Jurnal Teknologi

Full Paper

STATE-OF-THE-ART OF CLOUD COMPUTING ADOPTION IN MALAYSIA: A REVIEW

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Article history
Received
15 May 2015
Received in revised form
1 July 2015
Accepted
11 August 2015

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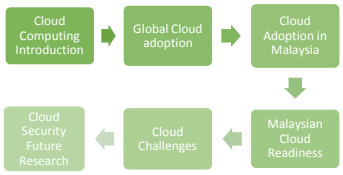
Graphical abstract



Abstract

Cloud computing has made a significant transformation of information technology environment as well as the way the business is conducted in any organizations. While its advantages are obvious, its challenges need to be clearly addressed to ensure successful adoption. This article provides an insights of cloud computing adoption in Malaysia at the national level as well as a review of cloud adoption from various fields and domains in Malaysia which led to research direction in the future. Malaysia is being dedicated towards cloud adoption nationally, and keep its good progress to equip itself as a cloud-friendly country. However, security challenges seem to slow down the effort, thus these need to be dealt with properly.

Keywords: Cloud computing, readiness, adoption, security

1.0 INTRODUCTION

Cloud computing is an emerging phenomenon and has been a major agenda in the field of computing over the last decade. With the potential to make IT organizations more responsive than ever, this emerging technology facilitates speed, agility, flexibility, infinite elasticity, innovation as well as economic advantage.

It uses the concept of offering everything as a service based on the demand from the users on a pay-per-use basis. The existence of cloud computing has actually begun way before the term 'cloud computing' was coined. Virtualization, distributed and grid computing are among emergent technologies which shapes the cloud computing paradigm and thus transform the information and communication technology atmosphere[1]–[3]. A well adopted cloud gives a lot of advantages to the organization such as easy and pervasive access of data and applications, increase cost effectiveness and build up competitive advantage.

Embracing cloud for the public and private enterprises as well as individual users is becoming a norm in the future just like subscribing to other utilities. Therefore, it is very important that the organizations get themselves prepared into the bandwagon since cloud gives so much opportunity for them to enhance their business competitive advantage. For non-profit organization particularly, cloud will increase the efficiency and effectiveness of their services to the citizen, thus enhance the government reputation as a whole in the eyes of foreign investors. This may boost up the confidence level of these foreign investors to invest their businesses which indirectly improve the country's economy, all because the government environment is cloud-friendly.

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 , but with the adoption of cloud

computing for its recovery accountability and transparency board, it could save $33,4800 in 2010 and $420,000 in 2011 [4]. Britain G-Cloud has been expected to save a substantial amount of expenditure about £1.7 – 1.8 billion ($ 2.5 -2.65 billion) yearly as reported in the Digital Britain 2 Report [5]. Having said that, developed countries are ready with regards to cloud adoption. 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. How about Malaysia?

This question motivates us to further review the current state of cloud adoption in Malaysia. To answer such question, this article is organized as follows; Section 1 Introduction, Section 2- the literature review, Section 3 – Methodology, Section 4 – Results, Section 5 – Discussion and Section 6 – Conclusion.

2.0 LITERATURE REVIEW

2.1 What is Cloud Computing?

There are various definitions of cloud but the most popular one is from the National Institute of Standards and Technology. Cloud computing is defined 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 [6].

IT offers three types of services models – Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS. SaaS is the highest level of cloud of which all of the services are offered by the cloud providers. Users who adopt PaaS only manage their applications and data and those adopting IaaS will have their infrastructure like server, storage and networking run by the providers.

There are three models of deployment - Public Clouds, Private Clouds and Hybrid Cloud. In public clouds, all of the services offered by the providers are shared together with all the cloud users. Private clouds is deployed when the users need to enhance their data security to which the clouds is exclusively catered for them. The hybrid cloud is the combination of both public and private clouds. The adoption of these deployment and services offered depends on the needs and requirements of the organization.

2.2 IT Innovation in Malaysia

The Malaysian Administrative Modernization and Planning Unit (MAMPU), a central government body under the Prime Minister Department, is responsible for the transformation and modernization of public sector services in Malaysia. Among others, MAMPU is responsible for planning and development of IT innovation adoption in the government agencies (ministry, department, state and statutory bodies). According to the Malaysian Public Sector ICT Strategic Plan (2011-2015), the IT innovation must strategically take into account the important elements of technology, people and process as well as internal and external requirements. The focal points to determine strategic directions are the productivity, cost effectiveness and transparency [7]. The ability to respond to the rapidly changing demands of the citizens is the key to enhance productivity. Service delivery that is based on IT innovation must be able to support these demands anytime and anywhere it is needed. ICT Governance should be intensified and reinforced especially in the areas of governance structure, change management and compliance [7].

The Multimedia Corporation (MDeC) was incorporated in 1996 to oversee the development of Multimedia Super Corridor (MSC) Malaysia which was also established at the same year, and to advise the Malaysian Government on legislation and policies, as well as to set breakthrough standards for multimedia operations.

Through MSC Malaysia, the government has been giving its strong support for the transformation of Malaysia towards a Knowledge-based economy for since the year 2000. MSC is responsible to create a conducive platform and nurture small and medium enterprises (SMEs) in Malaysia to become world-class businesses. MDeC publicize MSC Malaysia Cloud Initiative (MMCI), which plays an important role introducing the cloud computing to the public and giving awareness on the advantages it offers to the businesses specifically to the small and medium enterprises. MDEC is driving awareness of cloud computing ecosystem towards the implementation of SaaS, IaaS and PaaS.

Through MAMPU, Malaysian Government has also made a big step in enhancing its services to the citizen by implementing e-government, where Malaysian people have the opportunity to get online services at the fingertips. This electronic services was initially introduced to the citizen for the betterment of the nation in terms of increasing the efficiency of the management of public sector agencies as well as enhancing the effectiveness of the service delivery.

A Public Sector ICT Study of Malaysia done by [8] addressed strategic recommendations with the objective to increase public sector productivity, add value to services and improve efficiencies through a "whole-of –government" approach of ICT infrastructure. Among the strategies was the establishment of public sector cloud computing infrastructure, emphasizing on the private cloud deployment for total control and security. There were five distinct dimensions focused on the key aspects, as necessary to plan and implement comprehensive cloud computing capabilities i.e. finance, controls, technology, process and organization. The prioritization of cloud services will be based on factors like service estimated utilisation, service provisioning complexity and infrastructure readiness [8].

Digital Malaysia (DM) is a national programme initiated and led my MDeC, under the Ministry of

Communication and Multimedia. Its primary purpose is to create an ecosystem that could serve the whole country with global communication in real time which will enhance the standard of living, enhance productivity and increase efficiency. Through DM, the whole society is encouraged with the extensive use of ICT to transform Malaysia into a developed digital economy in 2020.

All of the initiatives undertaken shows that Malaysia strives to remain current in the pervasive use of ICT for the benefits of the society.

2.3 Malaysian Cloud Readiness

Based on the Measuring the Society Research 2014, for the year 2013, Malaysia ranked 9th in the Asia and The Pacific ICT Development Ranking and 71st for the Global ICT Development Ranking moving down 5 ranks from 66th in 2012 [6].

Asia Cloud Computing Association (ACCA) Readiness Index 2014 evaluates 14 Asian countries readiness in cloud computing adoption including Malaysia. There are 10 indicators of readiness measured – privacy, international connectivity, data sovereignty, broadband quality, government regulatory environment and usage, power grid and green policy, intellectual property protection, business sophistication, data centre risk and freedom of information as shown in Table 1.

Table 1 Cloud Readiness Index 2014 [9]

	Privacy	International connectivity	Data Sovereignty	Broadband Quality	Gov. Regulation Environment and Usage	Power Grid and Green Policy	Intellectual Property Protection	Business Sophistication	Data Centre Risk	Freedom of Information	CRI2014 Score	Rank	Change
Japan	9.5	5.5	8	9.1	5	7.1	8.1	8.2	6.6	9.7	76.8	1	-
New Zealand	8.8	4.6	7.9	7.6	5.6	9.2	8.6	6.8	7.8	9.5	76.3	2	4
Australia	8.8	4.4	7.6	8	5.3	7.8	7.6	6.7	9.4	9.6	76.3	3	4
Singapore	6	8.2	7.8	8.8	6.1	5.9	8.7	7.3	7.4	8.6	75.1	4	-
Hong Kong	6.8	7.7	7.6	9.3	5.1	5.6	8.1	7.5	7.4	9.6	74.8	5	-2
South Korea	9.7	5.5	7.2	9.4	5.1	6.6	5.7	6.9	8.6	8.6	73.3	6	-4
Taiwan	4.6	6.3	6.8	8.5	5	6.7	7.4	7.4	6.9	8.6	68.2	7	-2
Malaysia	5.8	5.8	6.7	7.1	5.2	4.9	6.9	7.2	8.5	8.2	66.2	8	-
Thailand	4	5	6.2	4.1	3.7	6.3	4.4	6.3	7.6	7.8	59.3	9	4
Philippines	5.8	5.4	5.9	4.1	3.7	5.5	5.1	6.1	5.5	9	56.1	10	2
China	5.9	3	4.8	5.9	4.3	4.3	5.6	6.2	6.5	7	53.3	11	-1
Indonesia	4.4	2.9	6.2	3.1	3.9	5.7	5.6	6.3	6.4	7.9	52.4	12	-1
India	4.6	2.3	6.5	3.6	4.1	5	5.3	6.3	3.4	7.8	48.8	13	-4
Vietnam	3.6	3.2	5.6	4.2	3.8	4.7	4.1	5.3	6.4	7	47.8	14	-1

The Asia Pacific countries are ranked into three groups – ready, dedicated and steady, against their total readiness indicators. According to the (ACCA) Readiness Index 2014, Malaysia was categorized as a clear middle band of economies, a dedicated improver [7]. Sharing this level with Thailand, Taiwan and Philippines, it is a leader in terms of low data centre risk index in this category. Malaysia is maintaining its 8th position in cloud readiness out of 14 other Asian countries assessed, the same position it had during previous assessment, as depicted in Table 1. However, this stagnant position does not indicate that the Malaysian cloud readiness is being decreased, but rather other countries are catching up very quickly [7].

However, the table shows that Malaysia still needs much effort with its green policy, government environment regulatory and usage, privacy, international connectivity and data sovereignty. Nevertheless, the government was reported putting up an effort to develop Malaysia's data management policies such as its Personal Data Protection Act and A Big Data Analytics' pilot in order to prepare Malaysia to be one of the most cloud-friendly markets in Asia [7]. This report has clearly shown evidence of Malaysian government dedication in cloud adoption

with regards to the technological factor. However, The Executive Director of ACCA, Lim May-Ann, stated that government has generally been tentative in its adoption of cloud computing, sending conflicting signals to the market"[7]. This has raised a question as to why the cloud adoption rate in Malaysian public sector is slow. Nevertheless, this ranking study was done at the Asia Pacific level to which it does not depict the actual readiness at the organizational level.

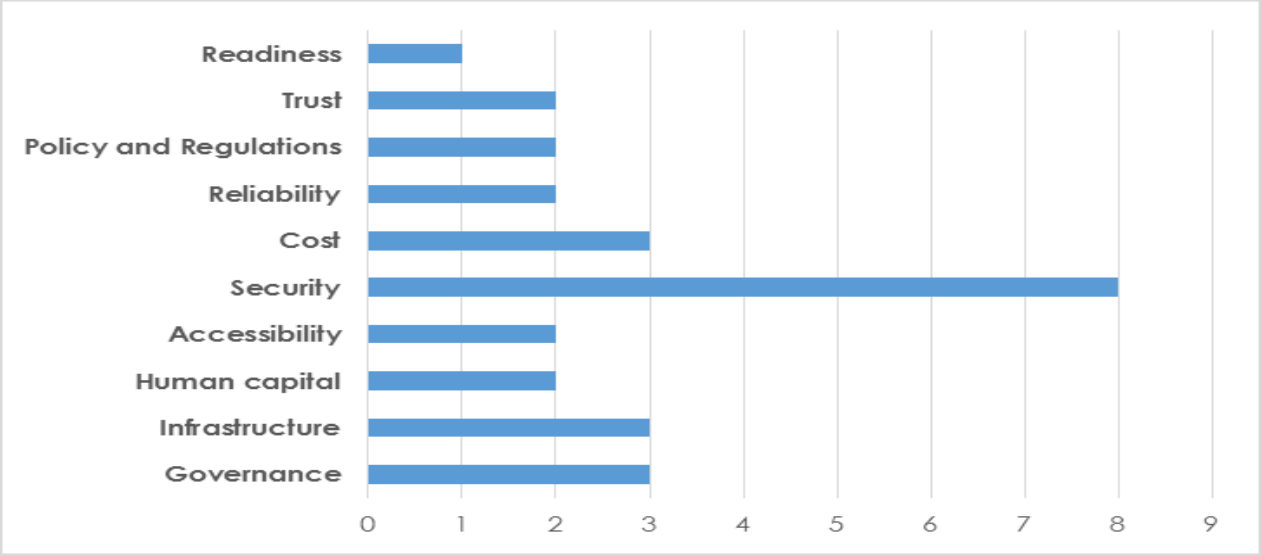
3.0 METHOD

This qualitative review used 4 main sources from IEEE, ACM, Sciencedirect as well as Google Scholar. The search applied Booleans AND and OR operations, emphasizing on keywords like cloud computing, Malaysia, adoption, innovation, implementation, migration, deployment and readiness. Recent data from the government reports was included as supporting documents where appropriate. Only data from year 2011 until 2015 was taken into consideration as cloud adoption was not that popular earlier than that year in Malaysia.

4.0 RESULTS

Whilst cloud computing may offer significant cost savings, scalability, effectiveness and service efficiency, it does come with its barriers as well. The implementation is not as easy as it may seem. There are many issues that may become major hindrance of cloud adoption based on Malaysian settings as depicted in Table 2.

Table 2 Challenges of Cloud Adoption in Malaysia



The security [10][11],[12] and governance [13] are among the obstacles of successful cloud adoption as depicted in Table 1. Issues like confidentiality, authentication, integrity, reliability and availability are among the top security barriers which have significant impact upon cloud adoption. These factors may also affect Malaysia which jumps into this bandwagon to leapfrog herself as a cloud-friendly market.

5.0 DISCUSSION

Malaysia is among developing countries that has a dedicated improvement in IT innovation adoption. Several studies have been done for the past five years (2011-2015) in Malaysia ranging from the awareness [14], readiness [15] and implementation of cloud computing adoption [16] from various domains and perspectives as shown in Figure 1. The domains include education [15], [17]–[19], healthcare [20], transportation [21], small and medium enterprises (SME) [27,29], and government[15,16] as well as from the perspective of various stakeholders like adopters and providers. Education domain has taken much attention of the previous researchers in Malaysia compared to the government sector. This is perhaps due to the nature of the academia who have better access at the education field compared to the public sector departments.

A few attempts were also made to healthcare sector. However, the cloud adoption studies in healthcare done by [20] did not seek the viewpoint of patients since it emphasized more on validating the cloud acceptance model. While [14]–[17], [23] conducted a complete study, [16], [21], [24], [25] developed non-validated cloud computing adoption model or framework and system architecture.

According to [12], MAMPU has highlighted five main factors that has become major barriers in cloud adoption – standardization, accessibility, reliability, affordability and personalization. However, this findings was discovered a few years back. With the dynamic changes of cloud computing, it cannot be certain that these factors are still being a major issues of adoption.

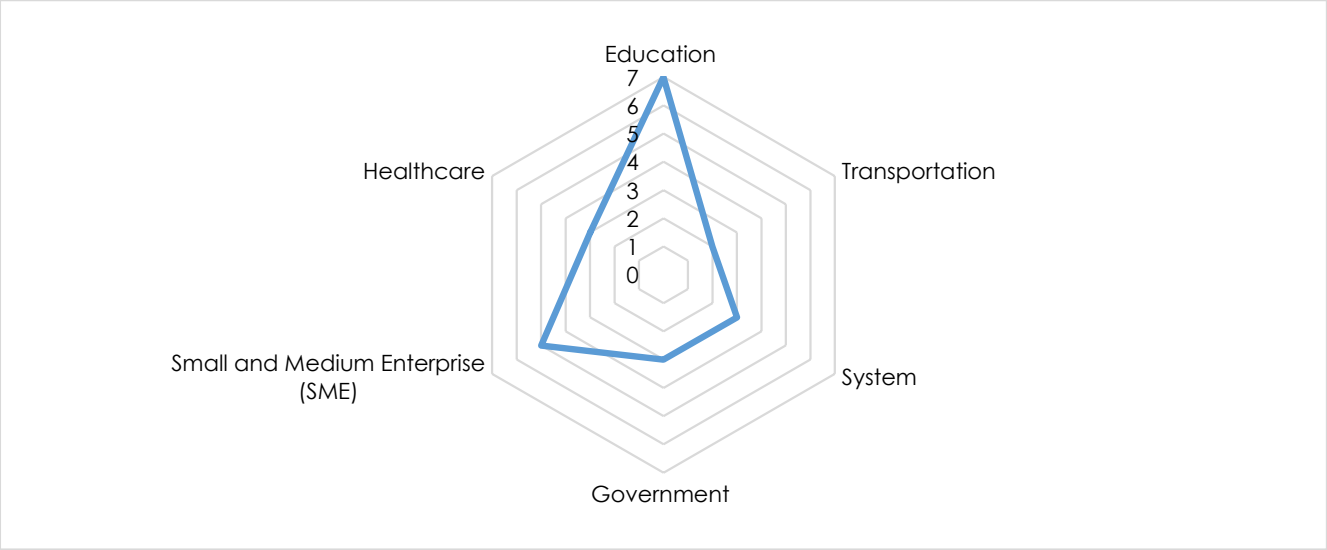


Figure 1 Cloud adoption studies in Malaysia based on domains

A review done by [18] on cloud adoption in the universities, revealed that cost and management issues have become the major hindrance of cloud adoption. However, a recent study done by [16] towards the users and cloud providers revealed that security is the main factor that affect the cloud adoption which is in line with the challenges reported by NIST [6] and Gartner [26]. Gartner highlighted that in 2015, security, environment and governance are still the major hindrance of cloud adoption in the organizations.

For instance, security incidents happened of recently proving this claim. On January 2015 Malaysian Airlines website was hacked by Lizard Squad displaying an image of a lizard wearing a hat with the caption of "Plane-Not-Found" following the incident of MH370 gone missing last year, after attacking Sony Play station and Microsoft Xbox Live in the earlier month. Google Malaysia was also hacked on April 2015 where users were redirected to the hacker site claimed as Bangladeshi Tigermate hacker [27]. All these incidents negatively influence the decision makers in adopting cloud computing in the organizations.

Nevertheless, the security risks and threats come not only from the outside of the organisation. Malicious insiders are said to be the most dangerous threats for their ability to access the system from within[28]. However, many crime incidents involving former employees were rarely reported to keep good name of the organisation. Quite often security is being compromised due to the human errors as well. Some stakeholders' action may unintentionally cause the security breach and this type of human error is very hard to trace[29]. The aftermath damage done for these errors may jeopardise the whole organisation.

Many researchers offer technical solutions [30], [31] to strengthen the security within and beyond the four walls of the organizations. The use of strong passwords, cryptography, firewalls and many more techniques to enhance security, however, security breach still happens all the time. It is time security issues be dealt from other than technical perspectives for human is always the weakest link of security breaches [32]. Inculcation of information security culture among stakeholders of cloud computing may reduce the risks and threats of information security, enhance the security readiness and gradually increase the level of cloud adoption in the organisations.

6.0 CONCLUSION

To this end, security by far is still the most debated hindrance factor in many cloud adoption studies. The security risks and threats give significant the adoption of cloud in the organizations despites various protections given from the technical perspectives. However, little is known to the security of cloud adoption from non-technical dimension. Humans are the main important element when it comes to technology adoption. They are a complex creature who have different kinds of backgrounds, habits, personal values and level of trust. This attributes could influence their behavior in the cloud environment and

eventually shape the security culture of the cyber world. This gap motivates the authors to further investigate the security culture of cloud stakeholders in this country. We are of the opinion that information security should be dealt from the sociocultural perspective as part of the cloud computing security readiness. Our future research will investigate the information security culture of the stakeholders in the cloud environment in the context of Malaysia.

Acknowledgement

We acknowledge the financial support from the Ministry of Higher Education, Malaysia and the Universiti Teknikal Malaysia, Melaka for their assistance in this research.

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