CHAPTER 2 : LITERATURE REVIEW

2.0 CLOUD COMPUTING LITERATURE

Cloud Computing, as believed by Cusumano, 2009 is led by Amazon and Google which Microsoft did not foresee the trend at first. Its adoption may have started with offerings like the free web mails applications from Google, Yahoo and Hotmail. The evolution of cloud computing then widespread to hosted applications made available by Application Service Provider (ASP) to organizations and enterprises like the Hosted Exchange by Microsoft applications whereby the email applications is hosted somewhere and accessible online and anywhere.

Currently, there is a widespread interest in cloud computing that may contribute to the revolutionary growth in available options for using cloud computing. There are advantages in using Cloud services, ranges from economies of scale and availability of large computing resources to many users (Greenberg, 2008).

Various organizations are beginning to adopt cloud computing, ranging from individuals and small medium enterprises and organizations that often do not have comparable dedicated resources available, to larger organizations that have chosen cloud model for various reasons. Reasons, among others are timeliness, cost and the requirement to improve the quality of IT support.

However, there can be gap between the promise of cloud computing and the market adoption, says Greenberg (2008). That is the reason this study is conducted, i.e. to find out the particular factor (reasons) that may influence the adoption of Cloud

Services in Malaysia. In one of the market research done specifically for an organization by TNS, in 2010, Malaysian are still skeptical in adoption of cloud, although they buy the concept of it and its advantage. Thus, this study will be the basis of the future findings.

Software-as-a-Service (SaaS) has been the most sexy and tempting offerings among the Cloud Services layers (Wu, W.. (2011). Despite that, SaaS to-date has yet been adopted with as much eagerness as was originally expected from the market. A variety of factors may influence the adoption of SaaS solutions. Wu, W.. (2011) has studies to explore the significant factors affecting the adoption of SaaS for vendors and enterprise users using an analytical framework via two approaches -- *Technology Acceptance* Model (TAM) and Rough Set Theory (RST). The study has revealed a considerable amount of meaningful information, which not only facilitates the SaaS vendors to grasp users' needs and concerns about SaaS adoption, but also helps the managers to introduce effective marketing strategies and actions to promote the growth of SaaS market.

The underlying factors in adoption of Cloud Computing is also studied by Katz, R.. (2010). Katz, R.. (2010) has conducted a panel discussion with several corporate higher education leaders and CIOs discussed the possible promise and peril to gather some additional perspectives on cloud computing and above-campus services. In the panel discussion, according to Elazar C Harel, it's not all new and different, but cloud services seem to provide a more granular set of options. These services can start and end at any time, taking advantage of the high-speed networks that is available recently.

In the study by Katz, R.. (2010), their panel Joanne Kossuth said that the cloud will increase their agility and responsiveness, especially with regard to research agendas and collaborative opportunities. Brad Wheeler added that as services become commoditized, there is less and less justification for premise-based solutions. This does not mean that everything should move to the cloud. Michael King added too that cloud computing also offers an economic advantage by allowing institutions to focus more resources on differentiating value, as opposed to managing and supporting a full suite of services expected by their enterprise's citizen.

A locally conducted study on cloud adoption is by Selamat, Z., & Jaffar, N.. (2011). It examined the adoption and acceptance of information technology from the perspective of Malaysian bankers. The results of this study indicate that majority of Malaysian bankers heavily used computer for routine jobs such as paper work and data maintenance but rarely use the computer for advance functions such as business analysis, planning and decision making.

Malaysian bankers also rarely used professional software for specific purposes such as statistical analysis or programming languages. The regression result of this study appeared to suggest that perceived usefulness, management support and external computing support were found to be the most influential factors in determining microcomputer usage among bankers in Malaysia. Overall, the results of this study are valuable to both researchers and bank management in providing new insights about the IT from bankers' point of view.

2.1 THEORETICAL BASES OF THIS STUDY

The theoretical framework proposed in this study is adapted from Technology Acceptance Model (Davis et al., 1989) and Innovation Diffusion Theory (Rogers, 1995). There is no one specific theory that addresses all these constructs, therefore the reason of adopting two (2) theories that discuss about construct. The model provides a strong theoretical base for researching on the behavioral factors contributing to technology acceptance, hence the choice in referring to these theory and not others. This study adopts primarily the theories and literature used to examine individual adoption of technology and innovations in order to identify potential factors that may affect individual (Selamat, Z., & Jaffar, N.., 2011) adoption of Cloud Computing.

2.1.1 Technology Acceptance Model (TAM)

TAM is one of the most utilised and referenced models for research in the adoption of information technology and information systems (Venkatesh, 1999). TAM has its roots in the theory of reasoned action (TRA) which explains individuals' behaviour on the basis of factors such as beliefs and intentions (Ortega et al., 2006). Technology Acceptance Model suggests that perceived usefulness (PU) and perceived ease of use (PEoU) of IT drive users' attitudes and intentions to adopt that technology (Davis 1989). PU is defined as the degree to which a person believes that use of technology will produce better outcomes (Davis, 1989). 'Usefulness' refer to capable of being used advantageously' (Davis, 1989).

In contrast PEoU is referring to the perception about the degree of effort needed to use a particular system (Davis, 1989). In general, if a system is easy to use, it requires less effort on the part of users, thereby increasing the likelihood of adoption and usage

(Selamat, Z., & Jaffar, N.., 2011). On the other hand, if systems that are complex or difficult to use are less likely to be adopted, since it requires significant effort and interest on the part of the user (Teo, 2001). In summary :

Table 2.1-1

Summary of TAM

Technology Acceptance Model (TAM)		
TAM is tailored to IS contexts, and was designed to predict information technology acceptance and usage on the job. Unlike TRA, the final conceptualization of TAM excludes the attitude construct in order to better explain intention parsimoniously. TAM has been widely applied to a diverse set of technologies and users.	Perceived Usefulness	"the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis 1989, p. 320).
	Perceived Ease of Use	"the degree to which a person believes that using a particular system would be free of effort" (Davis 1989, p. 320)

2.1.2 Innovation Diffusion Theory (IDT)

Innovation Diffusion Theory (Rogers, 1983; 1995) has always been the fundamental theoretical base of adoption research in various disciplines including sociology, communications, marketing, education, etc. (Gopalakrishnan and Damanpour, 1997: Ramamurthy and Prekumar, 1995). According to the study on IT innovation adoption by Jeyaraj, Rottman, and Lacity, 2006, IDT is a dominant theory used to examine organizational adoption of IT over the period of two (2) decades.

Rogers (1983,1995) through his innovation diffusion approach claims that there are fundamental characteristics of a new technology that promote usage and adoption of technology. According to Roger, there are eight (8) characteristics of innovations that influence acceptance :

- Relative advantage
- Compatibility
- Ability to try out innovation (Trialability)
- Ease of use
- Visibility
- Demonstrated results
- Image
- Voluntariness

IDT has introduced these perceived characteristics of innovating (PCI) proposed by Moore and Benbasat into Rogers' classical theory of innovation diffusion and further judged on the adoption rate from a MIS point of view. These Perceived Characteristics of Innovating (PCI) factors have been adapted into many other TAM factors and are included as the constructive determinants in the different layers of IT adoption intention in the framework. The PCI is more closely related to :

i. the users' personality;
ii. the characteristics of the specific technology;
iii. and the external conditions in the IT adoption environment (Nan Zhang, Xunhua Guo, Guoqing Chen, 2008) .

In this study, adoption and usage are used interchangeably although sometimes within the diffusion of innovation approach, there is an implicit understanding that the

adoption and usage are not synonymous. Karahanna, in her research shows that factors that influence adoption and usage are different.

Only two (2) factors from IDT are adopted in this study :

i. Compatibility: where the consumer identified how compatible the device was with his or her own lifestyle (e.g. work habits, etc.) (Hebron, 2008);
ii. Trialability or the ability to test the technology, or helped to encourage broader use; (Hebron, 2008).

Moore and Benbasat stated that the differences among these perceptions will lead to different user adoption behaviours. The choosing of only two (2) factors was done purposely due to the reason to avoid the circumstances when too many determinants are laid on one layer, the noise from the correlations might be amplified, leading to multicollinearity problems that finally generate disordered results that conflict with reality.

As a result, reasonable models should not directly include all the eight PCI in the same layer. In addition, the framework can also be used to explore the differences among which the different PCI factors impact user IT adoption (Nan Zhang, Xunhua Guo, Guoqing Chen, 2008). Thus, based on the above judgement and to ensure simplicity and clarity, only these two (2) factors were tested in his study, the Compatibility and the Trialability factors.

Summary of the IDT factors adopted are as follows :

Table 2.1-2

Summary of IDT Factors studied

Innovation Diffusion Theory (IDT)	Variable	Definitions
Grounded in sociology, IDT (Rogers 1995) has been used since the 1960s to study a variety of innovations, ranging from agricultural tools to organizational innovation systems, Moore and Benbasat 91991) adapted the characteristics of innovations presented in Rogers and refined a set of constructs that could be used to study individual technology acceptance. Moore and Benbasat (1996) found support for the predictive validity of these innovation characteristics (see also Agarwal and Prasad 1997, 1998; Karahanna et al. 1999; Plouffe et al. 2001).	Compatibility	"the degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters" (Moore and Benbasat 1991, p. 203)
	Ability to try out innovation (Triability)	"the degree to which an innovation may be experimented with before adoption", is an objective evaluation about popularization of an innovation.

Hebron, 2008 on Diffusion of Innovations: The Theory on Diffusion of Innovations (Dol) suggested that there are differences in the type of persons who approach new technologies, especially in respect to willingness to accept these. Rogers (1962) found

that there were five categories of adopters (e.g., persons who use technology), and that these were classified as the readiness to respond to technology:

1. Innovators were the first to adopt and did so without background information from other consumers;

2. Early adopters were those who responded to the usefulness of technology and read information from innovators concerning performance and outcome;

3. Early majority users did so based upon information within the social climate and responsible assessment of performance throughout the previous two groups;

4. The late majority formed the largest single group of adopters and were those who responded to general social shifts after others had altered the effectiveness of the climate in respect to technology; and

5. Laggards adopted only after all others had done so and society had changed to a point where they needed to conform to these outcomes or face negative consequences.

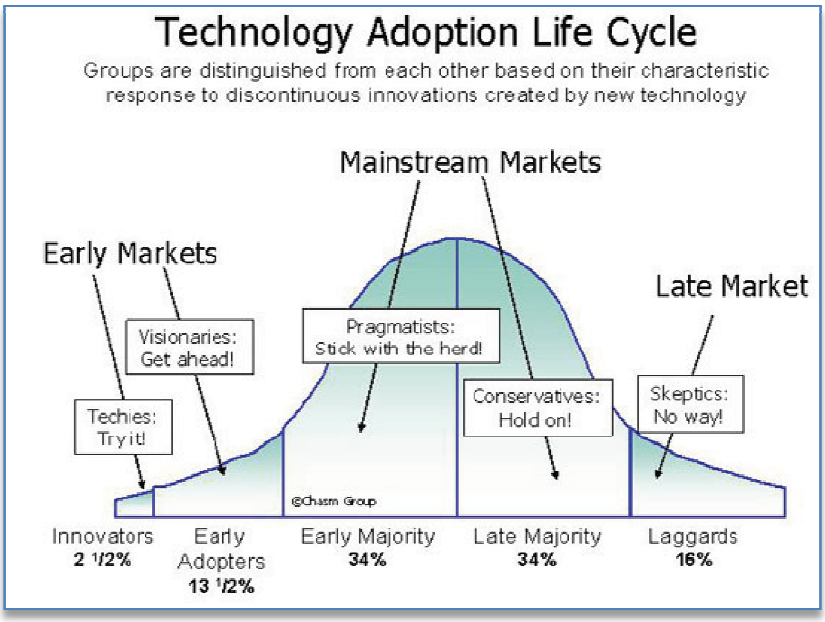

Figure 2.1-1 : Technology Adoption Life Cycle

In an extensive review of research study, it is found out that Hebron (2008) and Udoh, E.. (2010) detailed the behavioural factors affecting the adoption of wireless data technology and grid technology. Cloud technology or services could be via wired or wireless (Ahuja & Myers, 2006).

Several factors affecting wireless technology acceptance and grid technology were empirically studied and those factors sharing similarity with the adoption of cloud computing or services are given as follows :

i. stability and security,

ii. perceived usefulness,

iii. perceived ease of use,

iv. and attitude.

The explanations for choosing the Hebron (2008) instrument and the behavioral factors are given below. *Stability and security* of the wireless data network are central in deciding whether to use wireless technology or not. Clients are wary of the security of the wireless networks, especially during exchange of sensitive data. In the same vein, security is a major concern in Cloud Services and technology (IDC, 2009).

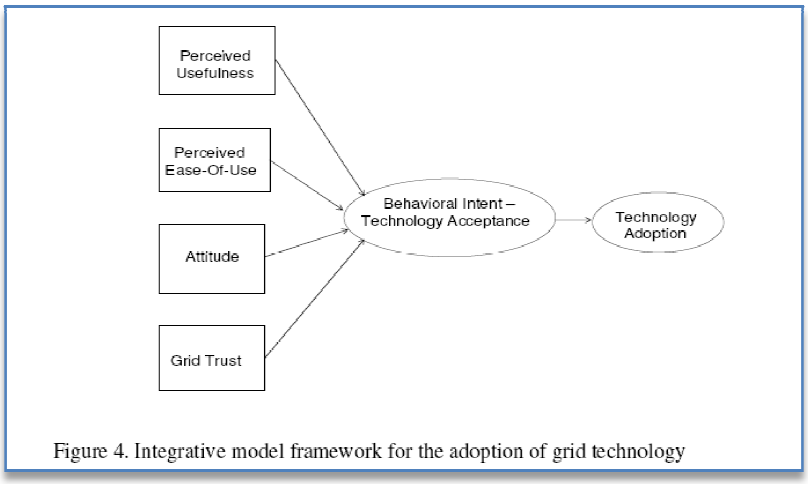

Figure 4. Integrative model framework for the adoption of grid technology

Figure 2.1-2 : Integrative Model Framework for adoption of GRID Technology

Collaborative works and interconnection of virtual supercomputers connote elements of system sharing that could be technically porous in terms of security. Organizations express anxiety or are concerned about exposing their systems, especially their prized database infrastructure to the outside world without maximum security assurance. This concern has featured in several cloud market research done by market research organisation such as Frost & Sullivan in its Cloud Computing End-user study, (2010).

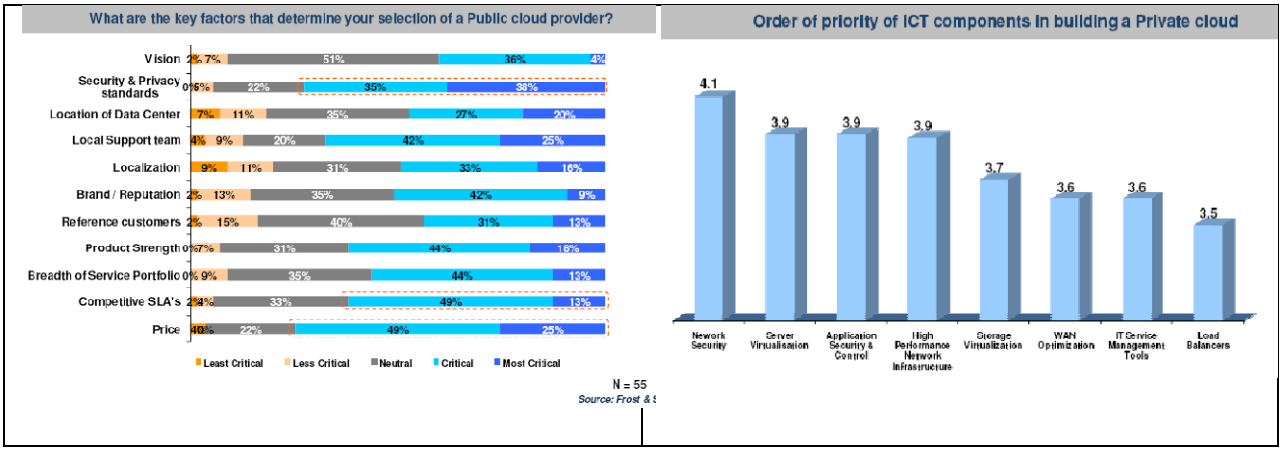

Figure 2.1-3 : Cloud Computing End-user study (Frost and Sullivan, 2010)

This study extended the Hebron's work and Udoh, E. Work into the Cloud computing study as represented under Cloud Trust.

2.2 CHAPTER SUMMARY

This chapter had presented the related literature reviews on Cloud Computing and technology adoption together with its underlying theories. Basically, the Cloud Computing consists of three (3) layers, that are Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software as a Service (SaaS). This study does not zoom into any of these categories, but only to perform a generic study based on the general Cloud Computing. The underlying theories used are mentioned in this chapter. The theories involved are Technology Acceptance Model (TAM) and Innovation Diffusion Theories (IDT).