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Conceptualizing Global Cloud Landscape: A Review of Adoption Issues and Challenges

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Abstract: An adoption of cloud computing in the IS has changed the way the business is conducted in any organizations. This IT innovation has created a new phenomenon of Information Systems (IS) from a conventional IS to the cloud-serviced IS. Nevertheless, cloud adoption is not as fast as the dynamic changes in the technology itself due to its issues and challenges. This study seeks to theoretically conceptualize cloud computing innovation adoption from technological, organizational and people dimensions focusing on the cloud adoption challenges. Although, the technical solution is abundant, security has been and is still identified to be the most critical challenges from all dimensions. The future research will lead to cloud information security assessment from the human perspectives.

Key words: Technology, global, cloud, landscap, issue

INTRODUCTION

Cloud computing is an emerging phenomenon and has been a major agenda in the field of computing over the last decade. The cloud makes an organization more responsive to which it facilitates speed, agility, flexibility, infinite elasticity, innovation as well as economic advantage (Kundra, 2011).

A well-known technology research consultant, Gartner has predicted 15 top business domains in 2015 implementing digital transformation through cloud deployment-automotive, banking and investment services, consumer goods, education, government, healthcare payers, healthcare providers, insurance, oil and gas, product design and development, retail, utilities (www.Gartner.com) considering all the advantages they could gain should they embrace cloud computing in their business operations.

However, the cloud adoption growth is not as fast as the dynamic changes of cloud technology itself in the cloud is not without its challenges. This study seeks to review the cloud adoptions based on these questions: What is the current state of cloud development at the different parts of regions? What are the factors influencing cloud adoption?

Literature review

IT evolution: Organizations in the whole world have been using Information Systems (IS) to gain business values ever since its introduction in the early 1950s. The strategic IS play a vital role in aligning the advent of information technology and the business goals of the organizations. The rapid development of information technology has revolutionized the IS and changed the way the business is done in the organizations.

The most current trend of computing technology is coined as cloud computing. However, before this term came into place, the technology itself has been through six phases of revolution along this half a century (Voas and Zhang, 2009). The IT started merely with terminals connected to mainframe which then enhanced the application of stand-alone personal computers. The next level involved with the application of local network where several computers connected to each other to share resources. This point has seen the extension of local networks to global network connection where the Internet came into the picture. In this phase, the users can share the resources and applications from remote areas.

The next phase has seen another improvement of technology where the concept of the grid was introduced. With the grid or known as distributed computing, users can share not only the resources and but also storage. All these developments have brought IT to the next level of computing called cloud. Cloud computing is primarily an enhancement of distributed computing, utility computing and grid computing (Dua, 2014). Cloud computing is also the emergence of three integrated cores-virtualization, multi-tenancy and web services (Marston *et al*., 2011).

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The cloud allows users to take advantage of the Internet to manipulate all the available resources in a more efficient way.

Global cloud adoption: Cloud computing has caught a lot attention from various levels of users. From the international perspectives, many governments in the developed countries have started adopting cloud for their business operations. In todays 'people-centered environment' it is critical that the governments and its agencies to give their best services to their citizens who demand a faster, richer and new-service environment (Liang *et al*., 2011) from the government regardless of time and location. This can be achieved through cloud computing which can help rationalize government operation and services. Gartner, a well-known IT marketing strategist has predicted in 2015 that governments will start implementing digital transformation to optimize or create new services (www.gartner.com). This transformation of digital government will change the way the government manages and source IT. Developed countries like the United States, United Kingdom, Japan and many others have started embracing clouds in their government operations.

For instance, the cloud efforts in the US government span from the General Service Administration (GSA), National Aeronautics and Space Administration (NASA), department of the interior, department of Health and Human Services (HHS), Census Bureau and White House (Wyld, 2010). Under the President Obama administration, US has formed a federal cloud computing program management office and has built up "Apps.gov" using cloud technology in 2009 with the objectives to deliver the most effective and efficient services to the citizens to reduce cost and to promote green environment policy (Liang *et al*., 2011). The GSA cloud adoption was expected to reduce administrative cost by 50% and decrease infrastructure cost by 90% (Wyld, 2010).

The adoption of cloud computing in the organization will increase a substantial saving with regards to capital expenditure and operational expenditure. The US government for example as reported by the government report, spends $76 billion annually on IT. However, the adoption of cloud computing for its recovery accountability and transparency board has realized savings of $33,4800 in 2010 and $420,000 in 2011 (Khan and Dakota, 2014).

Digital Britain was developed by the UK government, using a cloud platform in 2010. The government digital services London, 2012 reported that the digital transaction cost is 98% lower than a face-to-face transaction, 60% lower than telephone transaction as well as 40% lower than the postal transaction. The migration of 650 central government services to G-Cloud has been expected to save a substantial amount of expenditure about £1.7-1.8 billion ($2.5-2.65 billion) yearly as reported in the digital Britain 2 Report (The Cabinet Office, 2012, 2013). Digital Britain may even decrease costs across the public sector. Research estimates that annual savings of £134-421 million could be achieved through digitization of local government transactions. The Department of Health evaluates that National Health Services could have a substantially cost saving of £2.9 billion for adopting digital Britain. Providing non-digital services were estimated to cost the UK government £4 billion annually for support demands. However, a tremendous savings of £2.7 billion could be achieved in support of digital services under cloud platform.

Another prominent example from Asian region is Japan. Japan Kasumigaseki Cloud in 2009 was developed as an effort to integrate the services among the government agencies as well as to enhance knowledge sharing which was scheduled to be completed in 2015 (Liang *et al*., 2011). The Kasumigaseki Cloud was planned by the Government of Japan to invest in IT for a value of 100 trillion yen (approximately $829 billion). It is aimed to help stimulate economic resurrection by providing hundreds of thousands of innovative IT jobs and increase the size of IT market by 100% in 2020 (Wyld, 2010). According to Asian Cloud Computing Association (ACCA) Cloud Readiness Index 2014, Japan is steadily being consistent to position itself as Asia's most cloud-friendly economy. This includes having the best business environment, the most sophisticated data sovereignty, the highest band for broadband quality, data privacy, power grid and green policy (May-Ann *et al*., 2014).

Having said that, developed countries are ready with regards to cloud adoption and implementation. They spent a lot on IT investment for the long run benefits. Services efficiency, green environment and massive savings are among the driver of adoption of these countries. Nevertheless, developing countries are also catching up with the advancement of cloud computing. For instance, despite having to struggle with the green policy, environmental regulatory and usage, privacy issues, international connectivity and data sovereignty, Malaysia was ranked 8th among Asian countries with its cloud readiness as assessed by the Asian Cloud Computing Association (ACCA) in 2014 (Abdul Hamid and Yusof, 2015). Other countries also follow suit as they acknowledge that cloud technology give them an advantage in terms of cost saving, service efficiency as well as of geopolitical survival.

Cloud computing definition: The term 'cloud computing' was initially adopted in 1999 by www.salesforce.com to introduce its business applications for business purposes (Busch *et al*., 2014). Over the last decade, many definitions of cloud computing were coined to give

a clear picture of this promising technology. NIST defines cloud computing as a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction (Mell and Grance, 2009). Cloud Computing is also known as XaaS where X refers to anything as a service (Mladenow *et al*., 2012; Armbrust *et al*., 2010) asserted that cloud computing denotes both online applications delivered as a service and the hardware and systems software in the data centers that provide those services.

Cloud computing is also illustrated schematically as a system in which data center resources are shared using virtualization technology and service is provided elastically and instantly based on demand of users where the service is charged on a pay-per-use basis (Khorshed *et al*., 2012). The cloud model is composed of five essential characteristics, three service models and four deployment models (Mell and Grance, 2011). The three service models Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS) (Mell and Grance, 2011). IaaS is the lowest level of cloud adoption in the organization (e.g., the network, storage, servers and virtualization) followed by PaaS (only application and data are managed by the IT department). The real cloud adoption is with SaaS since all services are taken care of by the providers. This is a totally different environment compared to traditional IT of which all the development and maintenance are run by the internal IT department. With cloud adoption, the organization can instead fully pay its attention to the core of their business to achieve competitive advantage. NIST outlined that cloud is deployed in 4 ways-public, private, community and hybrid (Mell and Grance, 2009). In public cloud, a cloud provider runs a shared service environment accessible to any buyer. Community cloud grants access to a particular group of buyers (e.g., public agencies). Public and community cloud offer economies of scale but concerns about security, privacy, trust and control limit mission-critical uses. A private cloud is exclusive for an enterprise, run by the enterprise itself or through the virtual private environment by the cloud providers.

MATERIALS AND METHODS

The review process was done using an online database from IEEE, ACM, Science Direct and Google Scholar from the year 2010-2015. We used keywords like cloud adoption, implementation, migration and challenges, barriers or obstacles to find the most relevant studies. The reason was due to the fact that cloud adoption was only popular 5 years back and we also want to find the most recent findings of our review.

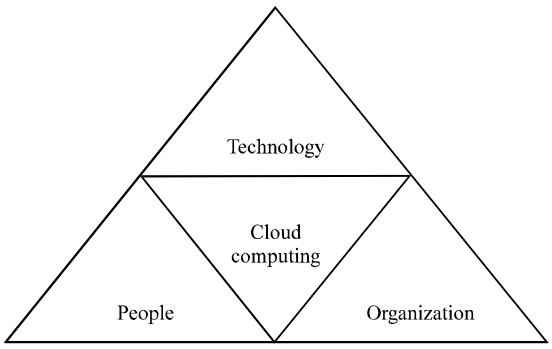

Fig. 1: Theoretical framework of cloud landscape

To understand how the IS has been revolved due to IT innovation, it is crucial to know the basic principle underlying the IS itself. An IS is any organized combination of people, hardware, software, communication networks, data resources, policies and procedures that stores, retrieves and transform and disseminates information in the organization (Brien and Marakas, 2005; O'Leary *et al*., 2015), whom outline that IS consists of 3 important elements-people, technology and procedures (Laudon and Laudon, 2015). Classifies 3 dimensions of IS framework-management, organization and technology.

This review framework is based on the integration of (Brien and Marakas, 2005; O'Leary *et al*., 2015; Keneth Laudon and Laudon, 2015) adapted in this landscape. The three main dimensions are technology, organization and people. The technology dimensions consists of hardware, software, data and network. The organization dimensions have attributes of management structure, culture, business process, standards and procedure, rules and regulations as well as policy. The people are cloud stakeholders like cloud adopters (Brohi and Bamiah, 2011). cloud users and cloud providers. Figure 1 shows the framework.

RESULTS AND DISCUSSION

Cloud adoption studies: Studies on cloud adoption have been done at the individual, organizational, national and international level for the past 5 years. Many researchers have targeted domains like education (Alam, 2013; Bora and Ahmed, 2013; Britto, 2012; Masud *et al*., 2012) healthcare (Doukas and Maglogiannis, 2012; Doukas *et al*., 2010; Glaser, 2011; Lohr *et al*., 2010; Sultan, 2014;Takeuch *et al*., 2012) and government (Busch *et al*.,

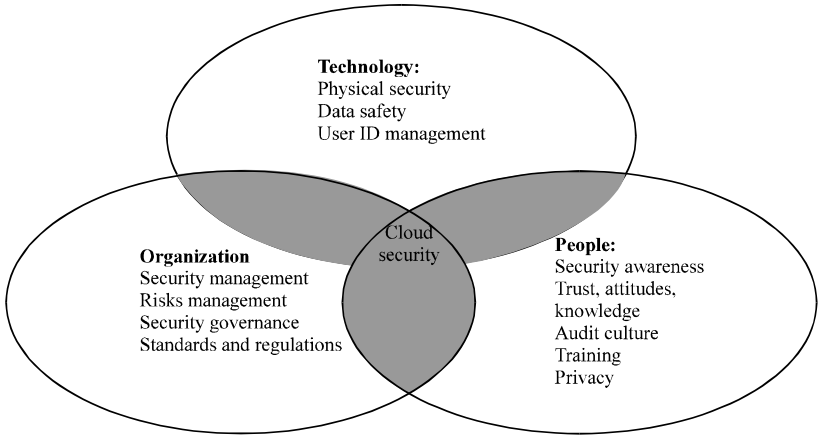

Fig. 2: Security challenges in cloud adoption

2014; Kamal *et al*., 2015; Kundra, 2010) and some other private sectors like manufacturing (Giriraj and Muthu, 2012). The cloud adoption study was also done from the system point of view (Jhawar *et al*., 2013). The cloud innovation adoption studies done on the users' acceptance (Alharbi, 2014; Shin, 2013; Wu, 2011) as well as on cloud readiness assessment (Akande and van Belle, 2014; Di Biase, 2013). Almost all of these studies seek the user perceptions of cloud technology with an emphasis of reasons and intentions of adopting. Various models used in adoption studies, like Technology Acceptance Models (TAM) (Davis, 1989) TAM2 (Venkatesh and Davis, 2000) TAM3 (Behrend *et al*., 2011) UTAUT (Venkatesh *et al*., 2003) Diffusion of Innovation (DOI) (Rogers, 1995). However, TAM has been widely used by researchers (Shin, 2013; Alharbi, 2012; Fung, 2013; Opitz *et al*., 2012; Pan and Jordan-Marsh, 2010; Yuvaraj, 2014) since it is the most established model in technology adoption.

Cloud adoption issues: After a comprehensive selection, 17 articles have been chosen from previous studies that met the outlined criteria. Based on the framework, the cloud issues are divided into technological, organizational and people dimensions. Every issue creates different challenges. These challenges are identified as the main reason why cloud adoption rate is not as dynamic as the cloud technology growth itself. The next section explains the challenges in detail.

Security challenges: Of all three dimensions, security has become and is still the main concern in cloud adoption as shown in Fig. 2. This is in line with the IDC (Gens, 2009) which reported that security was the main challenge of cloud.

Technically, hardware (Dua, 2014; Khorshed *et al*., 2012) software (Dua, 2014) and network security (Verma and Kaushal, 2011) are the area being extensively studied by researchers. These studies generally are hardcore in nature, looking ways from the technical points to prevent, detect or correct systems errors due to the risks, threats and vulnerabilities. There are tangible as well intangible risks (Paquette *et al*., 2010) associated with cloud computing that must be overcome to have a successful cloud adoption. While the system is in the cloud environment, security must be sufficient to protect the system from the attacks like tampering, eavesdropping, malware, spoofing, virus and worms etc. (Malik and Nazir, 2012). In the organizational context, the research mostly focuses on security management (Dua, 2014), security governance (Jamshidi *et al*., 2013), risk management (Avram, 2014) and rules and standards (Marston *et al*., 2011) related to security. Benchmarking strategy is always applied in such a research to ensure a secured environment in the organization like ISO 27000, COBIT and IT other standards. Security with regards to people dimension includes security training (Ion *et al*., 2011), security awareness (Rebollo *et al*., 2015), attitudes towards security (Heier *et al*., 2012; Marston *et al*., 2011) audit culture (Marston *et al*., 2011) and compliance (Marston *et al*., 2011) and trust (Khorshed *et al*., 2012; Gharehchopogh and Hashemi, 2012) as well as privacy (Dua, 2014; Marston *et al*., 2011; Khorshed *et al*., 2012; (Verma and Kaushal, 2011; Heier *et al*., 2012; Pearson, 2009). However, all of these studies were done with different objectives, i.e., identifying a single security factor that affecting the cloud adoption.

Nevertheless, regardless of the technical protection and organizational security standards, security breach happens all the time. It is our opinion that security challenges to be dealt with non-technical approach. Often human is the weakest link when it comes to security breach (Okere *et al*., 2012). The way people behave and act in the cloud environment may shape the cloud security culture which in turn has a significant factor

influencing or affecting the cloud implementation at the organizational as well as national level. An organization's security posture is defined by the three triads of information system-confidentiality, integrity and availability. However in nowadays computing, cloud computing for instance has exposed information to more security risks and challenges issues. Information is at risks of the existence of vulnerability and threats. (Alnatheer, 2015) argued that organizations which have a security risk analysis and assessment management in place are being more aware of their losses due to security breaches.

Despite information technology governance framework like COBIT and COCO are widely adapted by the organizations, these frameworks are found to be lacking in risk assessment and management purposes, however ISO 27001 seem to be promising in assessing risk security (Fazlida and Said, 2015; Sheikhpour and Modiri, 2012) claimed that combining ITIL and ISO 27001 can be the best benchmarking standard in information security management in the organization. With risk analysis, assessment and management, the organization will be able to identify areas that are highly critical for information security and to improve the security effectiveness. However, all those standards serve more on guiding the management and technical staff of how information security is governed and is still lacking in human aspects with regards to the security behavior of the employees in the organization. Technical protections are abundant, however, there are many other human and cultural factors that contribute to the security breaches in the cloud environment which needs to be explored. Our next plan is to conduct an information security culture assessment to the cloud stakeholders in the public agencies, taking into account the security challenges from the sociocultural perspectives.

CONCLUSION

Cloud computing provides platforms to meet the dynamic technology needs of organizations' business. Cloud gives significant advantage on time and costs spent for IT infrastructure deployment and support. This nest egg can be diverted to focus on their other business objectives. However, the cloud is not without its challenges: security, compliance, integration, global coverage and human factor cannot be considered as an afterthought. Embracing cloud in the conventional IS without careful consideration of its challenges may result in failure and a big disappointment. This review has revealed that security is the main factor causing slow growth of cloud adoption. Nevertheless, this theoretical landscape needs to be explored empirically to support this argument. Security is the main concern of people in the cloud environment since humans are the actual actors whose behaviors shape the security culture of the cyber world, however this still has little attention of the researchers. Our future works will lead to the cloud security assessment of the cloud users from human perspectives.

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