Volume: 2 Issues: 4 [June, 2017] pp.01-17]
Journal of Information System and Technology Management
eISSN: 0128-6666
Journal homepage: www.jistm.com

SAAS CLOUD COMPUTING AS A MEANS OF GREEN IT ACCEPTANCE MODEL: A THEORY OF PLANNED BEHAVIOR MODEL AT MALAYSIAN PUBLIC UNIVERSITIES' CONTEXT

Ghilan Al-Madhagy Taufiq-Hail[1]
Huda Ibrahim[2]
Shafiz Affendi Mohd Yusof[3]

[1]PhD. Candidate and IT consultant, School of Computing (SOC), UUM College of Arts and Sciences (CAS), Universiti Utara Malaysia (UUM), Sintok, 06010 Jitra, Kedah, Malaysia.
Tel.: +60124712405, E-mail: towfeeq2k5@yahoo.com or taufiq.ghilan@gmail.com (G. A. Taufiq Hail)
[2]Associate Professor Dr., Assistant Vice Chancellor/Dean,School of Computing (SOC), UUM College of Arts and Sciences (CAS), Universiti Utara Malaysia (UUM), Sintok, 06010 Jitra, Kedah, Malaysia.
E-mail: huda753@uum.edu.my
[3]Associated Professor Dr, Faculty of Engineering and Information Sciences, University of Wollongong, Dubai;
E-mail: ShafizMohdYusof@uowdubai.ac.ae

Accepted date: 15 May 2017, **Published date**: 5 July 2017

To cite this document:
Taufiq-Hail, G. A., Ibrahim, H., & Yusof, S. A. M. (2017). SAAS Cloud Computing as A Means of Green It Acceptance Model: A Theory of Planned Behavior Model at Malaysian Public Universities' Context. *Journal of Information System and Technology Management (JISTM), 2*(3), 1-17.

Abstract: *In recent decades, the technology has moved in a rapid pace to meet the growing demand for performance, reliable resources, increased revenue, and to facilitate the life. However, many negative aspects of technology remained unveiled. Cloud Computing (CC) with its Service Model SaaS (Software as a Service) emerged to overcome and eliminate the negative issues of IT. This trend is regarded as a Green Practice in which Green IT concept aims to accomplish. However, studying the Cloud Computing and Green IT jointly in a single study is overlooked in the academia especially with micro-level and in Higher Education sector in developing countries. Therefore, this study aims to fill this gap and further investigate and empirically test the factors influencing the adopting and acceptance based on the perception of individuals. Results revealed that attitude and perceived behaviour control are significant predictors of behaviour intention, while subjective norms is not. Further, behaviour intention emerged to be a strong predictor of Accepting and Using SaaS Cloud Computing services as a means of Green IT. Also, theory of planned behaviour (TPB) found to be an appropriate theory in this area of research. Limitations reside in conducting cross-sectional survey and using only students and lecturers as respondents. Future directions is recommended in using the model in different contexts with focus on Cloud and Green Computing adoption. Besides, extending the model is highly recommended and using advanced analysis such as Multi-group analysis and Importance-Performance MAP analysis.*

Keywords: *Attitude, Behaviour Intention, Green IT, Perceived Behaviour Control, Smart PLS, SaaS Cloud Computing, Subjective Norms, TPB.*

Introduction

In recent decades, the technology has moved in a rapid pace to meet the growing demand for performance, reliable resources, increased revenue, and to facilitate the life. However, many negative aspects of technology remained unveiled (Tunku Ahmad, Bello, & Nordin, 2013).Therefore, Green technology came to the forefront as an endeavour to eliminate these negative aspects (Bose & Luo, 2011). Among various attempts to go Green is the emergence of the Cloud Computing, which relies on virtualization in its core, that uses hardware efficiently and reliably (Bose & Luo, 2011; Durkee, 2010) to overcome the negative aspects of technology. Surprisingly, studying Green IT still at the early stage that needs further investigation in the academia especially at the micro-level (the individuals) (Al-Madhagy, Yusof, Hashim, & Alaswadi, 2015; Molla, 2009). This dearth of such studies motivated the researchers to probe further on this topic as it is a nascent topic in the academia to reveal more of it.

In the same token, Software as a Service (SaaS) Cloud Computing (CC), as a service model of CC, is still at an early stage as confirmed widely in the previous works (Marston, Li, Bandyopadhyay, Zhang, & Ghalsasi, 2011; Saedi & Iahad, 2013), in which Software as a Service (SaaS) is a service model of CC that needs further investigation to identify the factors influencing its acceptance as emphasized in the academia (Klug, 2014). The paucity of empirical studies in this area that focus especially on the individual is confirmed in the literature (Klug, 2014).

Besides, Low, Chen, & Wu, (2011) and Sabi, Uzoka, Langmia, & Njeh (2016) emphasize the crucial role of CC and its diffusion in academic research; however, they indicate lack of exploratory empirical studies on the diffusion and adoption of this technology especially in developing countries.

Additionally, the Higher Education sector, represented here by the Universities, is the focus on this current study. That is, the Universities are a collection of individual with different cultures, languages, religions, and perceptions that can give a clue of the whole community in their views and perceptions of the acceptance and adoption of SaaS CC as a means toward Green IT. Therefore, when studying the Universities, we are actually studying a large segment of the society in which would give us more insight of the salient factors that influence the adoption process and acceptance of the nascent technology of SaaS CC. Hence, the objective of the current study is to uncover these factors at Malaysian Higher Education (HE) sector represented by Public Universities' students and lectures.

Besides, the theory of planned behaviour (TPB) is the main lens to understand these factors as it contains the main different beliefs of attitudinal, social, and control beliefs. These different beliefs can give us better look of the perceptions and views of the individuals regarding the two topics under investigation, SaaS CC and Green concept. Furthermore, studying the Green concept and SaaS CC concept is one of the important objectives of the current study.

The following sections are organized as follows. Literature review of Cloud Computing and Green IT, followed by explanation of the factors estimated to influencing the acceptance and adopting of SaaS CC as a facility towards Green IT. Next, methodology is presented, followed by the findings and discussion; and lastly, the conclusion is presented with focus on the contribution of the current study, the limitations, and future research.

Literature review

Green IT and Cloud Computing

Green IT is the design, manufacturing, or usage of communication facilities that do not cause hazards to environment (Murugesan & Gangadharan, 2012). Also, it is defined in a broader scale as any device, tool, or practices that uses technology in its core, which does not have a negative impact on nature for the goodness of nature and human (Al-Madhagy et al., 2015). ICT (information and Communication Technology) is one of the significant sources of pollution that produces almost 2% (i.e., 0.86 metric Gig tons) of the global carbon emission (Bose & Luo, 2011; Tunku Ahmad et al., 2013). Although Green IT has an importance role that emerged to overcome negative aspects of technology, it is still a nascent concept and needs further investigation (Al-Madhagy et al., 2015; Tushi, Sedera, & Recker, 2014).

Besides, Cloud Computing can be identified as a model of shared pool of computer resources by means of network access that can be provisioned as in-demand resources and released rapidly with minimum service provider interaction (Mell & Grance, 2011). Furthermore, Cloud Computing has three service types, namely: Software as a Service (SaaS), which is the focus of the study, Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). In addition to Cloud service mode, there are four deployment models of CC, namely: Private, Public, Community, and Hybrid Clouds (Wang, Rashid, & Chuang, 2011).

Besides, the recent trend the technological market is to urge users to adopt SaaS CC services and applications in an aim to be familiarized them with this novel technology simply with less effort and knowledge at their fingertips. For example, the new smart devices of different types give free space as a storage for consumers of their technological devices.

Also, many service companies offer their services by means of on-line applications to place the orders, make reservations, pay their bills, update their personal information, or use on-demand computer resources in pay-per-use paradigm.

This new paradigm is a way to go for SaaS CC services and applications in which consumer can use SaaS CC services from any device, any place, and any time. Universities were not away from this market change. They offered students, academics, and researchers with SaaS CC in different forms. For example, the use of University portals, the e-library services, the provision of learning and teaching materials, the provision of free space and applications through Microsoft and Google SaaS CC services. This paradigm shift made Universities academic activities move to clouds, and consequently, can reduce carbon footprint emissions up to 90 percent (i.e., Large corporations can save 30-60 percent and mid-size businesses 60-90 percent)(Kumar & Buyya, 2012).

Though SaaS CC services have all these benefits, the research on it still at the early stage (Klug, 2014; Marston et al., 2011; Saedi & Iahad, 2013; Wu, Lan, & Lee, 2011) and is limited to business side effects, while factors influencing its acceptance from the perspective of individual is still limited especially at HE sectors represented by Universities, and developing countries(Klug, 2014), as is the case of the current study in Malaysia.

Hence, this article attempts to fill this gap on the area of SaaS CC and Green IT jointly in a single study employing the Theory of Planned Behaviour (TPB) by (Ajzen, 1985) as the underpinning theory for the model suggested. Figure 1 depicts the conceptual model of the current study.

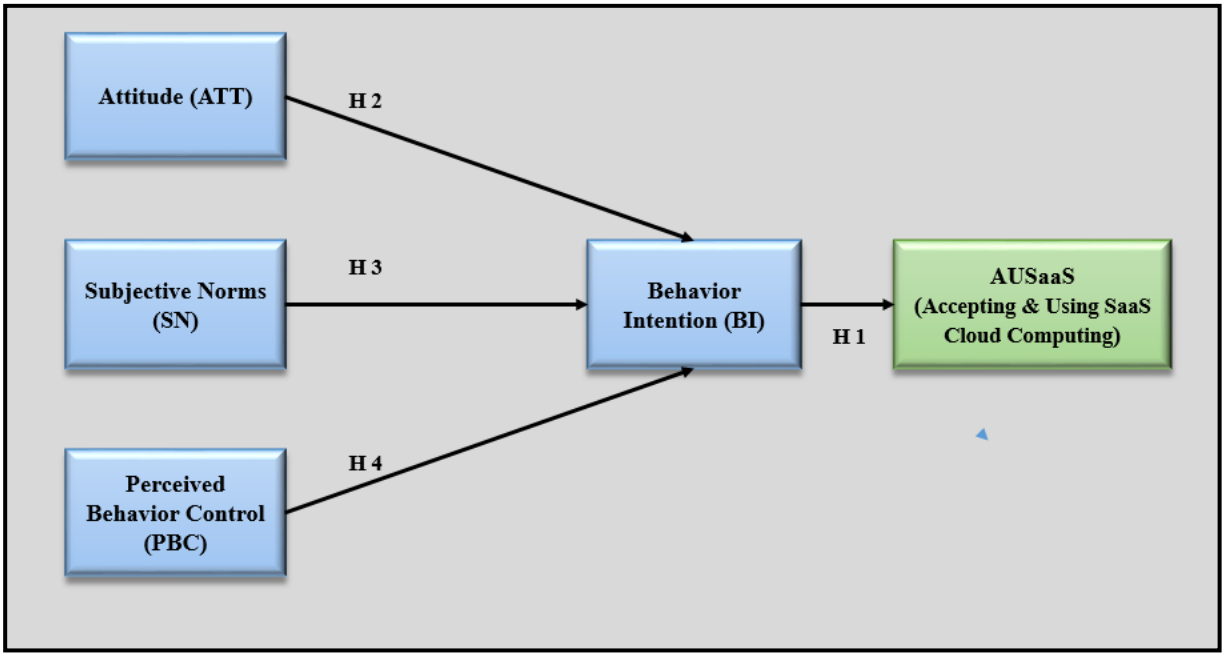

Figure 1: Measurement model assessment

Adopting SaaS Cloud Computing (AUSaaS)

Adoption, usage, actual behaviour or acceptance are used interchangeably in literature (Al-Jabri & Sohail, 2012). The Usage, acceptance or Adoption behaviour toward technology is a process that has many phases that need to extend over time and under the individual's will to perform or not to perform it (Rogers, 1983). It is defined as, "a decision to make full use of an innovation as the best course of action available." (Rogers, 1983, p.172).

The remarkably low rate of CC adoption in developing countries is emphasized in literature (Okai, Uddin, Arshad, Alsaqour, & Shah, 2014). Besides, many studies asserts this low adoption and in contrary to what was expected the rate is not rising well (Banerjee, 2009; Buyya, Yeo, Venugopal, Broberg, & Brandic, 2009; Goscinski & Brock, 2010; Low et al., 2011). Therefore, this issue warrants further investigation based on the foregoing previous works' findings.

In addition to that, it is recommended by Joglekar (2014) to conduct studies in developing countries and different organizations, as is the case in the current study of Universities, to find out the factors influencing the adoption process of Software as a Service Cloud Computing (SaaS CC). In doing so, the picture will be clearer to get more insight of this nascent phenomenon of SaaS CC from the perspective of individuals in other sectors, such as HE sector, as most of the studies focus mainly on the management and technical staff as mentioned earlier in previous sections. Therefore, the current study probes the major influencer beliefs of the technology adoption and acceptance by adopting TPB. This theory has the three main beliefs: The attitudinal, the normative, and perceived control beliefs, which gives it the priority over TRA (i.e., theory of reasoned actions) that has only two beliefs and overlooked the control belief to investigate the current issues of SaaS CC as a means of Green IT. Thus, TPB was used using the following three beliefs as constructs in addition to the behaviour intention.

Behaviour intention (BI)

Definition of behaviour intention can be said to be, "*the degree to which a student has formulated conscious plans to use or not use cloud services in the future."* (Arpaci, Kilicer, & Bardakci, 2015; p.95). In the current study, it is defined as the degree in which the individual, student & academic staff, using SaaS CC services has formulated conscious plans to use or not use some services of SaaS CC as a means toward Green IT in the future.

Behaviour Intention (BI) is found to be a significant and positive influencer and predictor of the actual use or behaviour in different contexts (Arpaci et al., 2015; Pinheiro, Aparicio, & Costa, 2014; Taylor & Todd, 1995). Hence, it is used as a major predictor of the final outcome of the study, i.e. accepting or adopting SaaS CC as a means of Green IT. The following hypothesis is, therefore, postulated:

H1. Behaviour Intention has a positive and significant influence on Adopting SaaS CC.

Attitude ***(ATT)***

Attitude is the degree of favourability/unfavourability that is felt by an individual towards an action or objective (Bagozzi, Baumgartner, & Youjae Yi, 1989). In the context of the study, it is defined as the degree of favourability or unfavourability felt by the individual in higher education (HE) in relation to the adoption, acceptance, or usage of SaaS CC as a means of Green IT.

Attitude is supported in previous work in different contexts and models in literature and results proofed its significant and strong positive relationship with BI (Ajjan & Hartshorne, 2008; Kim & Qu, 2014; Thoradeniya, Lee, Tan, & Ferreira, 2015). Therefore, its inclusion in the current study is warranted to test its applicability in the model proposed and the context of the current study. Hence, the following hypothesis is formulated:

H2. ATT is expected to have a positive and statistical significance on BI.

Subjective norms (SN)

Subjective Norms is the perception of others that are important to an individual and has an influence upon him/her to perform a behaviour or action (Taylor & Todd, 1995). In this study, it is defined as the perception of individuals at HE to respond to the significant others that have influence or importance on them to adopt, use, or accept SaaS CC services as a means towards Green it.

In principle, there are contradicting results with regard to SN found in literature. For instance, some found positive and significant relationship with BI (Al-Gahtani, Hubona, & Wang, 2007; Ekufu, 2012; Lian, 2015; Mishra, Akman, & Mishra, 2014); while others found no significant relationship between SN and BI (Picazo-Vela, Chou, Melcher, & Pearson, 2010; Shiau & Chau, 2016; Yang & Zhou, 2011). Therefore, the following hypothesis investigates this relationship in terms of HE sector at Malaysian Universities sector to probe its relevance in the context of SaaS CC. The hypothesis imposed:

H3. SN has a statistical relationship with BI that drives individuals to adopt SaaS CC as a means towards Green IT.

Perceived behaviour control (PBC)

Perceived behaviour control (PBC) is defined as the easiness or difficulty to perform a behaviour or an action in which it reflects past experience of the individual of having obstacles or difficulties (Ajzen, 1991). For the purpose of this research, PBC is defined as the perceived ease or difficulty of performing different tasks using SaaS CC services and it is assumed to reflect past experience of the individuals in HE to use technology skills they possess in addition to the anticipated obstacles to perform such tasks with SaaS CC services and applications.

This construct is found to gain support in literature to have a positive and significant relationship with BI (Susanto & Goodwin, 2013; Thoradeniya et al., 2015; To, Liao, Chiang, Shih, & Chang, 2008). Others, however, others found insignificant relationship between PBC and BI (Jain, Khan, & Mishra, 2017; Picazo-Vela et al., 2010; Yang & Zhou, 2011). These contradicting results lead to include this construct in the suggested model to investigate its effect on BI in the context of the current study. Hence the following hypothesis is assumed:

H4. PBC has a statistical and significant relationship with BI that individuals have towards adopting SaaS CC services as means of Green IT.

Methodology

The study employed the students and lecturers as respondents (unit of sampling) at four Malaysian Public Universities. The minimum sample size is considered to be 384 based on Cohen (1988)'s statistical tables with regard to the total number of the population. Nonetheless, the study employed more respondents to gain better insights (i.e., 800 respondents), obtain better statistical results, and to face less sampling errors (Creswell, 2012; Sekaran, 2003; Tabachnic & Fidell, 2013).

After the initial screening of the diagonal, line patterns answers, and the two end extremes patterns as per recommendations of (Hair, J. F., Hult, G. T. M., Ringle, C. M., 2014), the remaining responses were 579 valid responses of different University levels, races, and age. Moreover, outliers were removed using Mahalanobius distance in SPSS version 21 by following the guideline described in (Pallant, 2011; Tabachnic & Fidell, 2013). Furthermore, the Smart PLS 3 software by Ringle, Wende, and Becker (2015) was used. In addition, the self-administered sampling method was used for a period starting from December the first 2016 until the end of February.

The indicators were adapted from previous work that proofed its reliability and validity. Each construct has four items anchored with five-point Likert scale ranging from strongly disagree, "1", strongly agree, "5", with total indicators of 20 in addition to the demographic questions.

Findings and discussion

Demographic analysis

The total valid responses were 578, with 212 of males representing (36.7%) of the total responses and 366 females (63.3%). The age group is classified as: Group I (18-26) with majority of respondents 362 (62.6%), group II (27-35) has 62 responses (10.7%), group III (36-44) obtained 100 responses (17.3%), group IV (45-53) obtained 36 responses (6.2 %), and finally group V (age above 53) has 19 responses (3.2). Educational level of the respondents is as follows: Group I (Certificate) has 12 responses with percentage of (2%), group II (Diploma) with 15 responses (2.5%), group III (Bachelor) with 331 responses (57.3%), group IV (Master) with total responses of 96 (16.6%), and finally group V (PhD.) has 125 responses (21.6%).

Measurement model assessment

In this section the main analysis steps include: The convergent validity, the internal consistency and reliability (i.e., the composite reliability (CR) and Cronbach's alpha), and, finally, the discriminant validity(Hair, J. F., Hult, G. T. M., Ringle, C. M., 2014). Loadings of items on their respective constructs are recommended to be (0.7) or above, AVE at 0.5 or higher, CR range 0.6-0.95, and Cronbach's alpha in the range of (0.6-0.9) (Hair, J. F., Hult, G. T. M., Ringle, C. M., 2014; Hair Jr, Hult, Ringle, & Sarstedt, 2017).

The first step is to evaluate the convergent validity by investigating loadings of items and AVE. As shown in Table 1, this criteria is supported except for items AUSaaS1 and AUSaaS4 in which loading is slightly lower than the threshold. However, these items are kept as not to affect the content of the construct and the researchers found that when deleting them, it does not increase CR as it is perfectly highly above the cut-off value (0.82) (F. Hair Jr, Sarstedt, Hopkins, & G. Kuppelwieser, 2014).

Next the researchers investigated CR and Cronbach's Alpha, in which the results support their criteria, refer to Table 1. Thus internal consistency and reliability is accomplished. The final step is to investigate discriminant validity by looking at the cross-loadings (Hair, J. F., Hult, G. T. M., Ringle, C. M., 2014), Fornell-Larker Criterion (Fornell & Larker, 1981), and Heterotrait-Monotrait inference ratio ($HTMT_{inference}$) (Henseler, Ringle, & Sarstedt, 2015). As

shown in Table 2, the items uniformly loads with their respective constructs higher than other constructs; hence, no issues of cross-loadings (Hair Jr et al., 2017).

Also, the squared root value of AVE in the diagonal is higher than all other values in the columns and rows of all constructs in which the results accomplish this criterion (Fornell & Larker, 1981) and affirm that the constructs are discriminant from each other, refer to Table 3 for demonstration of results.

Finally, the HTMTinference inference should not include a value of (1) in either of its bounds by running the bootstrapping routine on Smart PLS 3 program with advance settings to use Confidence Interval Bias-Corrected (CI_{BC}). The results did not show any violations to this criterion; thus, the discriminant validity is established for the model and now it is possible to proceed with the structural modelling evaluation for the model estimated. Refer to Figure 2 for visualized results.

Table 1: Measurement model assessment (Convergent reliability & Internal consistency reliability)

Latent Variable	Indicators	Loadings > = 0.7	AVE > = 0.5	CR > 0.7	Cronbach's alpha (0.6-0.9)
AUSaaS	AUSaaS1	0.68	0.54	0.82	0.71
	AUSaaS2	0.78			
	AUSaaS3	0.80			
	AUSaaS4	0.67			
BI	BI1	0.84	0.75	0.92	0.89
	BI2	0.86			
	BI3	0.91			
	BI4	0.86			
ATT	ATT1	0.86	0.68	0.89	0.84
	ATT2	0.75			
	ATT3	0.87			
	ATT4	0.81			
SN	SN1	0.84	0.78	0.93	0.91
	SN2	0.90			
	SN3	0.90			
	SN4	0.88			
PBC	PBC1	0.82	0.68	0.89	0.84
	PBC 2	0.82			
	PBC 3	0.87			
	PBC 4	0.78			

Table 2: Cross-Loadings assessment

Item/Construct	ATT	AUSaaS	BI	PBC	SN
ATT1	**0.86**	0.49	0.61	0.47	0.35
ATT2	**0.75**	0.29	0.49	0.32	0.24
ATT3	**0.87**	0.45	0.62	0.46	0.33
ATT4	**0.81**	0.45	0.63	0.47	0.34
AUSaaS1	0.36	**0.68**	0.39	0.32	0.23
AUSaaS2	0.37	**0.78**	0.48	0.40	0.24
AUSaaS3	0.46	**0.80**	0.52	0.39	0.33
AUSaaS4	0.30	**0.67**	0.36	0.36	0.27
BI1	0.59	0.53	**0.84**	0.46	0.29
BI2	0.61	0.52	**0.86**	0.49	0.38
BI3	0.65	0.54	**0.91**	0.48	0.32
BI4	0.65	0.50	**0.86**	0.48	0.31
PBC1	0.46	0.41	0.48	**0.82**	0.41
PBC2	0.43	0.39	0.43	**0.82**	0.42
PBC3	0.45	0.45	0.48	**0.87**	0.42
PBC4	0.38	0.40	0.41	**0.78**	0.36
SN1	0.33	0.32	0.32	0.43	**0.84**
SN2	0.35	0.31	0.31	0.42	**0.90**
SN3	0.32	0.29	0.32	0.43	**0.90**
SN4	0.37	0.35	0.36	0.45	**0.88**

Table 3: Fornell-Larker criterion

	ATT	AUSaaS	BI	PBC	SN
ATT	**0.8**				
AUSaaS	0.5	**0.7**			
BI	0.7	0.6	**0.9**		
PBC	0.5	0.5	0.5	**0.8**	
SN	0.4	0.4	0.4	0.5	**0.9**

Table 4: HTMT criterion

Path	Path Coefficients	CI at 2.50%	CI at 97.50%
AUSaaS -> ATT	0.62	0.49	0.73
BI -> ATT	0.84	0.79	0.89
BI -> AUSaaS	0.71	0.61	0.81
PBC -> ATT	0.52	0.41	0.61
PBC -> AUSaaS	0.37	0.25	0.5
PBC -> BI	0.47	0.36	0.57
SN -> ATT	0.37	0.25	0.49
SN -> AUSaaS	0.43	0.32	0.53
SN -> BI	0.36	0.23	0.47
SN -> PBC	0.57	0.47	0.67

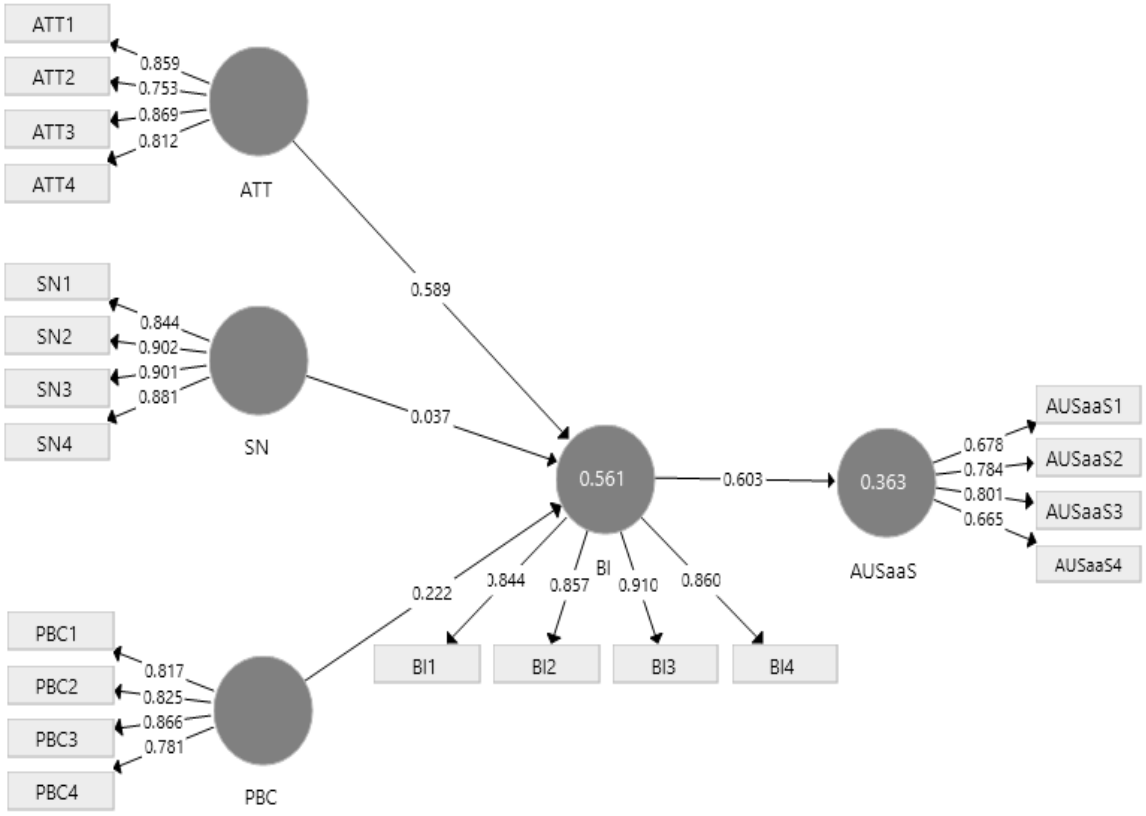

Figure 2: Measurement model assessment

Structural model assessment

The first step is to check collinearity issues if they are not violated in which Variance Inflation Factor (VIF) should be lower than 5 (Hair Jr et al., 2017) between the exogenous constructs and the endogenous constructs. The results show that ATT, PBC, and SN has VIF with BI (1.42, 1.36, and 1.60, respectively) and BI with AUSaaS (1), which confirms that no violation of the collinearity issues.

The hypothesis were analysed to examine their strength and significance of the relationship. As can be seen in Table 5, the results reveal that ATT ($\beta = 0.59$, $t = 18.18$, $P<0.05$) and PBC ($\beta = 0.22$, $t = 6.11$, $P<0.05$) exert a significant and positive relationship with BI, which lend support for hypothesis **H2** and **H4**. While inspecting the 95% Confidence Interval (CI), the results speak in favour of the significant relationship between ATT and PBC with BI, as CI did not include zero in its range. This result goes in concert with previous findings for the relationship between ATT & BI (Ajjan & Hartshorne, 2008; Kim & Qu, 2014; Thoradeniya et al., 2015), and for the relationship between PBC and BI (Susanto & Goodwin, 2013; Thoradeniya et al., 2015; To et al., 2008).

The findings shed more light on the crucial role of these two constructs in the area of Cloud Computing and Green IT at Malaysian Public Universities. This can be interpreted as ATT is created by a belief based on the evaluation, appraisal, or judgment of a certain behaviour, and this belief creates a motivation to conduct that action as a result of this salient belief (Ajzen, 1991), which is the case of the current study to use, accept, or adopt SaaS CC as a means of Green IT.

Besides, the results of PBC can be interpreted as the perceived ease or difficulty that the individual has in performing different tasks using SaaS CC services and based on his/her prior experience and anticipated obstacles to use technology skills (s)he possesses, develops and creates a motivation or intention to use, accept, or adopt the SaaS CC in their academic life. This motivation or intention is consequently driving the individuals to the acceptance, usage, or adoption of SaaS CC as a means toward Green IT.

On the other hand, the relationship between SN and BI was not significant, which lines up with other previous work (Picazo-Vela et al., 2010; Shiau & Chau, 2016; Yang & Zhou, 2011) and affirms that Hypothesis **H3** is not supported. Furthermore, CI confirms the non-significant relationship between SN and BI in which zero is included in its range. This can be interpreted as the findings give more insight in this explorative research on the nature of individuals at Malaysian higher education context in that they have their own strategy in future plans that builds upon their own perceptions of future use of innovative technology such as SaaS CC and not much affected by the social grouping inside or outside the University campus. In other words, the weak correlation between SN and BI warrants the minor effect of social beliefs in formulating the behaviour of AUSaaS CC and gives more room for individuals to decide their usage or not of this technology away from the influence, recommendations, or perceptions of others in their social community.

Furthermore, the three antecedents of BI explain 56% (R^2) of the variance of BI. Also, the effect size f^2 shows that ATT has a larger effect on BI ($f^2 = 0.56$) more than PBC ($f^2 = 0.07$), which reflect the path coefficients values in Figure 2. On the other hand, SN shows no effect

on BI (f^2 =0). This result explains the low path coefficient value in the relationship between SN and BI (β = 0.04).

Additionally, AUSaaS has an explained variance of 36%. By referring to the results revealed, BI (β = 0.60, t =20.90, P<0.05) yielded to have a positive and significant relationship with AUSaaS, which is in line with the hypotheses imposed **H1**. Moreover, CI confirms the findings. These results line up with previous works (Arpaci et al., 2015; Pinheiro et al., 2014; Taylor & Todd, 1995). Moreover, the findings indicate that respondents have formulated their conscious plans to use, accept, or adopt SaaS CC as a means of Green IT in the future. Not surprising, the path coefficient in the relationship between BI and AUSaaS CC is large (0.60), which also substantiate the strong effect of BI on AUSaaS CC. That means the intention of individuals in higher education sector, represented by University students and academic staff, is strong in terms of future use of the innovative technology of SaaS and confirms the strong predicting role of BI on accepting, using, or even adopting SaaS CC as a means of Green IT. Figure 2 demonstrates structural model assessment.

Table 5: path coefficients- significance of relationships

Path	Path Coefficients	*t* Statistics	*P* Values	CI at 2.50%	CI at 97.5%
ATT -> BI	0.59	18.18	0	0.53	0.65
BI -> AUSaaS	0.60	20.90	0	0.55	0.66
PBC -> BI	0.22	6.11	0	0.15	0.29
SN -> BI	0.04	1.03	0.3	-0.03	0.11

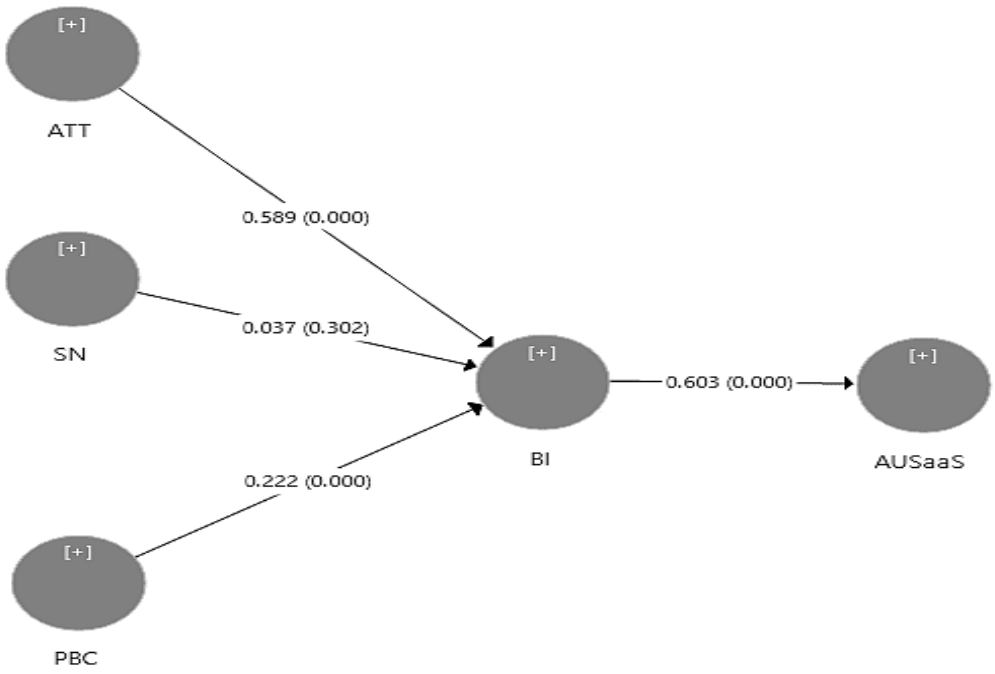

Figure 1: Structural Model Assessment

Predictive relevance Q^2 analysis

The predictive relevance was examined on the models by testing Stone-Geisser Q^2 value (Geisser, 1974; Stone, 1974). For this purpose, the blindfolding procedure was applied with omission distance (D= 7) to obtain the out-of-sample predictive relevance Q^2. If Q^2 values are greater than zero, it is an indication of the model's predictive relevance of the path model for the respective reflective endogenous construct (Hair Jr et al., 2017). After running the procedure, the cross-validated redundancy obtained shows that AUSaaS and BI possess the predictive ability over the model suggested. Refer to Table 6 for details.

Table 6: construct cross-validated redundancy

	SSO	SSE	Q^2 (=1- SE/SSO)
ATT	2,316.0	2,316.0	
AUSaaS	2,316.0	1,890.2	0.18
BI	2,316.0	1,396.0	0.40
PBC	2,316.0	2,316.0	
SN	2,316.0	2,316.0	

Conclusion

Many innovative technology emerged that increased the revenue of manufacturers, increased performance of technological devices, and made accessibility to resources much easier. The fast pace of technology changed the business paradigm, the human's life, and nature as well. However, these advancements were with cost that affected the environment negatively. Cloud Computing and Green IT are two research areas that emerged in the last decade strongly and rapidly to eliminated the side effects of technology.

On the other hand, these two areas are still in the early stage of development and research. Therefore, this paper attempts to shed more light on these two areas to find out the salient factors that influence the acceptance, usage, or adoption of SaaS Cloud Computing as a way to Green technology. Besides, TPB theory was used utilizing individuals at HE represented by students and lecturers at Malaysian Public Universities in Northern Malaysia.

The empirical results show that ATT and PBC that the individuals possess have a strong influence on driving their BI to adopt SaaS CC. In addition, the BI is found to be a strong driver towards the adoption process of SaaS CC. However, SN is found unsurprisingly to be non-significant predictor of BI. This indicates that individuals are building their beliefs and intentions to adopt innovative technology such as SaaS with no influence of significant others. This indicates, also, that the individuals at Malaysian HE are mature and technology savvy that do not need others to influence their beliefs or perception. Besides, TPB proofed to be an appropriate theory to be used to explain this phenomena of the current study and that the model proposed is adequately helped in explaining the phenomena of Green IT & Cloud Computing jointly.

This research used the cross-sectional survey that is considered a limitation. Further, the differences between the group of students and the lecturers were not explained using the Multi-Group analysis in Smart PLS 3. However, the limited space has driven this limitation.

Future direction are recommended to take into account studying the mediating effects of BI in the relationship between SN, PBC, and ATT with SaaS CC as well as the moderating effects of socio-demographic variables on different relationships. Also, using advanced topics in analysis such as Importance Performance MAP analysis, MGA analysis, and heterogeneity analysis are highly encouraged to give more insight of the acceptance and adoption of SaaS CC.

This study contributes to the knowledge and body of literature by combining the two concepts of Cloud Computing and Green IT concept in one single study and provides empirical support of the connectedness of the Green IT and SaaS CC. Furthermore, the main two beliefs of ATT and PBC have shown its strong influence towards the adoption of SaaS CC as a means of Green IT, While the social norms exerts a non-significant role in the adoption and acceptance process of SaaS Cloud Computing technology. This is goes in line with many previous works in different areas, however, the role of SN is, therefore, advised to be studied in future research to reveal its relationship with BI through other constructs such as ATT and PBC.

Lastly, future research is further warranted to cover other segments of the University society such as: Administration staff and technical staff to cover the limitations of this study.

References

Ajjan, H., & Hartshorne, R. (2008). Investigating faculty decisions to adopt Web 2.0 technologies: Theory and empirical tests. *The Internet and Higher Education*, *11*(2), 71–80. https://doi.org/10.1016/j.iheduc.2008.05.002

Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. *Action Control: From Cognition to Behavior*, 11–39. https://doi.org/10.1007/978-3-642-69746-3_2

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*, 179–211.

Al-Gahtani, S. S., Hubona, G. S., & Wang, J. (2007). Information technology (IT) in Saudi Arabia: Culture and the acceptance and use of IT. *Information and Management*, *44*(8), 681–691. https://doi.org/10.1016/j.im.2007.09.002

Al-Jabri, brahim M., & Sohail, M. S. (2012). Mobile banking adoption: Application of diffusion of innovation theory. *Journal of Electronic Commerce Research*, *13*(4), 379–391.

Al-Madhagy, T. H. G., Yusof, S. A. M., Hashim, K. F., & Alaswadi, W. (2015). Exploring the underlying factors of individual's perception and behaviour towards Green IT in Malaysia. *Advanced Science Letters*, *21*(16), 1729–1733.

Arpaci, I., Kilicer, K., & Bardakci, S. (2015). Effects of security and privacy concerns on educational use of cloud services. *Computers in Human Behavior*, *45*, 93–98. https://doi.org/10.1016/j.chb.2014.11.075

Bagozzi, R. P., Baumgartner, J., & Youjae Yi. (1989). An investigation into the role of intentions as mediators of the attitude-behavior relationship. *Journal of Economic Psychology*, *10*(1989), 35–62.

Banerjee, P. (2009). An intelligent IT infrastructure for the future. *15th International Symposium on High-Performance Computer Architecture, Proceedings*, 3.

https://doi.org/10.1109/HPCA.2009.4798230
Bose, R., & Luo, X. (2011). Integrative framework for assessing firms' potential to undertake Green IT initiatives via virtualization - A theoretical perspective. *Journal of Strategic Information Systems*, *20*(1), 38–54. https://doi.org/10.1016/j.jsis.2011.01.003
Buyya, R., Yeo, C. S., Venugopal, S., Broberg, J., & Brandic, I. (2009). Cloud computing and emerging IT platforms: Vision, hype, and reality for delivering computing as the 5th utility. *Future Generation Computer Systems*, *25*(6), 599–616. https://doi.org/10.1016/j.future.2008.12.001
Cohen, J. (1988). *Statistical power analysis for the behavior sciences*. *Lawrence Erlbaum Associates, Publishers* (2nd ed.). Hillsdale, New Jersey.
Creswell, J. W. (2012). *Educational research: Planning, conducting and evaluating quantitative and qualitative research*. *Pearson Education, Inc.* (4th ed.). Boston, MA.
Durkee, D. (2010). Why cloud computing will never be free. *Communications of the ACM*, *53*(5), 62. https://doi.org/10.1145/1735223.1735242
Ekufu, T. K. (2012). *Predicting cloud computing technology adopting by organization: An empirical integration of technology accepting model and theory of planned behavior*. Capella University.
F. Hair Jr, J., Sarstedt, M., Hopkins, L., & G. Kuppelwieser, V. (2014). Partial least squares structural equation modeling (PLS-SEM). *European Business Review*, *26*(2), 106–121. https://doi.org/10.1108/EBR-10-2013-0128
Fornell, C., & Larker, D. F. (1981). Evaluating structural equation models with unobserved variables and measurement error. *Journal of Marketing Research*.
Geisser, S. (1974). A predictive approach to the random effect model. *Biometrika*, 101–107.
Goscinski, A., & Brock, M. (2010). Toward dynamic and attribute based publication, discovery and selection for cloud computing. *Future Generation Computer Systems*, *26*(7), 947–970. https://doi.org/10.1016/j.future.2010.03.009
Hair, J. F., Hult, G. T. M., Ringle, C. M., & S. (2014). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. SAGE Publications, Inc.
Hair Jr, J. F., Hult, G. T. M., Ringle, C., & Sarstedt, M. (2017). *A primer on partial least squares structural equation modeling (PLS-SEM)*. Sage Publications.
Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, *43*(1), 115–135. https://doi.org/10.1007/s11747-014-0403-8
Jain, S., Khan, M. N., & Mishra, S. (2017). Understanding consumer behavior regarding luxury fashion goods in India based on the theory of planned behavior. *Journal of Asia Business Studies*, *11*(1), 4–21. https://doi.org/10.1108/JABS-08-2015-0118
Joglekar, V. (2014). *The effects of gender, age, and education on cloud computing adoption: A correlational study*. *ProQuest LLC*. Capella University.
Kim, M., & Qu, H. (2014). Travelers' behavioral intention toward hotel self-service kiosks usage. *International Journal of Contemporary Hospitality Management*, *26*(2), 225–245. https://doi.org/10.1108/IJCHM-09-2012-0165
Klug, W. E. (2014). *The determinants of cloud computing adoption by colleges and universities*. *ProQuest LLC*. Northcentral University.
Kumar, S., & Buyya, R. (2012). Green Cloud Computing and environmental sustainability. In J. S. Murugesan & G. R. Gangadharan (Eds.), *Harnessing Green It* (pp. 315–339). Chichester, UK: John Wiley & Sons, Ltd. https://doi.org/10.1002/9781118305393.ch16
Lian, J. W. (2015). Critical factors for cloud based e-invoice service adoption in Taiwan: An empirical study. *International Journal of Information Management*, *35*(1), 98–109. https://doi.org/10.1016/j.ijinfomgt.2014.10.005

Low, C., Chen, Y., & Wu, M. (2011). Understanding the determinants of cloud computing adoption. *Industrial Management & Data Systems*, *111*(7), 1006–1023. https://doi.org/10.1108/02635571111161262

Marston, S., Li, Z., Bandyopadhyay, S., Zhang, J., & Ghalsasi, A. (2011). Cloud computing — The business perspective. *Decision Support Systems*, *51*(1), 176–189. https://doi.org/10.1016/j.dss.2010.12.006

Mell, P., & Grance, T. (2011). The NIST definition of Cloud Computing recommendations of the National Institute of Standards and Technology. *Nist Special Publication*, *145*, 7. https://doi.org/10.1136/emj.2010.096966

Mishra, D., Akman, I., & Mishra, A. (2014). Theory of Reasoned Action application for Green Information Technology acceptance. *Computers in Human Behavior*, *36*, 29–40. https://doi.org/10.1016/j.chb.2014.03.030

Molla, A. (2009). The extent of Green IT adoption and its driving and inhibiting factors: An exploratory study. *Journal of Information Science & Technology*, *6*(4), 3–21. Retrieved from http://ezproxy.lib.swin.edu.au/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=52219077&site=ehost-live&scope=site

Murugesan, S., & Gangadharan, G. R. (2012). Green IT: An Overview. In S. Murugesan & G. R. Gangadharan (Eds.), *Harnessing Green IT: Principles and practices* (pp. 1–21). Chichester, UK: John Wiley & Sons, Ltd. https://doi.org/10.1002/9781118305393.ch1

Okai, S., Uddin, M., Arshad, A., Alsaqour, R., & Shah, A. (2014). Cloud computing adoption model for universities to increase ICT proficiency. *SAGE Open*, *4*(3), 215824401454646. https://doi.org/10.1177/2158244014546461

Pallant, J. (2011). *SPSS survival: A step by step guide to data analysis using SPSS*. *Allen & Unwin* (4th ed.).

Picazo-Vela, S., Chou, S. Y., Melcher, A. J., & Pearson, J. M. (2010). Why provide an online review? An extended theory of planned behavior and the role of Big-Five personality traits. *Computers in Human Behavior*, *26*(4), 685–696. https://doi.org/10.1016/j.chb.2010.01.005

Pinheiro, P., Aparicio, M., & Costa, C. (2014). Adoption of cloud computing systems. In *Proceedings of the International Conference on Information Systems and Design of Communication - ISDOC '14* (pp. 127–131). New York, New York, USA: ACM Press. https://doi.org/10.1145/2618168.2618188

Ringle, C. M., Wende, S., and Becker, J.-M. (2015). SmartPLS 3. Boenningstedt: SmartPLS GmbH.

Rogers, E. M. (1983). *Diffusion of innovations*. *Free Press A division of Macmillan Publishing Co., Inc* (3rd ed.). New York, NY, USA.

Sabi, H. M., Uzoka, F. M. E., Langmia, K., & Njeh, F. N. (2016). Conceptualizing a model for adoption of cloud computing in education. *International Journal of Information Management*, *36*(2), 183–191. https://doi.org/10.1016/j.ijinfomgt.2015.11.010

Saedi, A., & Iahad, N. A. (2013). An integrated theeoretical framework for Cloud Computing adoption by small and medium sized. *Proceedings of Pacific Asia Conference on Information Systems*, 1–12.

Sekaran, U. (2003). *Research methods for business: A skill building approach*. *John Wiley & Sons, Inc.* (4th Ed.). New York, NY, USA.

Shiau, W.-L., & Chau, P. Y. K. (2016). Understanding behavioral intention to use a cloud computing classroom: A multiple model comparison approach. *Information & Management*, *53*(3), 355–365. https://doi.org/10.1016/j.im.2015.10.004

Stone, M. (1974). Cross-validatory choice and assessment of statistical predictions. *Journal of*

the Royal Statistical Society., Series B (, 111–147.

Susanto, T. D., & Goodwin, R. (2013). User acceptance of SMS-based e-government services: Differences between adopters and non-adopters. *Government Information Quarterly*, *30*(4), 486–497. https://doi.org/10.1016/j.giq.2013.05.010

Tabachnic, B. G., & Fidell, L. S. (2013). *Using multivariate statistics*. *Pearson Education, Inc'* (6th Ed.). New Jersey.

Taylor, S., & Todd, P. A. (1995). Assessing IT usage: The role of prior experience. *Management Information Systems Quarterly*, *19*(4), 561–570. https://doi.org/10.2307/249633

Thoradeniya, P., Lee, J., Tan, R., & Ferreira, A. (2015). Sustainability reporting and the theory of planned behaviour. *Accounting, Auditing & Accountability Journal*, *28*(7), 1099–1137. https://doi.org/10.1108/AAAJ-08-2013-1449

To, P.-L., Liao, C., Chiang, J. C., Shih, M.-L., & Chang, C.-Y. (2008). An empirical investigation of the factors affecting the adoption of Instant Messaging in organizations. *Computer Standards & Interfaces*, *30*(3), 148–156. https://doi.org/10.1016/j.csi.2007.08.019

Tunku Ahmad, T. B., Bello, A., & Nordin, M. S. (2013). Exploring Malaysian university students' awareness of green computing. *GSTF International Journal on Education Vol.1 No.2*, *1*(2), 92–102. https://doi.org/10.5176/2345-7163_1.2.34

Tushi, B. T., Sedera, D., & Recker, J. (2014). Green IT segment analysis : An academic literature review. In *Twentieth Americas Conference on Information Systems* (pp. 1–15). Savannah.

Wang, W. Y. C., Rashid, A., & Chuang, H.-M. (2011). Toward the trend of Cloud Computing. *Journal of Electronic Commerce Research*, *12*(4), 238–242. https://doi.org/10.4304/jsw.6.7.1230-1234

Wu, W.-W., Lan, L. W., & Lee, Y.-T. (2011). Exploring decisive factors affecting an organization's SaaS adoption: A case study. *International Journal of Information Management*, *31*(6), 556–563. https://doi.org/10.1016/j.ijinfomgt.2011.02.007

Yang, H., & Zhou, L. (2011). Extending TPB and TAM to mobile viral marketing: An exploratory study on American young consumers' mobile viral marketing attitude, intent and behavior. *Journal of Targeting, Measurement and Analysis for Marketing*, *19*(2), 85–98.