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## CLOUD COMPUTING IMPLEMENTATION IN THE PUBLIC SECTOR: FACTORS AND IMPACT

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### ABSTRACT

This study is to examine the assimilation of cloud computing by measuring the organization's assimilation of cloud as well as performance in the Malaysian public sector. This study mainly integrates the Diffusion of Innovation Theory (DOI), Technology-Organization-Environment Framework (TOE) Human-Organization-Technology (HOT-fit) model and IS Success model to understand this issue. A total of 169 agencies from the Malaysian public sector have participated in this study. Data for all the study variables have been collected through self-administered survey questionnaires and analyzed using SEM-PLS. The study has shown that the effect of the operational effectiveness of cloud implementation is at the lower level. The study also reveals that only factors of technological, organizational and human characteristics are found to have a significant effect on cloud computing implementation. The results indicate that the model provides a good understanding of the factors that influence the implementation of cloud computing as well as operational performance.

Keywords: cloud computing, public sector, performance, assimilation, TOE framework, HOT-fit model, IS success model.

### INTRODUCTION

The introduction and implementation of IT innovation is still an interesting topic of research. Progress towards the implementation of IT innovation, companies capable of offering the potential to improve efficiency, improve service, reduce costs and increase company value. As the implementation of IT innovation becomes part of the enterprise, decision makers need to understand the power and design elements that make decisions about the adoption and implementation. But this plan is not easy. However, in a global and competitive global business environment, IT leaders and decision-makers need to make smart decisions and adapt new IT implementations to investment and institutional strategies.

Therefore, with respect to the emergence of new IT technologies such as cloud computing, organizational innovations that adopt this technology differs distinctly (Li, Zhao, & Yu, 2015). Although the cloud computing are asserted to offer various benefits to the organizations, the implementation of cloud computing among organization has been distant from expectations (Hassan, Mohd Nasir, Norhaiza, & Adon, 2017; Sallehudin, Razak, & Ismail, 2016). According to Sallehudin et al. (2016), various organizations are considering cloud computing quite warily by taking one step at a time or preferring to 'wait-and-see'. Therefore, it is crucial that a study on cloud computing implementation in organization is carried out to determine the factors that influence organizations to implement this technology.

According to Wyld (2010), cloud computing has been given an upward support by United State (US) country's first Chief Information Officer (CIO), Vivek Kundra to change

government's IT across US federal government to the cloud environment. He believes that cloud computing could represent a "tectonic shift" and providing better services than Internet did in early 90s. However, to bring the federal government into this innovation technology, massive strategic mind-set and operations change in the IT area in government is required (Kundra, 2011; Wyld, 2010). Similarly, to the United Kingdom (UK) government, cloud computing innovation technology effect has made the creation of the "G-cloud" by the government. The creation of G-cloud become one of the strategic priority in UK government towards cloud computing in IT strategic and operations across agencies.

In the Malaysian public sector, the government cloud initiatives or MyGovCloud (formally known as 1GovCloud) was introduced and officially launched in July 2013. MyGovCloud offers cloud hosting that provides a number of resources (network, storage, server and operating system) to the agency. The deployment model of MyGovCloud is based on private cloud and the service is based on Infrastructure as a Service (IaaS). Until now, a total of 250 applications that included in MyGovCloud such as MyMTC, MyMesyuarat, MAMPU website, MyRELA website, and e-Solat JAKIM. In addition, statistics from MAMPU indicated that hundreds of agencies have subscribed the services of MyGovCloud.

Furthermore, performance measurement along with the implementation of cloud computing help an organization develop good understanding of what it does best and take appropriate actions to handle the problems they face by focusing on its strength and weakness. Organization implement incentive measures to ensure the maximum performance of organization through collaboration. Important thing to notice here is that organization should not have any conflicting goals in place for their organization in terms of getting their key performance indicators done.

Thus, more and more organizations have invested heavily in new cloud computing in order to stay competitive in their given industries. This increased investment makes the investigation of IT innovation adoption and organization performance relationship particularly interesting (Petter et al., 2012). Given the financial stakes involved, determining the impacts of cloud computing investments on organizational performance has been and continues to be an important research concern for both academics and practitioners (Ainin et al., 2015; Cereola et al., 2012; Ghobakhloo & Hong, 2014; Hairuddin et al., 2012; Hamad, 2014; Iyengar et al., 2015; Tarutè & Gatautis, 2014; Tseng & Liao, 2015; Xin et al., 2014)

However, while past research has explored the factors that are related to the adoption of technological innovation by organizations Sallehudin et al. (2015), Ramdani et al. (2009) and Bakar (2004), there is a lack of empirical research examining the relationship of organizational technological adoption on organization performance (Ghobakhloo & Hong, 2014; Tarutè & Gatautis, 2014). There appears to be an implicit assumption in much of the literature that the adoption of innovations is intended to contribute to the performance of the adopting organization (Damanpour & Gopalakrishnan, 1998; Rogers, 1995). Rogers (2003) described this as a "pro-innovation" bias, which is the assumption that adoption of a given innovation will produce only beneficial results for its adopters. Thus, although this relationship has generally not been tested, the "pro-innovation" bias has resulted in research being concentrated on the actual adoption of innovations rather than the consequences of these adoptions (Ramamurty, 1990).

For that reason, the assertion the new technologies such as cloud computing and its technology components promise many great benefits should be studied. For instance, cloud computing services and resources is claimed to reduce IT operational efficiency since electronic information tends to be more accurate, timely and easily available (Armbrust et al., 2010). Another benefit claimed by cloud computing services and resources is the higher efficiency obtained in service delivery due to a fast and accurate processing of information (Armbrust et al., 2010; Buyya et al., 2011). Cloud-based services are likely to strengthen the competitiveness of organization as these technologies may change the relationship with customers by creating

stronger link between organization and its clients. These claims are supported by several scholars (Alkhater et al., 2014; Alshamaila & Papagiannidis, 2013; Borgman et al., 2014) who emphasize that cloud computing services and resources technology plays an important role in exchanging information, knowledge, and product designs between organization and its customers.

Thus, the purpose of this study was to survey the involvement factors of the public sector in cloud computing implementation and its impact in Malaysia. Without understanding the diversity factors affecting complex processes and stages of cloud computing implementation, the drive to adopt and develop cloud computing implementation will not effectively contribute to the public sectors' IT effectiveness (Sallehudin et al., 2016; Safie et al., 2017). Therefore, this study aims to fill this gap by investigating technological, organizational and human factors affecting cloud computing implementation by public sector.

## THEORETICAL FOUNDATION

The diffusion of innovation theory (DOI) from Rogers (2003) is often used to describe adoption and acceptance of innovation, especially in the fields of IT research. Rogers focuses on connecting ideas which consist of ideas, processes, and technologies throughout the interval between members in the social system. According to Rogers (2003), participants of the social system are adopters who can be individuals, organizations or communities. Rogers's DOI theorizes that five innovations characteristics - relative advantage, compatibility, complexity, trialability and observability; make it easier for technology innovation to be adopted and faster dissemination. Research on the use of innovation has explored the factors that affect the adoption of technological innovation using these characteristics. However, the nature of technology is characterized by the main objectives' context of the technology itself (e.g. cloud computing technology), rather than the independent context, such as the nature of the decision maker as well as regulatory and environmental factors (internal or external).

Another model of technology adoption that is the basis for many investigations of information systems (IS) use in organizational levels is the TOE framework. This model discusses the predictors of information systems penetration by (Tornatzky & Fleischer, 1990). The TOE framework is an organizational ranking model that describes three different context attributes of a company that influence the decision on use. These three elements are technology, organization and environment. Technological backgrounds represent technological and innovation characters used by organizations. The organizational context refers to the characteristics of the company, such as the size of the organization and the volume of resources. Finally, the context of the environment illustrates the structure of the industry and the environment surrounding the organization that conducts the business. The TOE model suggests that the attributes of the three contexts will influence the use of innovation within the organization particularly cloud computing (Alam et al., 2017; Hassan et al., 2017)

Focusing on human factors in the use of IT Innovation study, Yusof et al. (2008) presents a HOT-fit model that integrates human, organizational and technological context to assess the health information system framework. Their proposed model is to investigate whether the health information system is implemented as expected and the extent to which they support medical services. This model contains three key elements that need to be considered when adopting and implementing IT innovations in the context of organization.

Next, the IS success is one of the most studied topics in information systems literature (Ayyash et al., 2012). Measuring IS success is considered a critical issue in the IS field. Several studies have been conducted and many attentions has been given to this problem because of the amount of funds, time and effort spent on the IT projects (Mohammed & Ibrahim, 2015; Syed et al., 2018). IS literatures have some definitions and dimensions of IS success. As DeLone and

McLean (1992) stated that, even though there are many measures as there are studies; evidently, there is no decisive definition of IS success. The definition of IS success can vary depending on different IT types that provide different benefits to individuals, working groups, and organizations. This study specifies the result of the Malaysian public sector for IT implementation, particularly on operational efficiency. Based on definitions and construct conceptualization by DeLone and McLean (1992) IS success model, this study conceives Ramamurty (1990) implementation outcome as in reduced IT operating cost as well as principal to enhanced productivity and quality in service delivery.

## RESEARCH MODEL AND HYPOTHESES

Based on the work of DeLone and McLean (1992), Tornatzky and Fleischer (1990) and Yusof et al. (2008), a theoretical-based model for cloud computing implementation using a TOE framework, HOT-fit and IS Success Model was developed and is depicted in Figure 1.

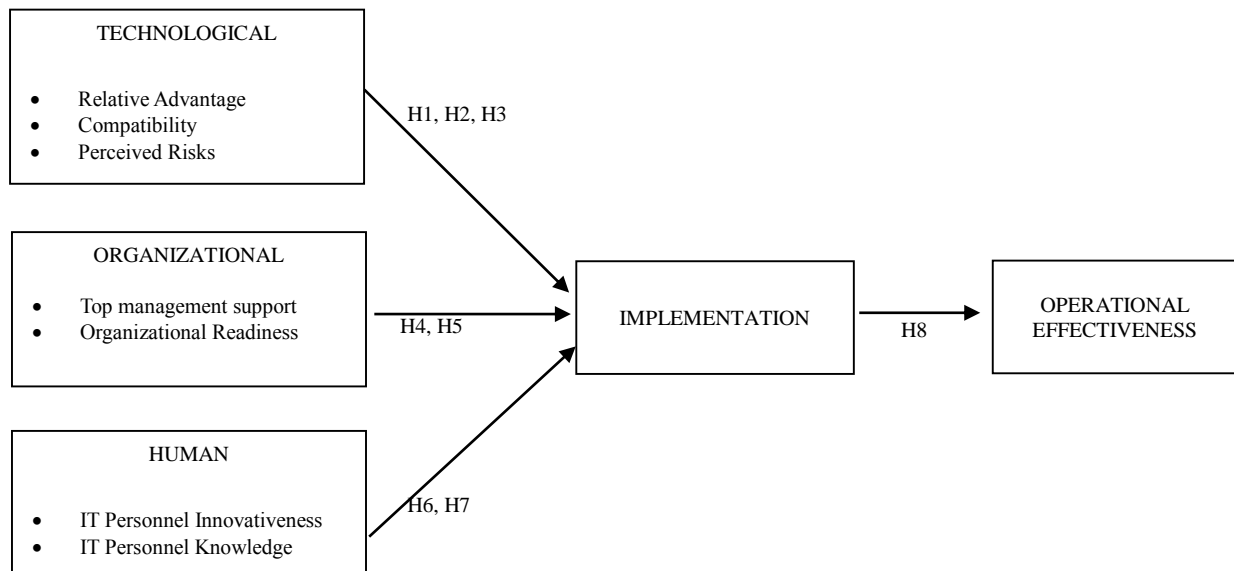


FIGURE 1. Research Model.

### TECHNOLOGY CONTEXT

In this study, the technological context characterizes the cloud computing characteristics such as relative advantage (benefits) and compatibility. Both factors might determine the likelihood might stimulate of cloud computing implementation by the Malaysian public sector. Both the DOI theory and TOE model of IT innovation emphasize on the importance of the innovation factor to the implementation of IT innovation.

Relative advantage is perceived as benefits for an organization over previous ways of completing the same task (Moore & Benbasat, 1999; Alam et al., 2011). Relative advantage has been found to be one of the dominant factor and completely correlated to an IT innovation implementation (Alam et al., 2017). Recent study by Alam et al. (2017) confirmed that relative advantage of cloud computing is positively associated to the cloud computing adoption within the SMEs in Malaysia. In view of the benefits that cloud computing, the Malaysian public sector who perceived cloud computing as advantageous would likely to adopt the cloud computing hence enhance their service delivery. Therefore, the following hypotheses was proposed.

*H1: Relative advantage positively effects the implementation of cloud computing.*

Cloud computing compatibility refers to the degree to which cloud computing is compatible with an organization's values and beliefs. The questions measure respondent's perspective in terms of the compatibility of the cloud computing on the current aspect of IT system/services in the agency and the fitness of cloud computing to be integrated with the current IT systems (Alam et al., 2017; Alam et al., 2011). In the Malaysian public sector, most of the traditional or incumbent systems and technology infrastructure are based on the famous and known technology solutions such as Microsoft, Linux, Oracle, Cisco, and etc. These technology supports cloud computing compatibility. Therefore, the following hypotheses was proposed.

*H2: Compatibility positively effects the implementation of cloud computing.*

The literature identifies perceived risks as an essential element of a relationship when security, trust or uncertainty is present (Akturan & Tezcan, 2012; Chen, 2013; Horst et al., 2007; Oh et al., 2012; Gewald & Dibbern, 2009). The intention to focus on implication and impact of perceived risk factor in this study is because of the dark side of cloud computing (Wyld, 2010; Buyya et al., 2009; Jaatun et al., 2012; Wang & Sen, 2011). In addition, Wyld (2009) specified that security concerns are the main barrier toward cloud computing acceptance, adoption and implementation. Despite vendor claims to improved security through improved expertise and redundancy, security remains a sticking point for cloud computing model. Customer of cloud computing will lose their control over their resources. They only provided with access to the subscribed package. In highly sensitive situation, security and other business requirements customized by the vendors but with extra and special setting and it's involved with high cost. Data integrity and privacy were other issues in cloud computing models (Wyld, 2010), (Alam et al., 2017). In traditional infrastructure environment, organization has full control over their sensitive and confidential data within organization or secret data recovery center in other places. However, in cloud computing environment, organization will lose their control over access of sensitive and confidential data because the data is stored outside of their premises or country. In the public sector particularly in Malaysian public sector, security and confidentiality of the data is the main focus for any new IT innovation implementation (Safie et al., 2017). Therefore, perceived risk factors will negatively influence this relationship when it compromises to IT security breach as a big issue in the public sector. Therefore, the following hypotheses was proposed.

*H3: Perceived Risks are less likely effects the implementation of cloud computing.*

#### ORGANIZATION CONTEXT

The organization context signifies the organizational elements, which is described by this study as the element of the agencies in the Malaysian public sector that determine its influence to adopt the cloud computing. Both TOE and HOT-fit framework emphasizes on the prominence of the organizational factor to the adoption of innovation.

Commitment and support by top management structure shown to be a favor for the acceptance of technological innovation in adopting organization (Borgman et al., 2013; Low et al., 2011). The influence from top management acts as change agents in the decision process. The decision could be positive or negative to the adoption. The positive decision by top management will create a full support to the adoption process and leads to project implementation success. In the context of cloud computing, this innovation provides a better solution for business process both in technical and non-technical. For the technical view, cloud

computing offers 3 types of service and 4 implementation models as discussed previously. From non-technical point of view which is considered as benefits for business advantage, cloud computing offers elasticity, simplicity, shared-services, enhanced service delivery and collaboration solution for competitive advantage that leads to greater achievement for e-government service sustainability. Therefore, the following hypotheses was proposed.

*H4: Top Management Support positively effects the implementation of cloud computing.*

Organizational readiness represents the internal IT maturity for new innovation implementation. The availability of financial, human and technical readiness should be adequate with the related of new innovation that will be implement. In the context of Malaysian public sector, agency's readiness would cover all these three aspects; adequate cost, competence human resources (IT staff) for support and troubleshoot, and sufficient technological/technical infrastructure. Prior study found that organizational readiness was the significant factor for IT innovation adoption such as enterprise resource planning (ERP), e-business and knowledge management system (Lin, 2012). New IT innovation implementation without organizational readiness in terms of inadequate financial, incompetence or insufficient IT staff support and lack of technological infrastructures will create problem to the implementation project and sometimes the project were delayed or failed. For cloud computing implementation in the Malaysian public sector, the agency should ready with competence IT staff to support and troubleshoot the services during and after implementation. Agency also should have sufficient computer network infrastructure with reliable internet connection and faster download/upload speed. This is because the access to cloud computing services is via computer networking infrastructure. Unreliable internet connection and slow download/upload speed in agency will create problem or disruption of services, thus will lead to the failure of cloud computing implementation. Therefore, the following hypotheses was proposed.

*H5: Organizational Readiness positively effects the implementation of cloud computing.*

#### HUMAN CONTEXT

The human dimension represents issues encountered by the Malaysian public sector IT personnel (including CIO, Manager or Head of IT department/unit and IT personnel) when agencies engage in the adoption of an IT innovation. For the Malaysian public sector, cloud computing technology is one type of new IT innovation. Therefore, the CIO, Manager or Head of IT department/unit and IT personnel will play an important role in the adoption decision process. For this reason and in line with Yusof et al. (2008) and Thong (1999), the author argues that if a CIO, Manager or Head of IT department/unit and IT personnel can easily accept and conform to an IT innovation, he/she will have/exert a positive attitude toward the adoption of that new IT innovation such as cloud computing services and resources. The IT personnel' technical capabilities, competencies and/or knowledge will also impact the agency when adopting an IT innovation. In addition, if the IT personnel has sufficient innovation, knowledge and the needed skills to adopt cloud computing, that agency will certainly have more confidence throughout the assimilation process.

Furthermore, human factor in this study characterizes the IT personnel characteristics in two dimensions, IT personnel innovativeness and IT personnel knowledge. Thus, in which it is defined as the characteristics of the IT personnel in the Malaysian public sector in which the agencies run its business that may contribute in creating the need for and ability to adopt and implement the cloud computing innovation. The model of IT innovation by Yusof et al. (2008) and Thong (1999) from the above discussion emphasizes on the importance of the human

characteristics factor to the adoption of IT innovation. Thus, in this study the personnel factor is modified to IT personnel based on the current issues and problems identified at the organizational-level adoption of innovations in the Malaysian public sector agencies. Therefore, the following hypotheses was proposed.

*H6: IT personnel innovativeness positively effects the implementation of cloud computing.*

*H7: IT personnel knowledge positively effects the implementation of cloud computing.*

#### CLOUD COMPUTING EFFECTIVENESS

The benefits of cloud computing in the public sector are also reflected in the use of an expanded IT to create government value. For instance, in the virtualization environment Buyya et al. (2011), the characterization of a cloud computing system allows adopters to feel the needs of the service provision and improve the capacity of the corresponding organization by unifying the IT infrastructure throughout the organization. With that environment, the organizations can evaluate or stimulate stakeholder' requests accurately and seek the provision of services provided by the government. As such, the extent of cloud computing implementation can lead to enhanced the productivity and quality in service delivery (Armbrust et al., 2010; Buyya et al., 2011).

In addition, the cloud computing implementation benefits the IT procurement cost by saving the procuring of redundancies hardware and software across agencies in public sector as well as improves IT staff utilization. Cloud computing offers inexpensive, faster, reduced inventory, enhance effectiveness of logistics, as well as improved access to IT services (Armbrust et al., 2010; Buyya et al., 2011). For instance, one platform of IT server or data centre can be consolidated by many organizations. As such, the operational IT services by one agency can be shared by other agencies may reduce the IT operational cost for entire organization. From the purchasing government's point of view, cloud computing facilitates procurement innovations to result in reduced purchased price, reduced cycle time, and improved IT sourcing (Craig et al., 2009; Wyld, 2009). Thus, the cost savings and efficiencies associated with cloud computing implementation would result in reduced IT operating cost, which in tum result in better financial performance thus improve the operational effectiveness. Therefore, the following hypothesis was proposed.

*H8: The implementation of cloud computing technology positively effects operational effectiveness*

#### RESEARCH METHOD

The study population surveyed includes Chief Information Officers (CIO), Heads of IT Departments, IT Managers, and IT personnel working in the Malaysian public sector. The selection framework of this survey included 730 organization in various ministries and departments, and agencies across country. Stratified sampling techniques used to identify the organizations to be as respondents. In total, 500 questionnaires were distributed, 226 questionnaires were collected and 169 data were analyzed for data analysis. From 169 valid responses, 36.1% were from the Federal agencies, State Statutory agencies by 17.8%, Federal Statutory agencies by 16.6%, Local Authority by 16% and followed with State agencies by 13.6%. Majority of the respondents were located in Klang Valley area consist of Wilayah Persekutuan Putrajaya by 39%, Wilayah Persekutuan Kuala Lumpur by 17.2% and Selangor by 10.1%. These can be explained that majority of the government agencies especially Federal

agency are centrally located at Wilayah Persekutuan Putrajaya and scatted around Wilayah Persekutuan Kuala Lumpur and Selangor.

Next, all item measurements are derived from previous studies that have been proven its validity and reliability. All items have been adapted and adjusted to coincide with the context of this research TOE, HOT-fit and IS Success Model construct. Five-point Likert scales ranging from “1=strongly disagree” to “5 = strongly agree” were used. Measures are presented in Table 1.

TABLE 1. Five-point Likert scales.

<i>Variables</i>	<i>Items</i>
Relative Advantage	i. Cloud computing services enables your agency to accomplish tasks more quickly. ii. Cloud computing services improves the quality of work your agency does.
Compatibility	iii. Cloud computing services makes it easier to do your agency activity. i. Cloud computing services is compatible with all aspects of IT services in your agency. ii. Cloud computing services is completely compatible with current IT system situation in your agency.
Perceived Risks	iii. Cloud computing services fits well with the way your agency delivers the services. iv. Cloud computing services fits into your agency’s service delivery style. i. Using the cloud computing services, there is high probability of your agency losing control over the privacy of information ii. The security of the cloud computing services for your agency’s data confidentiality will affect its implementation.
Top Management Support	iii. <i>Using of cloud computing services would lead your agency to a loss of privacy.*</i> i. <i>Top management team is highly interested in using cloud computing services.*</i> ii. Top management team is aware of the benefits cloud computing services for future success of agency. iii. Top management team has allocated adequate resources for the implementation of cloud computing services. iv. Top management team has a vision as a leader to promote cloud computing services to the agency. i. <i>Sufficient network infrastructure is implemented before the cloud computing implementation.*</i>
Organizational Readiness	ii. Internet connection in your agency is reliable. iii. Internet downloading/uploading speed in your agency is fast. iv. Lack of technical supports in your agency resulted in problematic cloud computing implementation.
IT Personnel Innovativeness	v. Manpower in your agency has the technical competence to implement cloud computing. i. Your IT personnel have original ideas. ii. Your IT personnel are self-directed and proactive iii. Your IT personnel often risk doing things differently
IT Personnel Knowledge	iv. Your IT personnel work well in cross-functional teams addressing business problems. i. Your IT personnel are knowledgeable about the key success factors that must go right if our organization is to succeed. ii. Your IT personnel are able to interpret business problems and develop appropriate technical solutions iii. Your IT personnel closely follow the trends in current technology. iv. Your IT personnel are knowledgeable about cloud computing technology v. Your IT personnel are skilled in cloud computing technology.
Operational Effectiveness	i. The extent of cloud computing use in leading to reduced IT operation costs at your agency. ii. The extent of cloud computing use in leading to increased productivity at your agency. iii. The extent of cloud computing use in leading to improved quality in service delivery at your agency.
Cloud Computing Implementation	Email, Data Centre, Database, File Storage, File Sharing, Antivirus & Anti-spam services, Data recovery Centre, Cloud-based desktop, Web hosting, Office productivity, Online collaboration or conferencing, Virtual Machine, Testing and Development

*\*Items was deleted due to low loading*

## DATA ANALYSIS AND RESULTS

The methodology for measuring the research model of this study was structural equation modeling (SEM) based partial least squares (PLS), SmartPLS M3 2.0 software. This approach has multiple advantages over other methods such as multiple regressions. SEM-PLS are a popular structural equation modeling technique to conduct data analysis.

Confirmatory factor analysis was performed to measure the reliability and uniqueness (dimensionality) of the items. As suggested, we used factor loading, composite reliability (CR) and average variance extracted (AVE) to assess convergent validity. The loadings of all items



have exceeded the recommended value of 0.5, except for one (1) item in the measures of organizational readiness, perceived risk and top management support that below the recommended value, which are dropped out for future analysis.

Based on Table 2, the CR value, which shows how constructive indicators indicate the latent construct, exceeds the recommended 0.7, ranging from 0.763 to 0.965. The AVE, which reflects the overall amount of variance in the indicators accounted for by the latent construct, were in the range of 0.514 and 0.837 which exceeded the recommended value of 0.5. This suggested that there was adequate convergent validity in all measures.

TABLE 2. Measures Validity and Reliability

Variables	Factor Loading	AVE	CR	Cronbach's Alpha
Relative Advantage	0.862	0.776	0.965	0.959
	0.887			
	0.885			
Compatibility	0.849	0.737	0.918	0.881
	0.874			
	0.894			
	0.814			
Perceived Risks	0.929	0.837	0.911	0.853
	0.812			
	NA*			
Top Management Support	NA*	0.523	0.763	0.643
	0.616			
	0.724			
	0.802			
Organizational Readiness	NA*	0.555	0.861	0.799
	0.799			
	0.722			
	0.724			
	0.680			
IT Personnel Innovativeness	0.702	0.573	0.843	0.750
	0.772			
	0.776			
	0.775			
IT Personnel Knowledge	0.760	0.514	0.840	0.766
	0.784			
	0.702			
	0.683			
	0.649			
Operational Effectiveness	0.791	0.796	0.921	0.874
	0.960			
	0.917			

Notes: NA\* items were deleted due to low loading.

Discriminant validity is supported when the square root of the average variant extracted for each latent construct is highest in its assigned construct. The evidence for the discriminant validity between dimensions is given by comparing the correlation between the square roots of the AVE among constructs. The results in Table 3 shows that the correlation of each construct is smaller than the value of square root of the AVE extracted by the index measuring the construct, thus indicating sufficient validity of discrimination. Overall, the measurement model confirmed adequate convergent validity and discriminant validity.

TABLE 3. Discriminant Validity of Latent Variables

	RA	COMP	RISKS	TMS	ORS	ITIN	ITKN	IMPL	OPEF
RA	<b>0.881</b>								
COMP	0.646	<b>0.858</b>							
RISKS	0.110	0.144	<b>0.915</b>						
TMS	0.272	0.369	-0.094	<b>0.723</b>					
ORS	0.204	0.312	0.054	0.314	<b>0.745</b>				
ITIN	0.175	0.268	0.048	0.151	0.259	<b>0.757</b>			
ITKN	0.295	0.299	0.165	0.107	0.254	0.472	<b>0.717</b>		
IMPL	0.348	0.270	0.021	0.049	0.263	0.119	0.317	<b>1.00</b>	
OPEF	0.450	0.491	0.125	0.303	0.395	0.463	0.386	0.184	<b>0.892</b>

Items on the diagonal are square roots of AVE scores

Lastly, the causal relationship between variables is examined through a structural model analysis. The path coefficient and t-value analysis can approve data to support hypothesis models. To run this analysis, statistical significance was assessed by t-tests based on a bootstrap procedure with 5,000 bootstrapping. This study begins our interpretation with the hypothesized factors. Table 4 shows the summary of the structural model in this study.

TABLE 4. Results of Hypothesis Testing

Hypothesis	Path Relationship	Path Estimation ( $\beta$ )	t Value	p Value	Results
H1	RA -> IMPLEMENTATION	0.194***	3.585	0.000	Supported
H2	COMP -> IMPLEMENTATION	0.086***	3.719	0.000	Supported
H3	RISKS -> IMPLEMENTATION	-0.017*	1.665	0.098	Supported
H4	TMS -> IMPLEMENTATION	0.160***	2.731	0.007	Supported
H5	ORS -> IMPLEMENTATION	0.145***	2.798	0.006	Supported
H6	ITIN -> IMPLEMENTATION	0.032ns	0.862	0.390	Not
					Supported
H7	ITKN -> IMPLEMENTATION	0.038*	1.906	0.058	Supported
H8	IMPLEMENTATION -> OPERATIONAL EFFECTIVENESS	0.267***	3.977	0.000	Supported

Note: Significant level = \*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.10$ ; ns not significant. RA=Relative Advantage; COMP=Compatibility; RISK=Perceived Risks; ORS=Organizational Readiness; TMS=Top management support; ITIN=IT Personnel Innovativeness; ITKN=IT Personnel Knowledge

The next step of structural model evaluation criteria analysis is the determination of  $R^2$ . The  $R^2$  provides the percentage of variation in dependent variable(s) explained by independent variable(s) (Keil et al., 2000). The  $R^2$  value is one of the methods that can be used to predict model accuracy in which a higher value of  $R^2$  means a higher level of predictive accuracy. The value of  $R^2$  varies according to the number of measuring independent variable(s) i.e. higher number of independent variable needs to produce higher value of  $R^2$  and vice-verse (Chin, 1998). Furthermore, the rule of thumb for acceptable  $R^2$  according to Chin (1998) that model having  $R^2$  as 0.67, 0.33, and 0.19 are considered as substantial, moderate, and weak respectively.

The result shown in Table 5 revealed that the  $R^2$ , implementation of cloud-based services and resources by the Malaysian public sector falls under moderate level that explained by Technology, Organization and Human factors, together explained 56.2% or half of the variance for implementation. However, only 17.1% of the variance for consequences by the cloud computing assimilation in the Malaysian public sector has been verified in this study.

TABLE 5. Results Of  $R^2$ 

Latent Variable	$R^2$ Value
Implementation	0.562
Operational Effectiveness	0.171

## DISCUSSION

The relative advantage was found to be the strongest total effect of the relationship between technological factors and initiation as well as implementation. Relative advantage was found to be a significant determinant of technology adoption in previous studies among organizations, firms and industries, including those related to e-commerce applications, Internet and e-business technologies, Internet-based ICT, e-commerce, and RFID adoption as well as cloud computing (Alam et al., 2017). With regard to the relative advantage in this study, it can be argued that the organization's initiation and actual implementation of cloud computing can be adequately predicted based on the relative advantage factors. One possible explanation for the relative advantage being significant in this study is the diverse types of cloud computing being adopted, with the belief that it provided a relatively greater improvement over their previous IT infrastructure.

Compatibility was also found to be the strongest total effect of the relationship between technological factors and the implementation of cloud computing by the Malaysian public sector. This finding is consistent with earlier findings in other previous IT adoption studies among organizations, firms and industries, including those related to e-commerce applications, enterprise application and e-business technologies by Alam et al. (2017) and Alam et al. (2011). that found compatibilities are significant to IT implementation. It can be argued that agencies perceived cloud computing as being compatible and consistent with their potential needs, and prior experience with the existing agency's policies, practices, and IT infrastructure. The cloud computing features that are compatible with all aspects of IT services in the Malaysian public sector lead to a higher level of implementation among the agencies. Most agencies in the Malaysian public sector also found that cloud computing services are completely compatible with the current IT system in their department, thus influencing cloud computing implementation.

Perceived risks were hypothesized to have a negative influence or barrier factors on the implementation of cloud-based services in the Malaysian public sector. This study found a significant support for the relationship between perceived risks as a barrier factor on the implementation of cloud computing services and resources by the Malaysian public sector. This finding is consistent with findings in the other previous IT adoption studies by Akturan and Tezcan (2012). This finding is also consistent with the perception by Armbrust et al. (2010) and Wyld (2010), which stated that security plays the main dominant factors of barrier to cloud computing implementation. It can be argued that agencies believe that the risks of the cloud computing may affect their implementation of the cloud environment, especially the public cloud. This is particularly true in the Malaysian public sector because agency's data requires a more secure environment for storage and retrieval. Privacy issues are also a critical concern in the public sector industry (Wyld, 2010). In addition, information and data confidentiality and privacy issues in a cloud computing environment also turn to be significant to the Malaysian public sector to implement this IT innovation.

Top management's support and organizational readiness were found to be a significant organizational factor in determining the implementation of cloud computing by the Malaysian public sector. Top management's support in an organization is important to enhance the diversity of cloud computing. Moreover, intensive cloud computing services and resources require top managers to continuously provide commitments and support to facilitate cloud computing projects (Wyld, 2010). This finding is consistent with findings mentioned in the other previous IT adoption studies such as enterprise resource planning application, e-commerce, Web 2.0, electronic supply chain and business intelligent applications by Akca and Ozer (2014) and Xin et al. (2014) that top management plays a significant role in enhancing IT innovation implementation in an organization. The positive effect of top management support may be even

more significant in the cloud computing service and resource context. It can be argued that cloud computing is a complex organizational IT innovation involving a transformation in business processes and strategies. Unlike e-business, ERP, e-commerce or other IT innovations, cloud computing services and resources assimilation involves more complex organizational restructuring and transformation. Therefore, continuous and practical supports from top managers may be more critical for cloud computing services and resources engagement than other IT engagements. It can be argued that the significant findings of top management support in cloud computing implementation extend the cumulative knowledge of top managers' role in innovation implementation of the cloud computing. That is, in the context of complex innovation, such as cloud computing, the power and influence of top managers remain substantial and necessary for diffusing and routinizing innovation within the Malaysian public sector.

Organizational readiness was found to have a significant effect on the implementation of cloud computing assimilation by the Malaysian public sector. This is consistent with the findings in other previous IT adoption studies such as green IT, RFID technology, enterprise systems and internet and web technology which found that organizations with more IT resources have more abilities to implement IT innovation. In studies specific to cloud computing adoption, organizational readiness was a positive significant factor in the study (Hassan et al., 2017).

Cloud computing is a complex organizational innovation, which implies the innovative use of the high-speed Internet and related technologies to enable government activities. Organizations with a higher level of IT infrastructure, human resource and system integration are expected to have technological and managerial resources and skills to assimilate cloud computing more intensively and pervasively.

The survey data did not support the nexus between IT personnel innovativeness and implementation of cloud computing in the Malaysian public sector. In this regard, the study confirms that the set of IT personnel soft skills strongly motivated the persuasion to new IT innovation (Yusof et al., 2008). However, the results contradicted the study by Sallehudin et al. (2015) which found that IT personnel innovativeness was insignificant to the initiation of cloud computing implementation. It can be argued that IT personnel in the Malaysian public sector are not innovate to the alignment of benefits and needs of cloud computing to their agency.

As asserted by Ainin et al. (2015) and Alam et al. (2011), sets of knowledge and skills required by the IT personnel positively influence an organization to implement new IT innovation. The result of this study found that IT personnel's knowledge and skills in cloud computing is positively significant to the implementation of cloud computing services and resources by the Malaysian public sector. This result is consistent with the study by Ahmadi, Nilashi and Ibrahim (2015). In this regard, these findings support the result from Sallehudin et al. (2015) that knowledge and skill are the main factors for IT personnel to be convinced of the cloud computing benefits to their organization thus influence its implementation. In addition, IT personnel effective learning to gain knowledge and skills proves that they are always up to date with the current technology such as cloud computing. Therefore, IT personnel knowledge and skills in IT innovation affect the organization's ability to deploy cloud computing in the most effective possible manner to support the organization strategies.

As expected, the implementation of cloud computing significantly affects the organization's operational effectiveness thus, providing evidence to support the hypothesis H8 of this study. The result of this study is consistent with the finding by Ainin et al. (2015) and Tseng and Liao (2015) that emphasized IT innovation implementation and use have a positive impact on several dimensions of organizational performance. In this regard, the consequence of organizational performance measured in this study is operational effectiveness. According to Kundra (2011) and Wyld (2010), the public sector will gain an advantage to their IT operation and services by implementing cloud computing. Therefore, the results confirm that the extent

of cloud computing implementation by the Malaysian public sector influences and is able to reduce IT operational cost, improve productivity and enhance service delivery systems. Although the study found a significant relationship between assimilation and impact, the variance effect of operational effectiveness and actual implementation is only 0.171 or 17.1%. According to Ahmadi et al. (2015) to gain value and take full advantage of IT innovation implementation, organizations should make efforts to fully routinize, and make full use of the cloud computing. In addition, another consideration to improve the value of operational effectiveness is a complete integration of IT systems into cloud computing of the Malaysian public sector.

## CONCLUSIONS

Although this study has produced interesting findings in term of presenting an extended model of an organization's assimilation process, these findings carry important limitation which is relevant for future research. This study limitation is the subjectivity of classifying cloud computing deployment strategies (public, private, and hybrid) and delivery strategies (IaaS, PaaS, and SaaS). In this study, the approached agencies initially were only asked whether they implement any of the thirteen types cloud computing in their agencies. Therefore, this study is unable to classify delivery and deployment strategies of cloud computing implementation by the Malaysian public sector. Another important factor for cloud computing, such as cost factors, is missing in this study. The cost of adopting an innovation includes initial setup cost, fixed as well as variable operational cost.

The study has achieved its research objectives to construct the implementation framework of the cloud computing services and resources in the Malaysian public sector based on TOE and HOT-fit model. It has been developed and validated by robust statistical analyses. The results generated based on the proposed assimilation framework of the cloud computing in the Malaysian public sector. It also can be used as empirical evidence for the decision makers in the public sector to provide a plan for the successful adoption and implementation of the cloud computing in the Malaysian public sector. The results also can help the vendors and developers of the cloud computing to enhance the existing cloud computing support in order to meet the requirements and needs of the public sector agencies.

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