Factors Affecting Trust of Software as A Service Usage in Public Network: A Correlation Analysis

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***Abstract*— Software as a service (SaaS) is a cloud computing model that are extensively adopted and being used every day in the growing technology era. SaaS has provided variety of functionalities and flexibilities to save time, cost and efforts on how people do and run their day to day work and tasks. Although SaaS provides opportunities and convenience, there are also a lot of security in particular trust related issues that are still exists. There are voices of public users on online articles emphasizing about how dangerous it is for connecting to a public network. Hence the aim of this research is to identify factors that may influence the users' trust in using the SaaS (public network). This study occupied quantitative methodology engaging 209 survey respondents. The correlation analyses were performed to find the association between deduced factors and trust in using SaaS within public network area. This study may assist the public network providers in designing related network security policies with regard to the presence of SaaS usage in public network.**

Keywords—Cloud Computing, Information Security, Public Network, Security Measure

I. INTRODUCTION

In the world of technology today, WiFi or known as Wireless Fidelity has become the fundamental of connectivity and it is used to establish a connection. Most of the time, devices are connected to company network when working and connected to public network when out of office area. Due to the nature of public networks that provides free WiFi in wireless state, the data are transmitted through an open space where the connection is more susceptible to attacks. [1] indicates that the threats occur when data is in transmitting from sender to receiver. Cloud computing often offers opportunities but so do challenges and threats. There are variety of security issues encountered in cloud computing domain as cloud computing platform is still in immature phase and opens the vulnerabilities to security threats and attacks [2]. The usage of cloud computing has been widely used around the world especially Software as a Services (SaaS). Examples of SaaS providers that are widely used are Microsoft OneDrive, Salesforce, Citrix GoToMeeting, Cisco WebEx, Dropbox and various Google applications such as Google Docs, Google Drive and Google Plus [3].

Data transmitted over the network may be subject to data leakage and privacy violation. According to recent survey conducted by Dell [4], there are four out of five respondents are reluctant to store confidential data to public cloud services like Google Drive. SaaS raises data privacy concerns due to public cloud is vulnerable to attacks and the connection are less protected over the data transmissions [5]. Based on the fact that SaaS usage transmits the data remotely from cloud between cloud storage and cloud service user, there are possibilities that the connection will be intercepted or eavesdrop. Indeed, privacy issue exists in cloud computing as personal information as well as business related confidential data are stored remotely on cloud platform due to the availability of its services & scalability for computing processes [6].

Cloud computing can be operated in three service models which are Software as a Services, Platform as a Service and Infrastructure as a Service. According to Kaushik and Kumar [7] and Yang et al. [8], SaaS is a service hosted by a vendor or cloud service provider that runs on a cloud infrastructure and made available for customer over the network and internet. Besides, understanding the antecedents and consequences of trust provides a comprehensive guideline for both clients and providers to increase SaaS performance [9]. Therefore, this study aims at identifying the factors that may influence the trust on SaaS usage in public network.

II. BACKGROUND

Based on formal definition defined by National Institute of Standards and Technology (NIST), cloud computing is a model for supporting appropriate shared pool of network access that can be quickly facilitated and released with minimal supervision and efforts or service provider interaction [7, 10]. These services are provided by CSP over the Internet. SaaS usage in public network has become a usual trend where public users connects their devices such as mobile phones or laptop computers to perform their daily tasks. The preference of SaaS usage in public network pushes away the security measures that should be considered when they are actually connecting to a network that is highly vulnerable to attacks and threats.

Due to the nature on vulnerability of security threats and attacks in public network which may potentially leads to data leakage, SaaS usage has caused worrisome and uncertainty of cloud computing users [11]. It is essential to perform a risks-trust assessment to build public network user confidence and trust towards the connected public networks. According to risk-trust assessment model proposed by Sunderman [12], social influence, personal disposition, familiarity, structural assurances and technology acceptance attributes are proposed

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to measure risks assessment to examine whether or not the risks are acceptable in context of trust.

There are several category of perceived risks. Perceived risks are further derived from performance risks, financial risks, time risks, psychological risks, social risks, physical risks, privacy risks and overall risks [13]. However, cloud users tend to rely on Cloud Solution Provider to provide security protections over data stored in cloud [14] even though they are vulnerable to the risk. Hence it is important to understand appropriate ways to protect the users from those risk and at the same time increase their trust in using such network. Zhou [15] defined trust as willingness to accept vulnerabilities according to positive prospects towards providers. This means that cloud service users feel comfortable and believes that data stored over the cloud is safely protected and willing to bare any damages or loss over the clouds. When transmitting data over public network, the privacy over individual sensitive data may also be such a significant concern. Dhami et al. [16], regarded perceived privacy as means that an individual can have control over information to be shared and protect profiles and information confidentiality. As a result, this study [16] have validated that perceived security and perceived privacy are significant antecedent to trust in the domain of social networking.

Apart from technological view standpoints, this study also considered elements from human dimension. [17] Indicated that the human dimension such as individual skills and personal management could steadily facilitate and ease the usage of cloud computing. These skills include individual ability to handle the associated risks in cloud computing. The model proposed by the author considered to be dimensional factors that affecting public cloud computing usage.

This study has considered several important factors deduced from relevant literature. Those factors are relatively relevant to either public network or cloud computing adoption and implementation domain. The list of factors derived from the literature review is shown in Table I. This study introduced the consideration of two-dimensional perspective in assessing the factors affecting trust on SaaS usage in public network. The inclusion criterion of the factors was based on the context of individual use of public network. As such, factors like management skill and Information Technology infrastructure were excluded from the selection.

TABLE I. RELEVANT DEDUCED FACTORS

Dimension	***Factors***	***Description***
Risk	Performance Risk (PR) [13]	PR refers to possibilities of product malfunctioning or not performing the way as expected
	Financial Risk (FR) [13]	FR refers to monetary risk and potential financial loss
	Privacy Risk (PR) [13]	PR refers to loss of controls over sensitive personal details being used without user consent and permissions
	Overall Risk (OR) [13]	OR represents the amount of vulnerabilities that one can accept
Human	Personal Disposition (PD) [12]	PD refers to behavioural perception towards connected network
	Familiarity (FM) [12]	FM refers to close acquaintance towards the connected public network, which indirectly causes user gain trust as time goes on
	Perceived Security (PS) [15-16]	PS refers to personal belief of using SaaS in public network does not incur any risks or damages towards an individual public network user
	Perceived Privacy (PP) [15-16]	PP refers to individual behaviour and actions to protect over their confidential information
	Strategic Thinking (ST) [17]	ST individual perceptions on considering potential risks and consequences that may possibly occur when user are connected to a public network access
Dependent Variable	Trust [15-16]	Trust is the willingness to accept vulnerabilities according to positive prospects towards providers

Hence, based on the deduction of the variables, this study postulated nine hypotheses as below:

H1: Performance risks is positively associated with trust on SaaS usage in public network

H2: Financial risks is positively associated with trust on SaaS usage in public network

H3: Privacy risks is positively associated with trust on SaaS usage in public network

H4: Overall risks is positively associated with trust on SaaS usage in public network

H5: Personal disposition is positively associated with trust on SaaS usage in public network

H6: Familiarity is positively associated with trust on SaaS usage in public network

H7: Personal security is positively associated with trust on SaaS usage in public network

H8: Perceived privacy is positively associated with trust on SaaS usage in public network

H9: Strategic thinking is positively associated with trust on SaaS usage in public network

We proposed a model of two dimensional perspectives namely risk dimension and human dimension as shown in Fig. 1. The baseline model used in this research is a theoretical model introduced by Luo et al. [13] revolving around perceived risks facets model. The model was chosen because it shows association between different significant categories of perceived risk (performance risk, financial risk, privacy risk and overall risk) with trust as the main focus for this research.

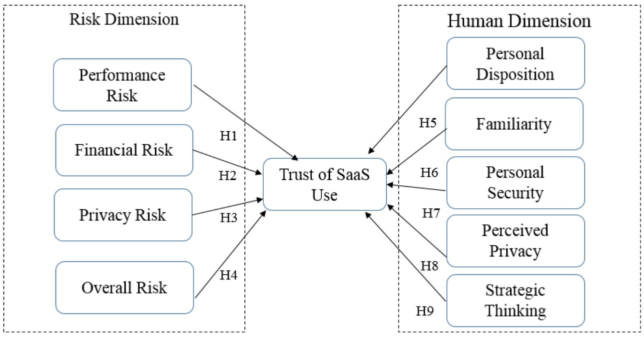

Fig 1. Proposed Conceptual Model for Trust of SaaS

III. METHODOLOGY

The unit of analysis of this study comprises individuals of SaaS users in public network (i.e users in shopping centres, airport, university and public restaurant) in Malaysia. In particular, the participants with age 18 onwards are identified as they are the group who highly exposed to data sensitivity. Questionnaire was distributed while the participants were at the public network area. Likert scale was used in all the questions related to the construct items except for demographic questions. According to Nunnally and Bernstein [18], likert scales are more reliable than single-item scales. A 5-point Likert scale was used in this study as it demonstrates a balance on both positive and negative sides of the feedback. Online survey Google Form was used to develop the online survey questionnaire. As the population is unknown, the determination of sample size was based on the guidelines for correlation analysis. According to sample size table for correlation analysis provided by Bujang and Baharum [19] which was based on the formula for calculation on two-tailed test [20], a sample size of 193 is needed if the aim of the study is to determine the correlation between "variable A" and "variable B" with significance of $p < 0.05$ and sufficient power of 80%.

The survey has been distributed via Google Form platform to a total of 209 valid respondents with each field is marked as mandatory to overcome data inconsistency. Google Form is used to ease the convenience for respondents and also reporting and analytical analysis via graph and pie-chart functions provided by Google Form. As the targeted respondents are aged 18 years and above, it became the best available tooling option for survey distributions as respondents can easily access to the survey regardless via computer, laptop and even mobile phone.

First section of the survey collects respondents' demographic backgrounds such as gender, age, education, job designations and years of working experiences. The second section of the survey aims to gauge the level of technical skills of respondents towards the usage of public network such as connected locations, hours spent, activities, threat awareness, online banking experience, slow internet connectivity, anti-virus tooling, computer driver updates and also security related course or training. While the last sections occupies 5-point Likert scale to measure the correlations to identify factors (performance risks, financial risks, privacy risks, overall risks, personal disposition, familiarity, perceived security, perceived privacy, strategic thinking) affecting trusts of SaaS in public network.

A total of 209 valid responses were obtained. Of 209 respondents, a total of 52% respondents are male and followed by 47% of the respondents are female. The respondents are targeted at age of 18 and above. 11.5% of respondents are high school graduate, whereby 21.1%, 54.1%, 12.0% and 1.4% obtained A-level/Diploma, Bachelor Degree, Postgraduate and Professional Certification respectively. In regard to working experience, 18% of the respondents have no experience, 46% have less than 6 years working experience, 16% have more than 6 years and less than 10 years working experience and the rest of the respondents have more than 10 years working experience. Respondents' demographic is shown in Table II and the distribution of questionnaire by location is shown in Table III.

TABLE II. SUMMARY OF RESPONDENTS' DEMOGRAPHIC

Variable	*Item*	*Percentage (%)*
Gender	Male	51.7
	Female	48.3
Age	18 - 24	18.7
	25 - 29	41.1
	30 - 34	23.4
	35 - 39	8.9
	Above 40	8.1
Education	High school graduate	11.5
	A level/Diploma	21.1
	Undergraduate/Degree	54.0
	Postgraduate	12.0
	Other Professional Certifications	1.4
Working Experience	Fresh Graduate	10.5
	1 - 2 years	20.1
	3 - 5 years	25.8
	6 - 9 years	15.8
	Above 10 years	27.8

TABLE III. COLLECTION OF DISTRIBUTED QUESTIONNAIRE

Location	*Frequency*	*Valid Respondent (%)*
Airport	20	9.6
Café/ Restaurant	125	59.8
Shopping Centre	20	9.6
University	29	13.9
Others	15	7.2
Total	209	100.00

IV. RESULT

A. Reliability Test

Cronbach's alpha (α) was used to measure the reliability of the instrument items [21]. The reliability coefficient finding shows that reliability of all measurement scales were above the recommended minimum level 0.7 [21][22]. The result is shown in Table IV.

TABLE IV. RELIABILTY ANALYSIS

Variable	*Cronbach Alpha Value*	*No. of Items*
Performance Risks	0.897	3
Financial Risks	0.789	3
Privacy Risks	0.852	4
Overall Risks	0.844	3
Personal Disposition	0.726	3
Familiarity	0.852	4
Perceived Security	0.741	4
Perceived Privacy	0.813	4
Strategic Thinking	0.817	3
Trust	0.821	4

B. Correlation Analysis

Factor analysis was firstly carried out using Kaiser-Mayer Olkin's Measure (KMO) approach before examining the correlation between independent variable and dependent variable. KMO is used to measure the variance among variables [23] in the research as well as to test measures sampling adequacy for each variable in the model. This analysis yielded that the KMO measure of sampling adequacy yielded a value of 0.895 (p-value < 0.01) which is above 0.6, indicating that sample size was large enough to assess the factor structure. Hence, it can be concluded that the selected variables (performance risks, financial risks, privacy risks, overall risks, personal disposition, familiarity, perceived security, perceived privacy and strategic thinking) are in commendable variance which fits the acceptable variance on research variables.

Pearson correlation coefficient (r) will be used to examine the strength and direction of the linear association between variables. The correlation analysis was executed to test nine association between independent variable (performance risks, financial risks, privacy risks, overall risks, personal disposition, familiarity, perceived security, perceived privacy and strategic thinking) and dependent variable (trust on SaaS usage in public network).

Coakes, Steed and Ong [24] highlighted that correlation analysis is a must to ensure the hypothesis is in an acceptable state. In additional, [25] suggested the absolute value for r as very weak (0.00 – 0.19), weak (0.20 – 0.39), moderate (0.40 – 0.59), strong (0.60 – 0.79) and very strong (0.80 – 0.10).

A total of nine hypotheses have been constructed in this study for identifying factors influencing trust on SaaS usage in public network. As a result of one-tailed test, the correlation between each of the nine independent variables (performance risks, financial risks, privacy risks, overall risks, personal disposition, familiarity, perceived security, perceived privacy and strategic thinking) and one dependent variable (trust on SaaS usage in public network) can be construed as:

a) There is a positive and significant correlation between performance risks and trust on SaaS usage in public network (p-value < 0.01) with coefficient r = 0.260.

b) There is a positive and significant correlation between financial risks and trust on SaaS usage in public network (p-value < 0.01) with coefficient r = 0.289.

c) There is a positive and significant correlation between privacy risks and trust on SaaS usage in public network (p-value < 0.01) with coefficient r = 0.425.

d) There is a positive and significant correlation between overall risks and trust on SaaS usage in public network (p-value < 0.01) with coefficient of r = 0.459.

e) There is a positive and significant correlation between personal disposition and trust on SaaS usage in public network (p-value < 0.01) with coefficient r = 0.161.

f) There is a positive and significant correlation between familiarity and trust on SaaS usage in public network (p-value < 0.01) with coefficient r = 0.427.

g) There is a positive and significant correlation between perceived security and trust on SaaS usage in public network (p-value < 0.01) with coefficient r = 0.417.

h) There is a positive and significant correlation between perceived privacy and trust on SaaS usage in public network (p-value < 0.01) with coefficient r = 0.450.

i) There is a positive and significant correlation between strategic thinking and trust on SaaS usage in public network (p-value < 0.01) with coefficient r = 0.163.

Five from nine postulated variables (privacy risks, overall risks, familiarity, perceived security and perceived privacy) were found to have moderate correlation towards trust of SaaS usage in public network with correlation coefficient values ranging between 0.4 and 0.59. On the other hand two variables (performance risks, financial risks) have shown weak correlation towards trust of SaaS usage in public network with correlation coefficient r values ranging between 0.20 and 0.39. Lastly, the other two remaining variables (personal disposition and strategic thinking) demonstrated a very weak correlation towards trust of SaaS usage in public network with correlation coefficient values ranging between 0.00 and 0.19.

V. DISCUSSION AND CONCLUSION

Usage of public network often inflicts trust and concerns are raised related to security issues and threats such as account compromised, data leakage, privacy violation and data loss. This research has identified nine factors to examine the trust significance on SaaS usage in public network. The findings of this study demonstrated five significant association relationships towards Trust of SaaS and these are privacy risks, overall risks, familiarity, perceived security and perceived privacy.

This study shows that performance risks, financial risks have weak correlation towards trust of SaaS usage in public network. This supports the study by Luo et al. [11] that demonstrate significant relationship with trust but with low correlation. It suggests that financial and performance risks can significantly reduce potential user's trust of SaaS in public network. Thus, it may imply that user will unlikely to perceive any risk related to financial and performance when using SaaS in public network. A very low correlation shows between personal disposition and strategic thinking towards trust proposes that user's trust of SaaS is not highly influence with these factors. Personal disposition has the lowest correlation strength which means that it may give the least influence over trusts of SaaS in public network. The findings show that some portion of public network users are not aware of their surrounding such as CCTV monitoring or shoulder surfing. In addition, majority of the respondents agree that they save their login number and password in their computer for convenience. It enables adversary to easily obtain the data by analyzing the data transmitted over the network. As personal disposition refers to the tendency of act and habit of an individual, the results vary according to different individual. This study also supports the findings from Rockman et al [17] that shows strategic thinking is a positively factor to public cloud computing usage.

It is anticipated that in increasing users' trust of SaaS usage in public network, they are supposed to see Cloud SaaS service as a new disruptive innovation that could offer many benefits considering the given factors. Additionally, some discussion notes can be drawn as follows:

a) Overall risks has shown the highest correlation with trust of SaaS as it covers various facet of risks such as performance risks, financial risks and privacy risks. As the response towards different types of risks may vary from each individual, different individual may have different level of trusts towards the network that they are connected to.

b) Data transmitted over the network can be more secured and protected when user has perceived privacy. Willingness to protect their own data confidentiality is very important. As data are transmitted over the network, it puts user privacy at risks where the connection is an open public access. User should not access or send any sensitive data when they are connected to a public network.

c) User that are already familiar with the network connection that they usually connects to tend to have less worries about the risks and threats as they feel that public network that they are familiar with will not harm them. Given that the convenience of establishing a network connection without prior authorization enable user to perform their intended activities on a public network such as surfing the web, accessing social media applications, sending email and even perform work related works over a public network.

d) Public network user should be aware that there will be limitation on how public network user is able to protect their own privacy on a public network. The risks of data being monitored by third party such as unauthorized user or public network administrator is possible as data that are transmitted over the network are vulnerable to threats such as eavesdropper and man in the middle attack. Given the fact that public network users have limitation and no controls over sensitive personal details being used without user consent.

e) Perceived security require an individual to have the perception that they need to protect their own data from unauthorized access. This can be achieved by installing basic security tools such as anti-virus and anti-malware to protect their own computer. Given the fact the public network provider may not have adequate security mechanism to help prevent attacks from unauthorized party in a public network. Public network users need to update their software and establish connection to virtual private network when required in order to provide a secured layer of protection on the connection.

This study may assist the policy maker such as public network providers in designing related security measures for SaaS usage in public network. This concludes that having a good and established perceived behaviour towards usage of SaaS in public network greatly helps to mitigate the risks and threats in public network. Nonetheless, the decision to protect own sensitive data on individual belonging varies according to individual. Therefore, there is a need for future study to explore the potential of other factors from different dimensions to enhance our study findings.

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