Acceptance of cloud computing in the Malaysian public sector: A proposed model

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Abstract

The Malaysian government has initiated a cloud government project as an integration of cloud computing and unified communication-based applications toward the digital and cloud work environment. However, the impact studies have found that the implementation of this project has several weaknesses such as lack of infrastructure support, weak IT knowledge, and lack of awareness among public sector employees causing applications not to be fully utilized. Therefore, it is crucial to conduct a study to measure the acceptance of government cloud project because there has been much investment in the project. This study applied Unified Theory of Acceptance and Use of Technology (UTAUT), Technology Readiness Index (TRI) and several factors to develop the research model which is divided into two main factors: technological and human. The technological factor might determine the likelihood of its acceptance by the public sector and might stimulate them to accept it. The human factor as the characteristics of the people in the public sector that may contribute to creating the need for and ability to accept cloud computing. This proposed model will be used to evaluate the individual acceptance of cloud computing in the Malaysian public sector. For future work, this model needs to be enriched with interview sessions and quantitative surveys to validate the findings.

Keywords

Cloud computing implementation, public sector, individual analysis, UTAUT, TRI, cloud computing acceptance, government cloud

Introduction

The evolution of technology has brought many conveniences to human life. Job is more comfortable to do and quickly set up and even provide a more efficient collaboration network for better working quality. The use of cloud computing technology in everyday work has proven to bring many benefits (such as cost-efficiency, collaboration, mobility, and security) to both employees and organizations.[1–3] Cloud computing-based applications can encourage people to be more efficient in their work. A wide range of cloud computing services is available online, either free or paid. Increasing use of cloud each year proves that this technology is an alternative to conventional data centers. Cloud services are not just for organizations or businesses but also available for individuals as per their usage levels.

Global computing acceptance and implementation of cloud computing is well on the rise with increasing usage over the years.[4] According to the Software Alliance,[5] 5 short years ago, cloud computing was a new tool, now a

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next-generation technology that promised to help companies and countries unlock greater productivity and expanded economic growth. With companies and governments increasingly moving their key IT processes to the cloud environment, the mix of important policy considerations has become increasingly clear such as privacy laws to protect users' data, access to robust, ubiquitous, and affordable broadband.

In the Malaysian context, cloud computing technology is a new concept. According to the Asia Cloud Computing Association (ACCA), Malaysia is ranked eighth behind Singapore, which tops the Asia-Pacific region.[6] An initiative is needed to drive the business and cultivate its use to gain the most celebrated benefit of cloud computing. Studies on the readiness and acceptance of cloud computing factors are essential so that initiatives framed by the authorities are acceptable to the users.

The cloud computing-based applications known as MyGovUC introduced by the Malaysian government is a unified communication and collaboration services which are regulated by the government. This cloud initiative project is a platform for communication channels such as e-mail, conference calls, and instant messaging.[7] The implementation of this project is one of the government's efforts to save the country's spending by integrating communication channels for all public sectors in Malaysia. In this way, collaboration and networking between government agencies can be integrated and provide more benefits to the people and the country.

However, there are some weaknesses reported through an impact report on application use offered in MyGovUC. Among the flaws are the lack of infrastructure that can support some applications that require strong online Internet capacity, and uneven application usage. Besides, there is a lack of awareness and IT knowledge of applications other than e-mail applications.[8]

Therefore, the objective of this study is to identify the factors that may influence the Malaysian public sector employees to use cloud-based applications. Besides, the basic framework of this study is the Unified Theory of Acceptance and Use of Technology (UTAUT) and Technology Readiness Index (TRI), which was refined with the incorporation of some other factors.

This article will explain how this model is developed through several stages of work. Beginning with previous studies on cloud computing technology, and the theory of innovation acceptance analysis past studies with several other sources of support to formulate a model of the research.

Literature review

Cloud computing background

Cloud computing technology is used to store and access data as well as applications over the network in a private storage hosting space. National Institute of Standards and Technology[9] defined cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction." Sallehudin et al.[10] simplified cloud computing as a model for providing on-demand access to computing services via the Internet.

In cloud computing technology, all data are stored in a server connected through an Internet network, where the user-required software and applications are available on the server. However, Avram[11] mentioned that "cloud computing is not so much a technology as it is the combination of many pre-existing technologies. These technologies have matured at different rates and in different contexts and were not designed as a coherent whole. However, they have come together to create a technology ecosystem for cloud computing." This scenario shows that cloud computing is a new platform for existing technologies to be used together as per the user's needs.

The multidimensionality of cloud computing services and characteristics includes resource deployment models (public, private, and hybrid) as well as service delivery models (software as a service, platform as a service, and infrastructure as a service). Cloud computing promises many benefits to users according to the types of services and models that users subscribe. Among the benefits are the scalability of the business, reduced IT costs, access flexibility, and strategic value.[12–14] A study by Amron et al.[15] revealed that the Malaysian government had managed to save government spending up to half of the original cost of developing and maintaining conventional data centers.

IT innovation acceptance

The users' or organization's acceptance of new technology mainly depends on how technology can help them to perform tasks more quickly and efficiently. The ability and greatness of technology are seen as a tool to facilitate the work. However, its effectiveness and benefits for users are subjective in many issues and circumstances. The definition of "acceptance" leads to two situations, whether "acceptable" or "not accepted." Davis[16] defines acceptance as users' decision on how and when they will use technology.

Looking at the challenges and issues that often dominate users to accept and use new technologies, there are many things to be measured before users or organizations can accept the technology. Many studies have been conducted in measuring users' acceptance of the implementation and use of cloud computing in both individual levels[10,17–21] and organizational levels.[22–25] Furthermore, these models and theories introduce other factors that can affect user acceptance in various contexts.
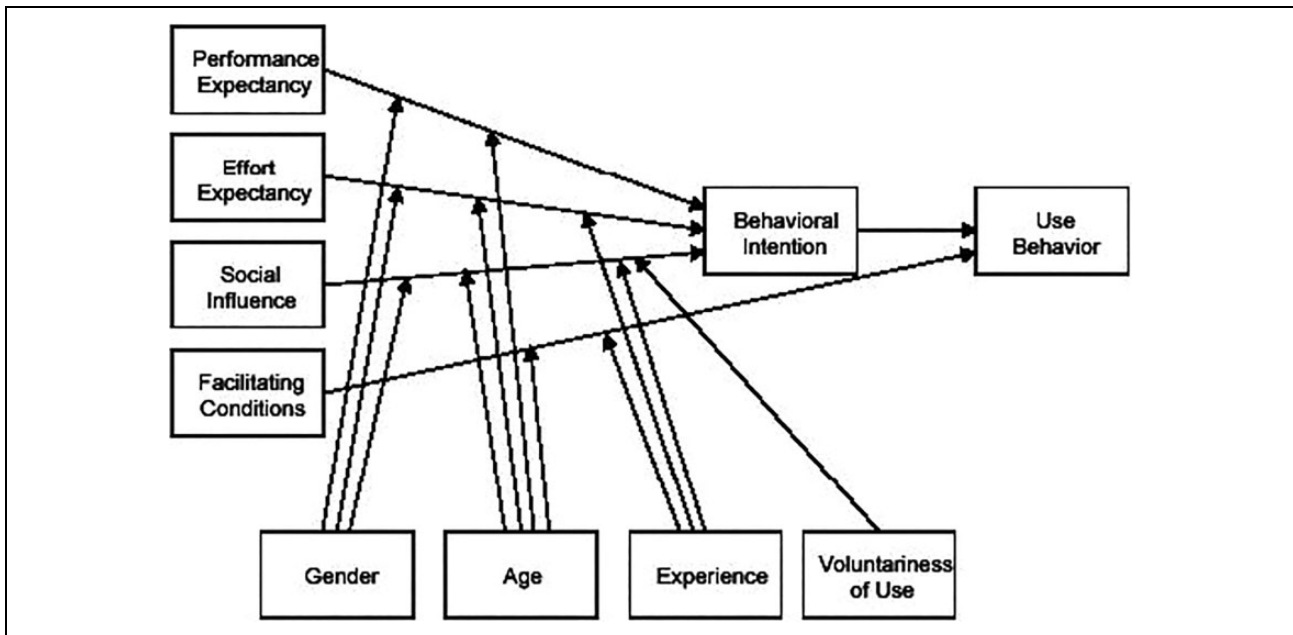
Figure 1. Unified Theory of Acceptance and Use of Technology.[30]

The Theory of Reasoned Action,[26] Theory of Planned Behavior,[27] Technology Acceptance Model,[16] Diffusion of Innovation,[28] and Task-Technology Fit[29] are among the theories used in innovation acceptance whereas UTAUT[30] is an excellent research framework that combines eight of the great theories (including the ones mentioned above) focusing on individual acceptance analysis studies of innovation. According to Salloum and Shaalan,[31] practical suggestions, including the UTAUT implementation, have clearly described the IT behavior, and others are inspired to continue validating and testing their model. Therefore, to examine the users' acceptance of cloud computing in Malaysia public sector, UTAUT was adopted as an initial theoretical framework in this study.

Unified Theory of Acceptance and Use of Technology

The UTAUT is a technology acceptance model developed by Venkatesh et al.[30] This model explains the intentions of users to use new technologies and subsequent usage behavior. This model consists of four core constructs, namely performance expectancy, effort expectancy, social influence, and facilitating conditions. The first three constructs are direct determinants of usage intention and behavior, while the fourth is a direct determinant of user behavior. Figure 1 shows the relationship between the primary constructs, moderator constructs, and predicted constructs in UTAUT.

The strength of UTAUT framework lies in the fact that it was founded on so many models and thus providing the researcher with a broader view of all existing models.[32] Moreover, UTAUT is a much stronger model for an explanatory power and use of conceptual and empirical
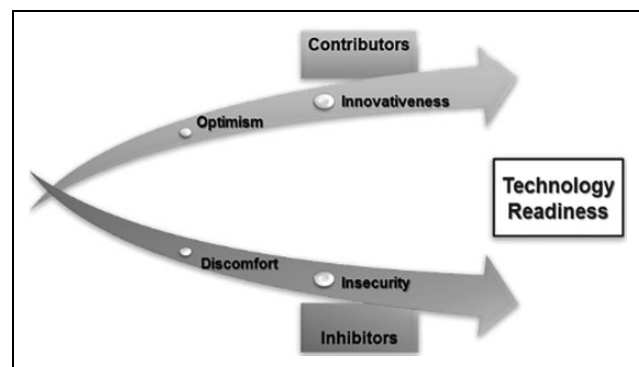
Figure 2. Technology Readiness Index 2.0.[35]

similarities and disparities across eight prominent models to formulate the theoretical framework.[33]

Technology Readiness Index

The TRI model developed by Parasuraman[34] and extended version by Parasuraman and Colby[35] as a measuring tool for examining and evaluating the readiness of the users toward new technology. This model consists of two main parts that act as drivers and inhibitors for the adoption of technology. Factors in the driver are optimism and innovativeness, while in inhibitor are discomfort and insecurity[34] as shown in Figure 2.

A study done by Pires et al.[36] uses TRI as antecedents of the acceptance model in measuring consumer acceptance on Internet banking in Brazil. It has concluded that TRI is beneficial in determining the level of consumer acceptance of IT innovations. An empirical study by Coughlan[37] in Business-to-Business (B2B) technology readiness has validated all
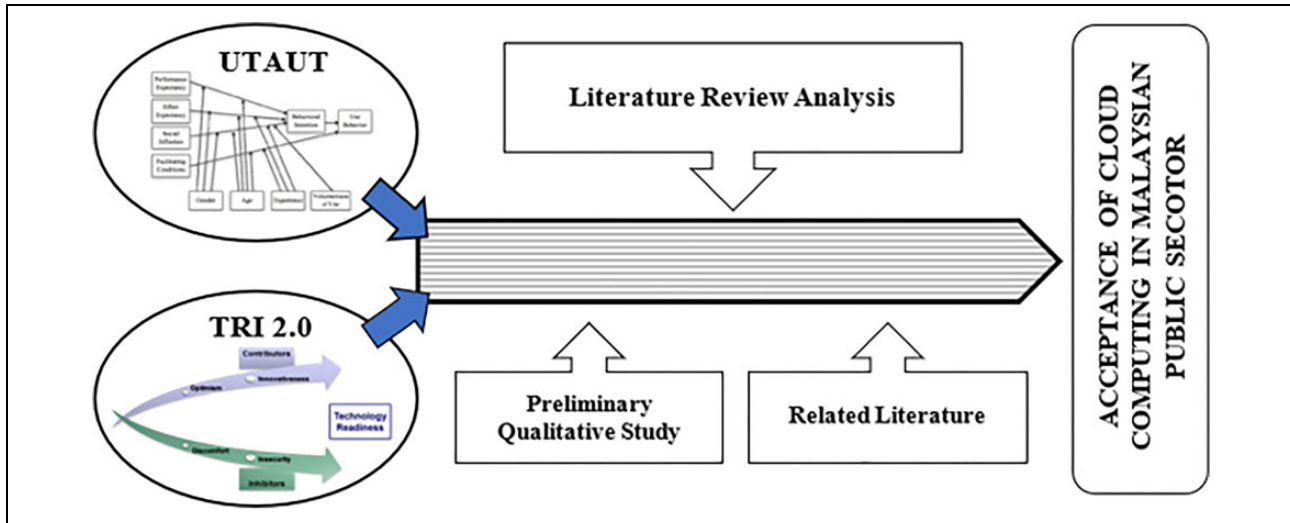
Figure 3. Research conceptual framework.

four dimensions of TRI through this study. However, it is surprising that study by Ariani et al.[38] of Small Medium Enterprises (SMEs) in Indonesia found that the TRI model gives more descendants on some indicators and variables. The study concludes that SMEs operators do not have good technological knowledge as their business practices.

Therefore, based on past research, several areas can be identified to fill in this study include the lack of research on individual analysis on cloud computing acceptance in the public sector and how individual readiness affects their intention to accept cloud computing.

Methodology

The theoretical literature review was designed based on a methodology for information system (IS) research that was proposed by Webster and Watson.[39] In developing the model, four main sources were used; review on related theories and models (UTAUT and TRI 2.0), literature review analysis, preliminary qualitative study, and related literature and other sources, as illustrated in Figure 3.

Firstly, this research deployed all four constructs of UTAUT, namely performance expectancy, effort expectancy, facilitating conditions, and social influence. The selection of these theories was based on the appropriateness of theories to explain the acceptance of IT innovation at the individual level, as suggested in the literature.[40–42]

Since this study is the first research in exploring the essential determinants of cloud computing by the Malaysian public sector, the selection of the determinants of UTAUT framework is justified to be a proper foundation for this research. Furthermore, UTAUT framework is valid, strong theoretical integration, supporting customer context, and most dominant in studying individual-level adoption.[43,44]

To strengthen the foundation of the proposed model and create a novelty value to the context of this study, TRI 2.0

has been embarked into the model. It will enable to evaluate the level of individual readiness toward acceptance of cloud computing. As suggested by Parasuraman,[34] TRI models should be proposed to test several antecedents and consequences as much for consolidating the TRI model as for extending the four factors. Selection of TRI 2.0 in this model is in line with the recommendations put forth by Padhi and Mohapatra[45] and Makkonen et al.,[46] so that TRI can be tested in a various geographical area and difference interactive context and services to find out if results obtained would persist in different environments.

Next, this study conducted a theoretical literature review to identify the factors affecting cloud computing acceptance by the public sector in Malaysia. Indeed, thematic analysis, as suggested by Maguire and Delahunt,[47] was conducted to obtain the ranking of the factors used in the previous study. An analysis has been done on 49 articles to identify the most frequent factors proposed from the past studies regarding cloud computing acceptance in various fields.[48] The previous studies have given useful insights for this research study to outline the model.

Apart from that, two preliminary study sessions were also conducted by interviewing government officers and agencies representatives who have been using the MyGovUC. The results of this preliminary study give a clearer picture of the actual situation faced by users. Besides, several related documents have also been reviewed, such as the MyGovUC users' impact report and the users' readiness report.

In summary, four factors that were chosen to be adopted in the model is originally from UTAUT constructs (performance expectancy, effort expectancy, facilitating conditions, and social influence). Another five factors based on matched issues between the impact report by MAMPU[8] and the preliminary study done in the Malaysian public
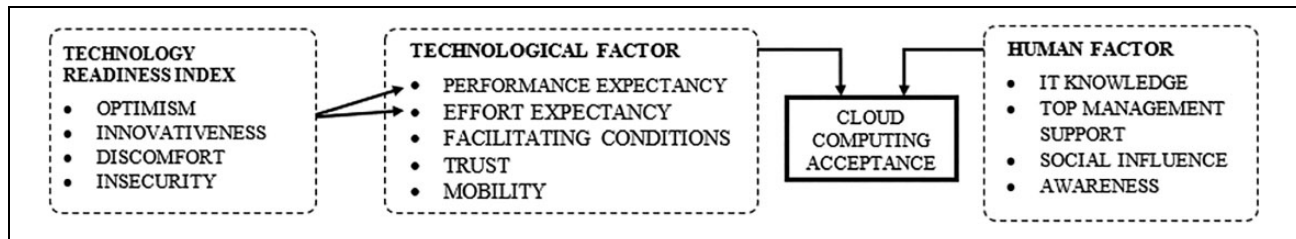
Figure 4. Research proposed model.

sector. These factors are trust, IT knowledge, top management support, mobility, and awareness.

A proposed model

As discussed in the previous section, the conceptual framework has assisted this research in developing a model mainly to evaluate the level of readiness and acceptance of public sector employees in Malaysia toward cloud-based applications. As shown in Figure 4, five constructs are categories under the technological factor (performance expectancy, effort expectancy, facilitating conditions, trust, and mobility), and four constructs under human factor (IT knowledge, top management support, social influence, and awareness), accelerate the acceptance of cloud computing by individual in the public sector.

Technological factor

The technological factor refers to the technologies relevant to the organization.[49] The technological dimension will focus on technical aspects related to cloud computing, characteristics, and elements that contribute to the acceptance of this technology. This factor measures five constructs separately as below:

1. Performance expectancy

Performance expectancy refers to the extent to which cloud computing technology is used in everyday tasks can provide the benefit and improve individual work performance while enhancing individual beliefs to innovations. Venkatesh et al.[30] highlighted performance expectancy as an individual believes that using the system will help them to attain gains in job performance.

Additionally, this construct helps individuals who accept innovations to have clear benefits over other technologies for the organization.[50] Benefits and ease of use are among the main things that organizations evaluate before using cloud computing. With much investment, the organization would like to get a lucrative return on business and increase. Therefore, it is reasonable to argue that performance expectancy will affect individual cloud computing acceptance positively.

2. Effort expectancy

Effort expectancy defined as the degree of ease associated with the use of the system.[30] User experience is essential in providing an indicator of the convenience and convenience of an individual while using technology. The innovation of new technology should be more user-friendly and helpful. However, there is a technology that is difficult to accept because it is hard to learn, not user-friendly, too complicated and limited. This situation will expose users and organizations to failure to fully utilize new technology.

Bozan et al.[51] highlighted this construct as one of the critical factors, and it has been found that it has changed considerably among users whereby they play an essential role in their relationship with behavioral intentions. Therefore, individuals with adequate effort expectancy have stronger intention toward cloud computing acceptance.

3. Facilitating conditions

Facilitating conditions refers to the extent to which cloud computing technology provided is appropriate and fits with the existing infrastructure. This construct plays a vital role as a degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system.[52] The availability of technical resources such as networking, the Internet, PCs, and also external sources such as finance, assistance, time, and effort is indispensable to facilitate the performance of a particular behavior. It is essential to examine the strength and availability of IT-related resources within the organization, as many organizations are less prepared in this context and ultimately lead to their failure.[53]

4. Trust

In this study, we believe trust is other essential factors influencing users to accept cloud computing services. Generally, trust is the feeling and level of confidence that innovation is trustworthy and reliable. According to Liang,[23] trust is the degree of an individual's confidence in cloud computing and a willingness to adopt. The level of comfort toward technology will make it easy to accept the innovation. This belief is based on the trust it provides, the assurance of security, the policy on user rights, and the reliability of data privacy.

Trust is still a crucial part of wiping out the anxieties and risks faced by users despite many other challenges in implementing cloud computing.[54] Thus, this construct is not the same for every country and technology, so it is in line with a suggestion by Salloum and Shaalan[55] and Saxena.[56]

5. Mobility

One of the cloud computing characteristics is the mobility that allows applications in this technology to be accessed more easily from any authorized Internet network. This feature gives one advantage to cloud computing to be more readily accepted as an alternative to conventional data centers. A study by Taib et al.[57] defined mobility as the factor for technology to provide a ubiquitous connection is encouraging users' behavioral intention to use the services. Besides, mobility is the dominant predicted factor for potential users to adopt the new mobile-based innovation.

As a good characteristic in cloud computing, this construct should be a gauge to determine user acceptance to cloud computing as reviewed by Saxena[56] which emphasizes the mobility as an important perspective in the implementation new mobile and electronic-based innovation. Based on these arguments, this study may suggest that mobility as a factor that will influence the users' intention to used cloud computing.

Human factor

The human factor represents issues encountered by the individual when the organization engages in the adoption of cloud computing. Each will face an issue that will prevent him from using innovations. Issues such as basic IT knowledge and environmental influences will impact their willingness to use new technologies. Furthermore, human factors in this study will propose four constructs as below:

1. IT knowledge

To accept new technology, every individual involved should be prepared with IT-related knowledge. The ability of IT personnel to use technology should be considered so that their implementation will not be disturbed due to failure to use them. According to Sallehudin et al.,[10] IT personnel can influence IT innovation adoption by transforming their knowledge and innovativeness. Competent IT personnel can put innovation and the need for new technologies in place. This situation will give added value to the organization to continually seek space to improve operational efficiencies. One of the critical elements is internal expertise or IT knowledge among the employee in the organization. One of the problems in IT project implementation is the lack of IT knowledge among the staff involved.

Besides, the IT skills of non-IT employees are also expected to impact the diffusion of innovations.[58]

Therefore, in this study, construct IT knowledge need to be established to measure an individual's IT knowledge and can encourage them to adopt cloud computing-based applications.

2. Top management support

Top management support plays a vital role in determining the successful implementation of cloud computing in the organization. Top management is an executive group that creates the policies and decisions within the organization. A favorable decision made is critical in the acceptance process and leads to project implementation success. According to Sallehudin,[59] the influence of top management acts as change agents in the decision process. Top management support will ensure the effectiveness of cloud computing through their employees and respond to the people.

In this study, construct top management support refers to what extent an individual within the organization sees the commitment and support given by his top management in encouraging his employees to use cloud computing-based applications in carrying out their day-to-day tasks. Hence, the top management role in providing sufficient need for the process of change to new technologies is significant. The facilities offered will motivate staff and users to accept new technologies more readily.

3. Social influence

According to Venkatesh et al.,[30] social influence refers to the degree to which an individual perceives that significant others believe he or she should use the new system. In this study, social influence will measure to the extent which individuals will be affected by their environment in encouraging them to accept and use cloud computing-based application facilities. Influences such as colleagues, continuous support, and assistance from top management and environments enable an individual to accept cloud computing technology.

A study by Farah et al.[40] highlighted that the user is relying heavily on the feedback and the experience of others who first use new technology. Also, this study indicated that social influence is the most critical factor in determining a user's likelihood to adopt mobile applications. Therefore, social influence will affect individual cloud computing acceptance.

4. Awareness

Awareness is a valuable indicator of the perceived affinity and perceived utility of a technology.[60] In this study, construct awareness refers to the extent to which an individual is aware of the availability of cloud computing-based application services that are provided to them and consider the goodness of their use. Implementation of innovation will not work if it is not used.

Hence, it is essential to give them exposure and knowledge of the technologies that will help them. Users should not only be aware of the new technology but must also be exposed to the benefits that they will gain from their use. When users are aware of the advantages of this technology, users will be interested and try to use it. Positive results will affect other users to share with them.

TRI factor

The TRI dimension is a model designed by Parasuraman[34] to measure the readiness to embrace new technologies. The optimism factor is a positive sense of confidence and believes in a technology that will facilitate one's work. A positive outlook will encourage users to feel the cloud computing is elementary and useful. Next, it will lead users to improve the performance and quality of work.

The innovativeness factor, defined as nature wants to try new things, and fresher ideas will highlight an individual as a champion in mastering changes to the organization. The exploration of new ways and the latest innovations will expose consumers to more working ways that will result in better quality. An innovative employer and employee will have a positive impact on the performances of the work, and the effort will be made more accessible and concise.

The discomfort factor is the negative perception of innovations will cause individuals to feel uncomfortable and unable to use the cloud computing service properly. The discomfort experienced by the user will affect the work routine. Adverse concerns about new technologies will stunt the user's intentions to explore. Next will cover the goodness of the technology.

The insecurity factor is anxiety and skepticism of an individual toward cloud computing will limit it to enjoying the benefits of the technology. Some individuals do not want to use cloud computing because of their innate fear of IT innovation. This fear will prevent individuals from using the perceived benefits of the technology to facilitate their work. There is no doubt that there are many issues, such as security, privacy data, and implementation costs, that are always debated.

Discussion and conclusion

This study reviewed, analyzed, and proposed a research model of cloud computing acceptance among the public sector in Malaysia. Proposed models are integrated from UTAUT and TRI models along with several other factors identified from past studies, preliminary studies, and other related literature. This model builds on two main factors, namely, technical and human factors. Besides, the TRI factor is added to strengthen this model as an index to measure the level of individual readiness to innovation.

This research has the potential to assist organizations or governments in assessing the readiness of their staff toward cloud computing technology before the deployment. Implementation of cloud computing in Malaysia and other developing countries is growing and even intensified in recent years. However, the human factor should be emphasized so that users do not feel burdened behind the passion of pursuing the technology.

In this regard, this study attempted to add to the new body of knowledge regarding cloud computing implementation by involving individual acceptance toward IT innovation. This proposed model may provide policy makers and decision makers with information regarding the cloud computing acceptance process and can be used by IS researchers and practitioners to access the individual employees' acceptance of cloud computing services. The completion of this study will help to formulate a basis for reviewing existing cloud computing policies that may be unbalanced in terms of usage compared to the facilities offered.

Considering this research is still ongoing, future work will be done to evaluate the model whereby both qualitative and quantitative study will be applied. The qualitative part will include interviews with several experts in this field, including CIO from public sector agencies. While the quantitative part will involve data collection work through a survey among public sector agencies which implementing MyGovUC and data will be analyzed to verify the proposed model.

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