefore in the context of cloud computing the below hypothesis is formulated:

HT1: Relative advantage will be positively correlated to the adoption of cloud computing

T.2 Complexity: Rogers (2003) defined complexity as "the degree to which an innovation is perceived as relatively difficult to understand and use", which is a definition which applies to Cloud Computing. According to (Buyya et al., 2009) organizations may doubt and have no confidence regarding the use of cloud computing because it is a relatively new technology for them. It may take time for users to understand and implement the new system. Thus, complexity of an innovation can act as a barrier to implementation of new technology; complexity factor is usually negatively affected (Premkumar et al., 1994). Therefore, researcher hypothesizes that in the context of cloud computing the level of complexity of the system has a negative influence on adoption of cloud computing:

HT2: Complexity will be negatively correlated to the adoption of cloud computing

T.3 Compatibility: Based on (Rogers, 1983) compatibility refers to "the degree to which innovation fits with the potential adopter's existing values, previous practices and current needs". Compatibility has been considered as a significant factor for innovation adoption (Cooper and Zmud, 1990; Wang et al., 2010). In this study compatibility is defined as "the degree to which cloud computing is perceived as consistent with the existing values, work styles, past experience, and requirements of the TTOs". When technology is recognized as compatible with work application systems, organizations are likely to consider the adoption of new technology. When technology is viewed as significantly incompatible, major adjustments in processes that involve considerable learning are required. Thus, the following hypothesis is proposed:

HT3: Compatibility will be positively correlated to the adoption of cloud computing

T.4 Uncertainty: Uncertainty refers to the extent to which the results of using an innovation are insecure (Ostlund, 1974; Fuchs, 2005). Rogers considers uncertainty as a significant barrier for innovation adoption (Rogers, 2003). In the context of cloud computing, security, privacy and lock-in are typical concerns that organizations may have (Aziz, 2010; Alshamaila & Papagiannidis, 2013). Therefore, uncertainty of the innovation can act as a barrier for cloud computing adoption. In this research uncertainty refers to insecurity. Recognition of concerns in cloud computing can be a possible hindrance to TTOs adopting cloud computing until uncertainties are resolved.

HT4: Level of uncertainty of the cloud computing will be negatively correlated to the adoption of cloud computing

O.1 TTO's Size: Size of the organization is one of the major determinants of IT innovation (Dholakia & Kshetri, 2004; Pan & Jang, 2008; Low et al., 2011). It is found to be an important factor that can influence the adoption of cloud computing. Firms with larger size have more flexibility in managing their resources either in the adoption or implementation of new IT. Hence they are more likely to take risks when adopting new IT (Premkumar & Roberts, 1999; Kevin Zhu et al., 2006; Low et al., 2011; Olivia et al., 2014). On the other hand, smaller firms have limited resources, which restrict their ability to take the risk of adopting new technologies. Consequently, firm size is an important factor that affects the perceived strategic importance of cloud computing in

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innovation technology development (Low et al., 2011).

HO1: TTO's size will be positively correlated with the adoption of cloud computing. TTOs with larger size are more likely to adopt cloud computing.

O.2 Collaboration: The degree of inter-organization collaboration includes contacts, interactions, relationships, joint programs and written agreements between trading partners (Granot, 1997) having equal aims in terms of product or service delivery, quality, productivity, and customer satisfaction (Chong et al., 2009). For organizations such as TTOs, having good communication pathways and improving collaboration among TTO partners is crucial to achieving their business goals. Thus for TTOs increasing and improving collaboration among TTO and partners is very significant. This claim can be supported by Subramani's (2004) study which found that the use of IT or internet-based technologies is a significant determinant leading to closer trading partner relationships. Morgan and Kieran (2013) in their study of Cloud Computing adoption revealed that one of the organizational factors influencing CC adoption is the desire to improve collaboration. They mentioned that adoption of cloud computing has resulted in more collaboration among partners. Consequently, if TTOs are willing to have more communication and collaboration with their partners they are more likely to adopt Cloud Computing in their business. These considerations lead to the following hypothesis:

HO2: Desire to improve collaboration for TTOs will be positively correlated with the adoption of cloud computing.

O.3 Technology Readiness: The technological readiness of organizations refers to technological infrastructure and IT human resources, which influence the adoption of technology (Kuan & Chau, 2001; Zhu et al., 2006; To & Ngai, 2006; Pan & Jang, 2008; Oliveira & Martins, 2010; Wang et al., 2010; Low et al., 2011). Technological infrastructure refers to installed network technologies and enterprise systems which provide a platform on which the cloud computing applications can be built. IT human resources provide the knowledge and skills to implement cloud-computing-related IT applications (Wang et al., 2010). Cloud computing services can become part of value chain activities only if firms have the required infrastructure and technical competence. Therefore, firms that have technological readiness are more prepared for the adoption of cloud computing. These considerations lead to the following hypothesis:

HO3: Technology readiness will be positively correlated with the adoption of cloud computing.

O.4 Information Intensity: Thong (1999) defined information intensity as "the degree to which information is present in the product or service of a business". Business or firms in different sectors have different information intensity. Moreover; those in more information intensive sectors are more likely to adopt IS (Porter & Millar, 1985). In this research information intensity is described as the firm's reliance on accessing accurate, up-to-date, relevant and reliable information whenever they need it. Based on the definition companies whose business depends on information are more likely to adopt cloud computing. The following hypothesis is related to this construct:

HO4: Information intensity will be positively correlated to the adoption of cloud computing

O.5 Satisfaction: defined as "the degree of satisfaction level with existing systems (Chau & Tam, 1997). The level of satisfaction with existing systems plays a significant role as far as motivation to change is concerned. It means that organizations that have high level of satisfaction with their current systems are not willing to adopt new technology (Chau & Tam, 1997). Organizational innovation proceeds in phases in which problems are first identified and then solutions are compared and evaluated (Rogers, 1983; Tornatzky & Fleischer, 1990). A low satisfaction level with existing systems, generally referred to as performance gap, will provide the impetus to find new ways to improve performance (Rogers, 1983). Based on this argument, the following hypothesis is suggested:

HO5: Satisfaction with existing systems will be negatively correlated to the adoption of Cloud Computing

E.1 Competitive Pressure: Competitive pressure refers to "the level of pressure felt by the firm from competitors within the industry" (Oliveira & Martins, 2010; Low et al., 2011). This factor is recognized in the innovation diffusion literature as an important driver for innovation diffusion (Low et al., 2011). By adopting Cloud Computing, firms benefit greatly from better understanding of market visibility, greater operation efficiency (Misra & Mondal, 2011). Cloud

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computing, as one of the new computing paradigms, is one way to achieve competitive advantage. In the context of this study researcher believes that TTOs that operate in more competitive environment are more likely to adopt cloud computing. The following hypothesis is suggested:

HE1: Competitive pressure will be positively correlated to the adoption of Cloud Computing

E.2 TTO Partners: Some empirical studies have identified that trading partners are an important determinant for IT adoption and use (Chong & Ooi, 2008; Lai et al., 2007; Lin & Lin, 2008; Pan & Jang, 2008; Zhu et al., 2004). Partners may be a facilitator for innovation adoption (Wang et al., 2010; Gibbs & Kraemer 2004). Many organizations rely on trading partners for their IT design and implementation tasks (Pan & Jang, 2008). Trading partner power or recommendation also have a positive effect on IT adoption decisions; this power can be either convincing or compulsory (Chong and Ooi (2008) and Oliveira and Martins (2010)). Moreover when firms face strong competition, they tend to implement changes more aggressively. Hence, in the context of this research, in order to have good communication between university and industry and to facilitate the technology transfer process, TTO partners positively influence on the adoption of cloud computing.

HE2: TTO Partners will be positively correlated to the adoption of cloud computing.

E.3 Cloud Computing Service Provider Support: Marketing activities that suppliers execute can significantly influence TTOs' adoption decisions. This may affect the diffusion process of a particular innovation. Previous researches such as Hultink et al. (1997), Frambach et al. (1998), Woodside & Biemans (2005), Alshamaila & Papagiannidis (2013), have attempted to show a link between supplier marketing efforts and the firm's adoption decision. In many studies these are known as "external factors" defined as "the perceived importance of support offered by cloud computing service providers". In this research, support includes marketing, training, customer service and technical support provided by cloud providers. Hence researcher thinks higher levels of marketing effort and support provided by cloud computing service providers increases the chance of cloud computing adoption by TTOs; therefore, the following hypothesis is proposed:

HE3: Higher level of support from cloud providers will be positively correlated to the adoption of cloud computing by TTOs

E.4 Government Support: Government support is another environmental factor that can influence Cloud Computing adoption. Government support is defined as "the different types of helps given by the government." (Khan & Chau, 2001 ; Zhu et al., 2004 ; Li et al., 2010; Das et al., 2011; ; Saedi & Iahad, 2013; Li, 2008). It refers to the support given by the authorities in order to promote the increase of IS innovations in firms. The perception that firms have of the existing laws and regulations can be determinant in this process. Thus, governments could encourage TTOs to adopt Cloud Computing by creating rules, support and promotion to protect businesses in the use of this system. For this research, the following hypothesis is proposed:

HE4: Government support will be positively correlated to the adoption of cloud computing.

H.1 Top Management Support: Top management support is a significant factor in the adoption of new technologies and has been found to be positively related to adoption (Premkumar & Roberts, 1999). Top management can provide vision, support, and a commitment to create a positive environment for innovation (Lee & Kim, 2007). Top management support and their attitudes towards change can be effective in the adoption of innovation (Premkumar & Michael, 1995; Eder & Igbaria, 2001; Daylami et al., 2005). Moreover, top management can send signals to different parts of the organization about the importance of the new technology (Thong, 1999; Wang et al., 2010; Low et al., 2011). Consequently, top management support is considered to have an impact on the decision to adopt cloud computing (Thong, 1999; Daylami et al., 2005; Wilson et al., 2008).

HH1: Top management support will be positively correlated to the adoption of cloud computing

H.2 Innovativeness: Thong and Yap (1995) defined Innovativeness as "the level of decision makers' preference to try solutions that have not been tried and therefore are risky". This factor can be linked to the individual or human characteristics of the decision maker's cognitive style (Marcati et al., 2008). According to (Alshamaila & Papagiannidis, 2013) "innovativeness refers to the openness to follow new ways and methods by which clients

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process information, take decisions and solve problems". Managers or decision makers who prefer to perform the tasks differently are more innovative; and hence they usually adopt new technologies (Alshamaila & Papagiannidis, 2013). Therefore it is hypothesized that TTOs managers or decision makers who are more innovative are more likely to adopt cloud computing.

HH2: Innovativeness is positively correlated to the adoption of cloud computing

H.3 Cloud Knowledge: As indicated in Diffusion of Innovation theory, that organizations have enough knowledge about an innovation for both decision maker and employees is the first step in adoption process. According to Thong (1999) CEO's knowledge of information system (IS) has a positive impact on the adoption of information systems. In this context the researcher believes that TTOs whose decision makers or managers are knowledgeable about cloud computing are more likely to adopt it. Similar to decision maker's cloud knowledge, employees' knowledge about cloud computing is also significant in the adoption of information systems. In addition, TTO whose employees have more knowledge about innovation offer less resistance towards the adoption of new technologies. There is also empirical evidence that shows the positive relationship between employees' IS knowledge and the decision to adopt IS (Thong, 1999). In the context of cloud computing, the following hypothesis has been proposed:

HH3: Having knowledge about cloud computing is positively correlated to the decision to adopt cloud computing

Cloud Computing Adoption: Cloud computing adoption is the only dependent variable in this research. Measuring the adoption of cloud computing is done by creating items to measure the intention to use and adopt cloud computing by the TTOs.

5. DISCUSSION AND CONCLUSION

Literature review shows there has been no previous study to analyze the factors influencing the adoption of cloud computing in the context of TTOs. This study proposed an integrated theoretical framework based on the DOI theory and TOE framework. This research identifies four contexts: Human characteristics, technological, organizational and environmental which are essential elements for adoption of Cloud Computing. This research can be a starting point for future developments on the determinants that facilitate or inhibit the adoption of Cloud Computing by TTOs. This study can serve as a foundation for TTOs' decision makers considering whether to adopt cloud computing in their TTOs or not. The study is a resource for organizations and researchers that may use the conclusions of this study to extend their knowledge in this area and eventually develop other externalities. Researcher expects proposed theoretical framework could be grounded and a starting point for future research on the adoption of Cloud Computing.

Cloud computing is a new computing paradigm which is advantageous for organizations. Services offered by cloud service providers help TTOs to perform their tasks quicker, easier and more efficiently .To promote cloud computing adoption, it is important to clarify the factors which influence CC adoption. This study was aimed to understand the process of cloud computing adoption and to identify factors that affect the adoption of Cloud Computing. According to (Saya et al. 2010) it is crucial for CC service providers to determine how to influence organizations' adoption decision, and also to understand how to convince them to migrate to the cloud based solutions. Therefore based on the research objectives, this study offers an integrated framework for Cloud Computing adoption that can be useful for both TTOs and Cloud Computing service providers. (Benlian & Hess, 2011) believe that CC service providers must be considered as factors that influence adoption decisions and then prioritizing or downplaying them when offering CC services to organizations at different stages of their technology adoption lifecycle.

6. LIMITATIONS AND FUTURE RESEARCH

This study is in its early theoretical concept stage, in which a preliminary model is suggested based on the literature review and conceptual reasoning. Performing further researches in this field of study is highly recommended. Cloud computing is a new phenomenon and not many studies have been conducted in the field of cloud computing adoption. Researcher suggested that future studies use and combine other adoption theories. Researcher highly recommends future studies and other researchers to test and confirm the proposed conceptual model in other contexts. It is always recommended that researchers improve the models that are proposed by adding or removing constructs from the model. It is helpful in a sense that it allows both researchers and practitioners to have a better understanding about cloud computing adoption.

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Table 1: Previous Research Combined TOE and DOI

Authors	IT Adoption /Context	Theory	Analysed Variables
Thong (1999)	IS Adoption Small Firm	TOE and DOI	Organizational characteristics: Business size; Employees' IS knowledge; Information intensity. CEO characteristics: CEO's innovativeness, CEO's IS knowledge IS characteristics: Relative advantage of IS, Compatibility of IS; complexity of IS Environmental characteristic: competition
Dedrick and West (2003)	Open Source	TOE and DOI	Relative advantage , Compatibility, Cost savings
Zhu *et al*, (2006b)	E-business usage	TOE and DOI	Technology: Relative advantage; Complexity; Compatibility Organization: Top management support; Firm size; Technology competence Environment: Competitive pressure; Trading partner pressure; Information intensity
Leinbach (2008)	E-commerce	TOE and DOI	Technology :Relative advantage, Compatibility ,Technology Readiness, Cost saving ,Security concerns Organization: International scope ,Firm size Environment : Competitive pressure ,Regulatory Support
Chong et al. (2009)	Collaborative commerce (C-commerce)	TOE and DOI	Innovation attributes: relative advantage; compatibility; complexity. Environmental: expectations of market trends; competitive pressure. Information sharing culture: trust; information distribution; information interpretation. Organizational readiness: top management support; feasibility; project champion characteristics
Azadegan and Teich (2010)	Benchmarking Adoption	TOE and DOI	Relative advantage, compatibility
Wang et al. (2010)	RFID	TOE and DOI	Technology: Relative advantage, Complexity, Compatibility Organization: Top management support; Firm size; Technology competence Environment: Competitive pressure; Trading partner pressure, information intensity
Ifinedo (2011)	Internet /E-business Adoption	TOE and DOI	Technology : Relative advantage ,Compatibility, Complexity Organization: Management support, Organizational readiness Environment :Competitive pressure , Customer pressure ,Partners pressure ,Government support
Tiago Olivia et al. (2014)	Cloud Computing	TOE and DOI	Technology: Technology Readiness Organization : Top Management Support , Firm size Environment: Competitive Pressure , Regulatory Support Innovation Characteristics: Relative advantage (cost saving , security concern) ,Complexity Compatibility

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Table 2: Variables Used In This Research

Variables	Authors
Relative advantage	Rogers (1983), Thong (1999), Premkumar & Roberts (1999), Rogers (2003), Ramdani et al. (2009), Premkumar & king (1994), Chong et al. (2009), Ifinedo (2011), Dedrik &West (2003), Ling (2001), Low et al. (2011), Zhu et al. (2006), Li (2008), Wang et al. (2010), Alshamaila & Papagiannidis (2013), Saedi & Iahad (2013), Olivia et al. (2014)
Complexity	Rogers (1983), Premkumar & king (1999), Thong (1999), Chong et al. (2009), Wang et al. (2010),Tiwana & Bush (2007), Li (2008), Ifinedo (2011), Alshamaila & Papagiannidis (2013), Morgan & Kieran (2013), Olivia et al. (2014)
Compatibility	Rogers (2003), Premkumar (2003), Low et al. (2011), Cooper & Zumd (1990), Wang et al. (2010), Ramdani et al. (2009), Premkumar & king (1999), Thong (1999), Alshamaila & Papagiannidis (2013), Olivia et al. (2014), Ling (2001), Li (2008), Chong et al. (2009), Zhu et al. (2006a), Dedrik & West (2003), Saedi & Iahad (2013)
Uncertainty	Ostland (1974), Fuchs (2005), Leinbach (2008), Zhu et al. (2006a), Jain & Bhardwaj (2010), Subashini & Kavitha (2011), Jalonen & Lehtonen (2011), Alshamaila & Papagiannidis (2013), Featherman et al. (2003), Alshamaila et al. (2013), Teo et al. (2006)
Size	Ling (2001), Low et al. (2011), Zhu et al. (2006b), Zhu et al. (2004), Ramdani et al. (2009), Zhu et al. (2006a), Saedi & Iahad (2013), Olivia et al. (2014), Liu (2008), Pan & Jang (2008), Zhu et al. (2003), Zhu & Kraemer (2005), Thong (1999), Wang et al. (2010), Gibbs & Kraemer (2004), Hsu et al. (2006), Olivia & Martin (2010b), Dholakia (2004), Lin (2009)
Collaboration	Granot (1997), Riggins & Rhee (1998), Dhillon & Caldeira (2000), Icasati-Johanson & Fleck (2003), Subramani (2004), Chong et al. (2009), Baas P. (2010), Morgan & Kieran (2013)
Technology Readiness	Olivia & Martins (2009), Kuan & Chau (2001), Oliveira & Martins (2010a), Oliveira & Martins (2010b), Pan & Jang (2008), Wang et al. (2010), Low et al. (2011), Zhu et al. (2006a), Zhu et al. (2006b), Zhu et al. (2004), Lin & Lin (2008), Zhu & Kraemer (2005), Olivia & Martins (2008), Wang et al. (2010), Li (2008), Olivia et al. (2014)
Information Intensity	Thong & Yap (1995), Porter & Millar (1985), Thong (1999), Wang et al. (2010), Arpaci et al. (2012)
Satisfaction	Chau & Tam (1997), Baas, P. (2010), Olivia & Martins (2011)
Competitive Pressure	Zhu & Kraemer (2005), Premkumar & Roberts (1999), Alshamaila & Papagiannidis (2013), Ling (2001), Low et al. (2011), Zhu et al. (2006b), Zhu et al. (2004), Ramdani et al. (2009), Lin & Lin (2008), Chong et al. (2009), Zhu et al. (2006a), Oliveira & Martins (2010), Wang et al. (2010), Li (2008), Olivia et al. (2014), Khan & Chau (2001), Saedi & Iahad (2013)
TTO Partners	Doolin (2007), Wang et al. (2010), Gibbs & Kraemer (2004), Chong et al. (2009), Chong & Ooi (2008), Lai et al. (2007), Lin & Lin (2008), Pan & Jang (2008), Zhu et al. (2004), Zhu et al. (2006b), Zhu et al. (2003), Oliveira & Martins (2010b), Hsu et al. (2006)
CC Service Provider Support	Frambach et al. (1998), Premkumar & Roberts (1999), Ramdani et al. (2009), Saedi & Iahad (2013), Alshamaila et al. (2013)
Government Support	Khan & Chau (2001), Zhu et al. (2004), Li et al. (2010), Das et al. (2011), Mastton et al. (2011), Saedi &Iahad (2013), Li (2008)
Top Management Support	Ling (2001), Low et al. (2011), Ramdani & Kawalek (2009), Chong et al. (2009), Premkumar & Roberts (1999), Alam (2009), Saedi & Iahad (2013), Wang et al. (2010), Li (2008), Alshamaila & Papagiannidis (2013), Lee & Kim (2007), Olivia et al. (2014)
Innovativeness	Rogers & Shoemaker (1971), Thong (1999), Rogers (2003), Damanpour (1991), Marcati et al. (2008), Alshamaila & Papagiannidis (2013), Wang & Quall (2007)
Cloud Knowledge	Chau & Jim (2002), Thong (1999), Thong & Yap (1995), Lee & Kim (2007)

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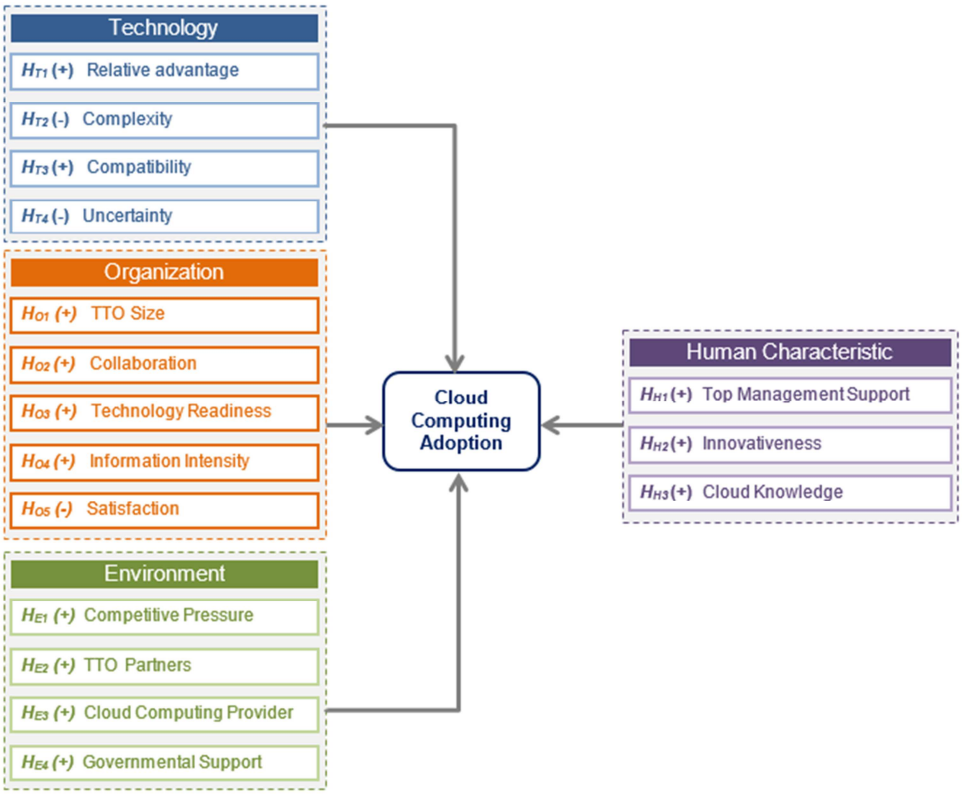

Figure1: Initial Integrated Theoretical Framework for Adoption of Cloud Computing by TTOs