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An Empirical Study on the Impact of Information System Quality on Software as a Service

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Abstract
Purpose: Cloud computing specially on Software as a Service (SaaS) is currently powerful instrument and has attracted substantial attention from industrial, practitioners and academics. This paper aimed to develop an integrated model designed to predict, to examine and to understand information system quality on Software as a Service during the formation of sustainable of continuous intention of customers in cloud computing contexts.
Design/methodology/approach: The participants were from 144 samples, most of respondents were CIOs and CEOs. Structural equation modelling was applied to demonstrate the stability of the proposed model and the results of hypotheses testing.
Findings: The analysis results demonstrated that customers' continuous intention and customers' satisfaction were determined significantly by SaaS Quality. Satisfaction was also the significant motivator of customers' continuous intention.
Research limitations/implications: The differences among various types of SaaS application were not analysed. This study suggests that future studies should extend research including users of various SaaS applications such as office application software, enterprise resource plan, customer relationship management system and so on.
Originality/value: This paper proposed a comprehensive model to synthesize the essence of SaaS quality for explaining customers' satisfaction and customers' continuous intention of SaaS.

Keywords: SaaS Quality, customers' satisfaction, customers' continuous intention

Introduction

Software as a Service (SaaS) is part of cloud computing technology and one of the service type, an innovation of software application based on web 2.0 (Chou & Chou, 2007). Success stories can be seen from leading companies such as SalesForce.com, Amazon's EC2, Google's App Engine, Microsoft CRM, and GoGrid. SaaS application works on cloud servers distributed by SaaS providers. Customers only need to pay based on customer usage or service delivered, it is called on demand purchase model. This model is kind of mode of service utility, customers just subscribe an application, no need to buy the software or develop their own software and hardware such as server. So customers can focus on their main business activities and reduce their cost. SaaS model usage in organization is able to outsource applications for their needs, such as tools (i.e. office software application, antivirus, e-mail, music player) and business applications (i.e. finance or accounting software, human resources management system, customer relationship management, enterprise resource planning). Cost saving is one reason why an organization adopts SaaS application but it is too lack or not sufficient and it needs to explain more about SaaS adoption decision. Furthermore, the behavioural impacts of SaaS adoption are needed to assess and how customers use of SaaS application during and post adoption.

Even though the drivers of success in implementation of SaaS can be reduced, IT and IS cost are elastic in their operation, faster in upgrade, on demand and easy to implement. Service quality is becoming huge issue and is very important. To achieve maximum quality in SaaS, it needs new requirements toward service quality, information quality and system quality, due to SaaS has difference characteristics. For examples, SaaS is requiring and is dependently on internet connection, strong security due to safeguard data and information, 24 hour's service availability and flexibility afforded. Since, customers or users do not have their own software and do not maintain the infrastructure, they only need to pay what they use for SaaS services (pay as you go models). This model gives customers more option to choose the other SaaS providers easily. All these factors present unique challenges to SaaS providers to keep customers' requirements for service to achieve their customers' satisfaction and intent to use.

Notwithstanding the fact that the SaaS has been spread widely and increasingly in recent years, but few studies discussed about the adoption or acceptance in cloud computing especially on SaaS quality. However, some studies have explained about service quality and system quality in the area of marketing and information system. One famous theory of information system came from theory of DeLone and McLean (2003). They argued that to achieve users' satisfaction there are three dimension to be used namely information quality, system quality and service quality (Delone & McLean, 2003). Meanwhile, SaaS application has basic difference paradigm of software application. The main basic function of SaaS is the agility. This function cannot work on the classical software application. DeLone and McLean (2003) in theory of information success factor did not estimate the agility of the software application. So in order to increase functionality of the information system quality it needs adaptability in the area of SaaS application, such as rapport and responsiveness.

This study established a conceptual model to characterize and to predict users' or customers' sustainable usage behaviours and factors that relate to SaaS application usage, based on their perception of SaaS quality and different values. Besides, it is also an important issue to understand how the effect of SaaS quality influenced the satisfaction and continuous intention among industrial agencies and customers. Therefore, this research aimed to find out the sustainability of factors that affect users' continuous intention to understand the SaaS application to propose an integrated model based on SaaS Quality.

Literature Review

Software as a Service Quality (SaaSQ)

Some studies describe and define system quality as the system performance recognized by users' information such as stability, usability, accessibility, availability, adaptability, and ease of use. Meanwhile, Information quality is defined as the degree to which users' expectations and requests are satisfied by the information obtained such as relevance, accuracy, timeliness, and completeness (DeLone and McLean, 1992; Pitt et al, 1995; Seddon, 1997; Rai et al, 2002; DeLone and McLean, 2003; DeLone and McLean, 2004; Bradley et al, 2006). Overall, in specific, Information-System-Quality (ISQ) can be defined as the degree of the quality which has technical components and contents of the information in the system application of the software such as help screens, user manuals, useful functionality, accessibility, flexibility, integration among sub systems, response time, reliability, accuracy of data processing, ease of use, and ease of learning (DeLone & McLean, 1992; Liu & Arnett, 2000). ISQ is used in many study areas. Kim et al (2009) used ISQ to investigate factors affecting ubiquitous computing use and U-business value, and they argued that ISQ was the important factor which determined the creation of value in a ubiquitous computing environment. Chen (2010) measured the tax payers' satisfaction with an online system for filing individual income tax returns, and concluded the ISQ was more important than service quality in measuring tax payers' satisfaction.

SaaS is one innovation that revolutionizes application delivery based on cloud computing, growth during the last few years (Yang et al, 2015). There are a lot studies related about SaaS i.e., SaaS Development (Noura Limam, 2010; Du et al, 2014), in the area marketing management (Ma, 2014; Rohitratana & Altmann, 2012), from the perspective of organizational (Yang, 2015), and from the perspective of management information system (Wu et al, 2012; Du et al, 2013; Chou & Chiang, 2013; Goode, 2015; Lee et al, 2013). Benlian et al (2012) described their study about how SaaS service quality factors affected IS continuous intention by virtue of influencing customers' satisfaction and perceived usefulness and how these factors currently fulfilled from a business and customers' perspective. The most important service quality factors in SaaS were responsiveness and security or privacy. In other studies they developed and descibed, refined, and tested SaaSQ, in the zones of tolerance (ZOT) based service quality measurement instrument for SaaS solutions. Besides they have already been validated and established service quality dimensions (i.e., rapport, responsiveness, reliability, and features), they also identified two new factors (i.e., security and flexibility) that were essential for the evaluation of service quality of SaaS solutions (Belian et al, 2011).

In this study, usage SaaSQ was adopted from Belian with six dimensions (Belian et al, 2011);

Flexibility: refers to the way of relationship between SaaS vendors and customers. How to change contractual such as cancellation period, payment model or technical such as change scalability storage capacity, modifications to the application service.

Features: refers to the application features and degree of functionalities in aspects of use, such as application support, data extraction, or application type. Those functions of a SaaS application must be suitable with the business requirements of a customer.

Reliability: consists of all aspects of features of a SaaS vendor's ability to perform their promised services, being trusted, dependably and accurately, vendor can provide services what customers pay on time.

Rapport: all information and all aspects of SaaS providers including ability to provide knowledgeable, caring, and technical support in order to solve the problem and to support in aligned working styles, as well as to support individualized attention such as trainings and courses for specific customers.

Responsiveness: all capability aspects of a SaaS provider in order to ensure that the availability and performance of the SaaS are running as they are needed. Providing professional or good planning on disaster recovery or ready for loading balancing problem, as well as the responsiveness of support staff in 24 hours and hotline availability.
Security: refers to all aspects to ensure preventive of the measured problems related to security data, encryption, and antivirus, to safeguard data and to avoid lost information.
Satisfaction (Sat) and Continue Intention (CI)
Satisfaction and continuous intention are two indicators used to measures users' experiences. To analyse and describe continuous intention, Bhattacherjee (2001) modified expectation confirmation theory in order to fulfil standard information system and developed the post-acceptance model of IS continuance. This model explained that system of continuous intention was influenced by satisfaction, and that continuous intention for using IS was similar to the repurchase of some products or services intention generated during a purchase. Satisfaction referred to user happiness after positively experienced in that product or service, meanwhile continuous intention referred to willingness to reuse that product or service after positively experienced in that product or service (Premkumar and Bhattacherjee, 2008).

Research design
Research framework and hypotheses

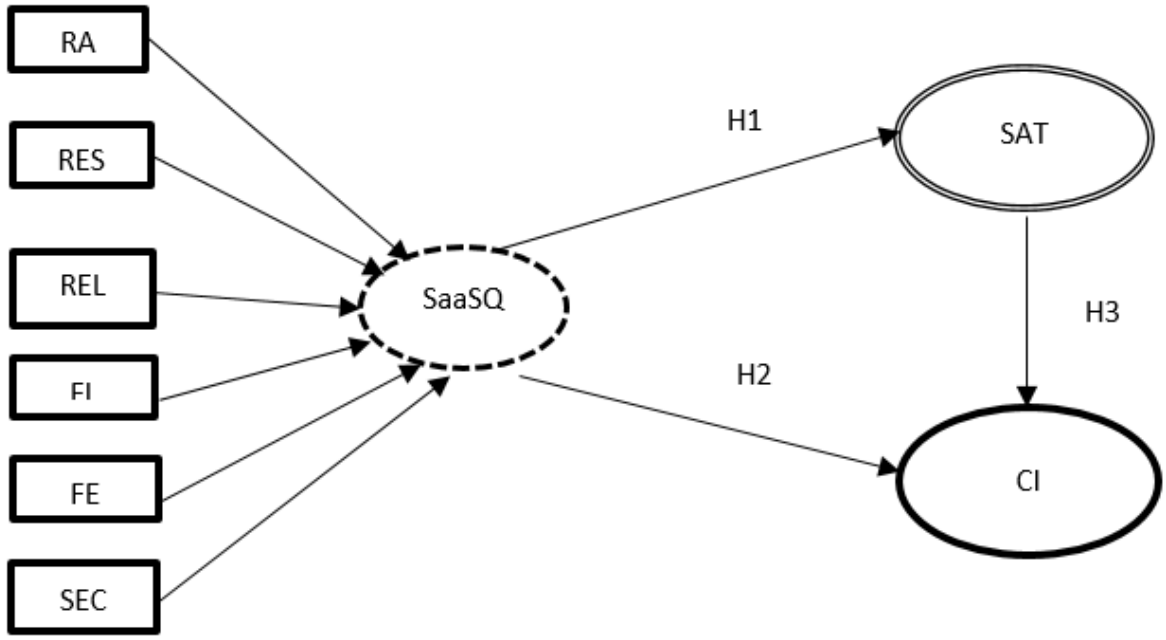

Figure 1: Software as a Service model

Second order reflective construction

Note: Software as a Service Quality (SaaSQ), Continuous Intention (CI), Satisfaction (SAT), Rapport (RA), Responsiveness (RES), Reliability (REL), Flexibility (FL), Features (FE), Security (SEC).

Figure 1 shows the proposed research model with all theoretical constructs. In this study, we modified Delone and McLean IS success and extended SaaS Quality.
The service quality of cloud computing has become an important and essential issue since there were many open challenges which need to be addressed related to trust in cloud services (Abdelmabouda et al, 2014). The theory of relationship marketing and organizational behaviour

viewed satisfaction as a key factor in affecting collaboration and social relationships for outsourcing in general and online services in particular (Chou & Chiang, 2013). Meanwhile, Benlian et al (2011, 2012), confirmed that SaaSQ had six facet indicators they were rapport, responsiveness, reliability, features, security and flexibility. They mixed perceived usefulness and satisfaction to measure SaaS continuous intention. From that study, it can be concluded that SaaS quality with six facet indicators were significant and other three were significant too. Thus, we proposed the following hypotheses.

H1: SaaS Quality had a positive influence on customers' satisfaction.
H2: SaaS Quality had a positive influence on customers' continuous intention.

Based on some literature reviews of expectation confirmation theory, satisfaction is one of the most key indicator that can be influenced of users' continuous reuse or repurchase (Oliver, 1980). Bhattacherjee (2001) described that the continuous intention of customers depends on the users' previous satisfactory experience of using IS namely the post-acceptance model. Some studies of expectation confirmation model confirmed that satisfaction and continuous intention had positive relationship and influenced each other in the area of information system and information Technology (Hong et al., 2001; Thong et al., 2006; Bhattacherjee et al., 2008). Thus, the following hypothesis is proposed.

H3. Customers' satisfaction had positive influence on customers' continuous intention.

Research Method

The method used in this study was by distributing data from various companies which used cloud computing technology, especially Software as a Service. To strengthen the hypothesis and research framework we referred to scientific papers from journals which have strong reputation. In this study, total questionnaires were 171 questionnaires which were collected from competent sources in the field. The data were from respondents who had strong experiences in the area of SaaS, most of our respondents were CIOs and CEOs. The way we got the data from respondents was through e-mail, we sent directly to the respondent that we headed. We collected the data started from March 2015 to September 2015. Table 1 presents the demographics of the respondents to describe the sample structure.

Table 1: Sample Demographics

Characteristics		**Frequency**	**Percent %**
Respondent title	IT executives (chief information officer/chief technology officer/vice president of IS/IT)	53	31.0%
	Business executives (chief executive officer, chief financial officer, and chief operating officer)IT	44	25.7%
	IT (middle) managers	42	24.6%
	Business managers and users	32	18.7%
Length of SaaS usage of respondent	< 3 months	5	2.9%
	3 to less than 6 months	20	11.7%
	6 to less than 12 months	60	35.1%
	12 months or more	86	50.3%
Frequency of SaaS usage of respondent	4 or less times a month	2	1.2%
	5 to 8 times a month	5	2.9%
	9 to 12 times a month	20	11.7%
	13 or more times a month	144	84.2%

Data analysis

To test the hypotheses, we used structural equation modelling (SEM) with partial least squares (PLS). There were some reasons why using PLS. First, PLS can be used to analyse models on process reflective indicators and formative indicators simultaneously. Second, PLS used was suitably for small sample size and can overcome multicollinearity among independent variables. Third, PLS did not require a normal distributional assumption (Chin, 1998; Chin and Newsted, 1999; Urbach and Ahlemann, 2010). In this study, we used the software SmartPLS 2.

Outer Model

Outer models were used to assess the validity and reliability of the construction. Outer models with reflective indicators evaluated through convergent and discriminant validity of the indicators forming latent constructs and composite reliability and Cronbach's alpha for the block indicator.

To ensure the reliability of the existing construction, then the expected value of the Cronbach's alpha must be greater than 0.70 and composite reliability value must be greater than 0.70. Table.2 was all values of the Cronbach's alpha and composite reliability which was greater than 0.70, then all constructs were reliable.

To test the discriminant validity, two tests were performed: the convergent validity test and the discriminant validity test. Fornell and Larcker (1981) suggested to test the convergent validity loading Factor and AVE which were performed, expected value of loading factor must be greater than 0.60, the value of the AVE must be greater than 0.50 (Hair et al, 2011a). In Table 2, shown that the value of each factor loading was greater than 0.50, the value of AVEs was greater than 0.50. Meanwhile, the square root of AVE was greater than the correlation coefficient of the construction, it was tested to confirm discriminant validity. The existing construction had matched with the criteria of convergent validity. Based on Table 2 and Table 3, the constructs exhibited discriminant validity.

Table 2: Reliability Analysis and Convergent Validity

Construct	**Measurement Items**	**Factor Loading /Coefficient (t-value)**	**Composite Reliability**	**AVE**	**Cronbach 's Alpha**
Software as a Service Quality (SaaSQ)	RA	0.281	N.A	N.A	N.A
	RES	0.135			
	REL	0.183			
	FL	0.179			
	FE	0.212			
	SEC	0.136			
Continue Intention (CI)	CI1	0.974	0.989	0.940	0.968
	CI2	0.965			
	CI3	0.970			
Satisfaction (SAT)	SAT1	0.748	0.870	0.691	0.776
	SAT2	0.863			
	SAT3	0.877			
Rapport (RA)	RA1	0.732	0.903	0.537	0.877
	RA2	0.733			
	RA3	0.760			
	RA4	0.716			
	RA5	0.793			
	RA6	0.736			
	RA7	0.681			
	RA8	0.707			
Responsiveness (RES)	RES1	0.693	0.857	0.547	0.791

Construct	Measurement Items	Factor Loading /Coefficient (t-value)	Composite Reliability	AVE	Cronbach 's Alpha
	RES2	0.781			
	RES3	0.753			
	RES4	0.822			
	RES5	0.635			
Reliability (REL)	REL1	0.928			
	REL2	0.929			
	REL3	0.523	0.948	0.821	0.927
	REL4	0.820			
	REL5	0.942			
Flexibility (FL)	FL1	0.891			
	FL2	0.855	0.929	0.765	0.897
	FL3	0.838			
	FL4	0.912			
Features (FE)	FE1	0.809			
	FE2	0.793			
	FE3	0.734			
	FE4	0.715	0.921	0.596	0.902
	FE5	0.690			
	FE6	0.731			
	FE7	0.780			
	FE8	0.902			
Security (SEC)	SEC1	0.758			
	SEC2	0.836			
	SEC3	0.821	0.899	0.641	0.859
	SEC4	0.836			
	SEC5	0.749			

Note: Software as a Service Quality (SaaSQ), Continuous Intention (CI), Satisfaction (SAT), Rapport (RA), Responsiveness (RES), Reliability (REL), Flexibility (FL), Features (FE), Security (SEC).

Table 3: Correlation Matrix

	CI	FE	FL	RA	REL	RES	SAT	SEC
CI	**0.970**							
FE	0.573	**0.772**						
FL	0.517	0.699	**0.787**					
RA	0.531	0.516	0.553	**0.669**				
REL	0.588	0.769	0.710	0.777	**0.810**			
RES	0.473	0.574	0.434	0.409	0.528	**0.619**		
SAT	0.592	0.780	0.568	0.546	0.687	0.404	**0.831**	
SEC	0.526	0.628	0.651	0.576	0.634	0.696	0.614	**0.769**

Note 1 : Continuous Intention (CI), Satisfaction (SAT), Rapport (RA), Responsiveness (RES), Reliability (REL), Flexibility (FL), Features (FE), Security (SEC), Software as a Service Quality (SaaSQ).
Note 2: The diagonal line of the correlation matrix represents the square root of AVE

Inner model

Inner model was used to predict the relationship between latent variables. Inner models was evaluated by the size of the variance, explained by looking at the value of R-Square. For the results of the path coefficient, the t-value and significance can be seen in Table 4. As in Fig.2 describes the results of hypothesis tests the inner models. From Fig.2 and Table 4 and 5 shown

that all hypotheses (direct or indirect) that exist in this research have been supported or accepted.

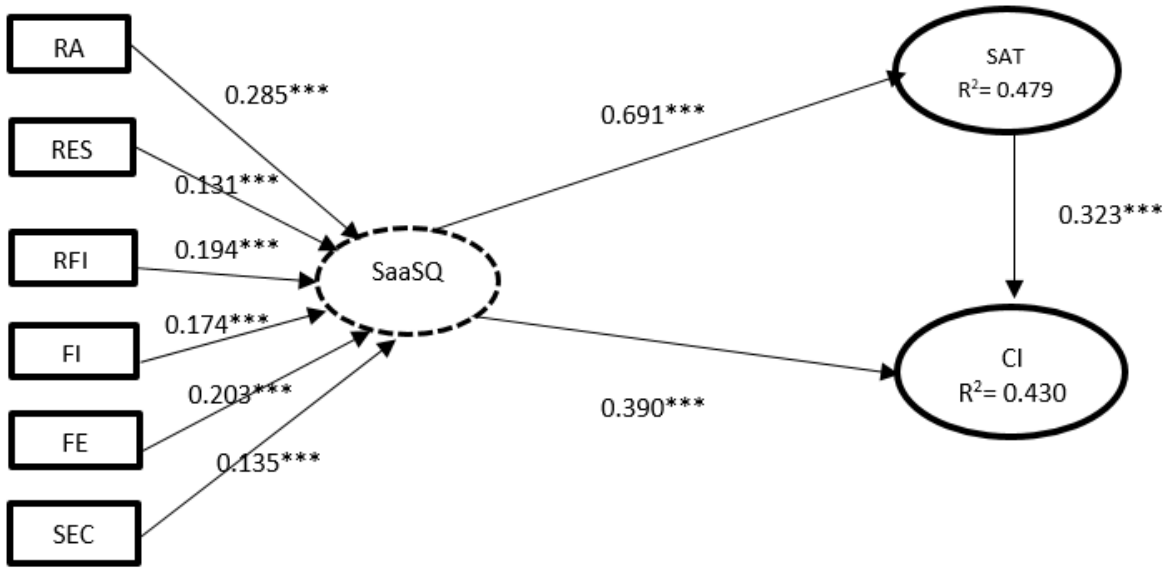

Fig 2. Inner Model and Path Coefficient

Second order reflective construct

Note 1 : Software as a Service Quality (SaaSQ), Continuous Intention (CI), Satisfaction (SAT), Rapport (RA), Responsiveness (RES), Reliability (REL), Flexibility (FL), Features (FE), Security (SEC).
Note 2: * p-value < 0.05, ** p-value < 0.01, *** p-value < 0.001

Table 4. Summary of Hypothesis Testing Results

Hypothesis	Path	Standardized path coefficient	t-value	Supported
H1	SaaSQ -> SAT	0.691***	18.461	Yes
H2	SaaSQ -> CI	0.390***	4.571	Yes
H3	SAT -> CI	0.323***	4.282	Yes

Note 1: Software as a Service Quality (SaaSQ), Continuous Intention (CI), Satisfaction (SAT).
Note 2: * p-value < 0.05, ** p-value < 0.01, *** p-value < 0.001

Mediation effect testing

To test mediation effects, in this study we used Sobel test (Sobel, 1982), the indicator used was the t-value, which will be considered significance if the t-value was greater than 1.96. To see the results of the mediation effect testing, from the table 5. all values of coefficients have been significance.

Table 5. Mediation Effects Testing

Constructs	Construct relationships	T-value of path Coefficients	Sobel test's z-value
SaaSQ -> SAT -> CI	SaaSQ -> SAT	18.461	4.171***
	SAT -> CI	4.282	

Note 1: Software as a Service Quality (SaaSQ), Satisfaction (SAT), Continuous Intention (CI)
Note 2: * p-value < 0.05, ** p-value < 0.01, *** p-value < 0.001

Discussions

This research can be used for practitioners and academics to assess the impact of the use of cloud computing especially Software as a Service. From the results of hypothesis 1 and 2, the SaaSQ had a positive and significant impacts on the SAT and CI directly. In other words, SaaSQ will greatly affect the satisfaction of customers, the same thing happened to CI, SaaSQ also positively and significantly impacted on the CI. SaaSQ also positively and significantly impacted on the CI through SAT indirect. It means that the SaaSQ including the RA, RES, REL, FL, FE, and the SEC will determine whether the customer will use SaaS services are sustainable or not. SaaSQ is the new method of the assessment of the IT/IS quality, with the SaaSQ customers can get high experiences, emotions, and interests. Customers interacted and produced the psychological evaluation of generated preferences concerning to the SaaS application. Thus, SaaSQ can stimulate customers' satisfaction, then users will more strongly stick with the services. Consequently loyalty of the customer will increase. When this effect was produced, SaaS providers can get customers' intention and customers will survive to use SaaS application in the long time period.

This study also examined the impacts of the relationship SAT on CI hypothesis 3. From the analysis, we concluded that satisfaction were the essence in determining whether customers will continue to use a SaaS application or not, as the evidence SAT and CI had significance relationships. It means that psychologically customers will use SaaS application if the customers have satisfaction to the SaaS providers. The SaaS providers must provide high SaaSQ in order to make good relationship to customers. Consequently, intention of the customers' usage of SaaS was increased, while the relationship between the customer and provider was improved. The SaaS provider may able to keep the SaaSQ and the SAT as two important considerations.

Conclusion

Cloud computing especially SaaS has become part of the trend and at the same time become industry which is needed. Nowadays, providers of SaaS have to provide high quality services to provide customers' need. This study displayed an overview as a model which can be a reference for SaaS provider industry, to do what customers really need in SaaS application. The indicator on SaaS we used in this study referred to the research of Benlian et al (2011, 2012), we also modified two indicators in this study, they were satisfaction and continuous intention.

In this study we investigated customers of SaaS with high competence in assessing the feasibility of the SaaSQ, in order to illustrate concretely and clearly effects of SaaSQ to customers, either directly or indirectly. In this study, it was found that SaaSQ influenced customers' satisfaction, which in turn will have influence to the customers' continuous intention.

Based on empirical data, the contribution of this work is to develop a model for elucidating and predicting the relationships between users or customers' and SaaS provider. The results can be served as a reference to practitioners' who seek to establish favourable relationships between the customers' of SaaS and SaaS providers'. In the future, the SaaS providers' need to focus on

SaaSQ in order to increase their customer satisfaction. Method of SaaSQ was used to improve information system quality and to exploite customers' expectation. Customers today not only focused on the functionality and stability of systems, but also demanded that SaaS providers' provided memorable and pleasurable experiences (Komppula and Gartner, 2012).

This study explained how customers maintain their CI toward SaaS application owing to SaaSQ. Subsequently, SaaSQ was presented as a reflective construct, which involved RA, RES, REL, FA, FE and FL, which are used to establish an integrated model and observe the effects of this model on maintaining CI. The present study argued that SaaS provider can use SaaSQ strategies to interact with the customers' SaaS application, not only increasing their satisfaction in SaaS application, but also helping to generate various emotions toward experiences. In recent years, the prevalence of software application has shifted computing methods, from the focusing solely on internet computing to the cloud computing. Cloud computing has been spread widely in every single business activity, no longer distances, everyone can use it on demand.

If SaaSQ can be designed well, it is possible to use to enrich content of application, and enrich customers' satisfaction, then customers' will benefit from novel experiences and create more added value for SaaS providers'. The findings of this study can be used as a reference for scholars and practitioners and software engineers in the establishment of SaaS application, sustainability of the SaaS customers' and SaaS providers'. SaaS providers' must consider how to establish customer satisfaction using various types of SaaSQ, due to SaaS application are agile and very different to the other software applications.

For SaaS providers, have to consider customers' expectation, trust and satisfaction come up from the SaaSQ, customers' tend to CI if those established as well. When customers' are able to interact easily with the SaaS application and their experience without making too much effort and without excessive expense, their interest in products or services will increase.

In the future, cloud computing especially SaaS will become a new trend for the industry, along with the increasingly rapid Internet development. Customers will switch to SaaS because SaaS is more flexible, secure, easy to use and affordable cost. SaaS users' are not only industrial level, but also reach out to the general users'.

The limitations and future prospects of the present study are summarized as follows. First, the differences among various types of SaaS application were not analysed. This study suggests that future studies should extend research to include users' of various SaaS application such as office application software, enterprise resource plan, customer relationship management system so on. In order to providing more representative results and implications.

Furthermore, future studies can adopt the SaaSQ perspectives of different types of SaaS application or in the different type of cloud computing such as PaaS and IaaS, in order to develop experimental features with various properties. These features can be used to assess the behavior of the consumers' toward SaaS application in more detail and thus consequently produce agility of system and application layouts and content. Second, this study did not measure the potential contribution of the government policy, in the area of cloud computing needed government policy to support business environment and to safeguard sense of security customer. Further work must be conducted to elucidate the advanced government policy in the area of SaaS application.

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