



UNIVERSITI PUTRA MALAYSIA

***ORGANIZATIONAL LEVEL CONTINUANCE MODEL OF
CLOUD COMPUTING FOR HIGHER EDUCATION
INSTITUTIONS***

QASEM YOUSEF ABDULELAH MOHAMMED

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**ORGANIZATIONAL LEVEL CONTINUANCE MODEL OF
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By

QASEM YOUSEF ABDULELAH MOHAMMED

**Thesis Submitted to the School of Graduate Studies, Universiti Putra
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of Philosophy**

May 2021

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DEDICATIONS

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*To all my dearest of friends who generously gave me so much of support and love through the many mediums of transcending paradigms,
I really bow down to you and I thank you very much!*

“=====”

∞

To all whom I love.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

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QASEM YOUSEF ABDULELAH MOHAMMED

May 2021

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Faculty: Computer Science and Information Technology

Cloud computing (CC) has emerged as the main standard of service and resource delivery. In Higher Education Institutions (HEIs), CC is acquiring much importance in the contemporary innovation as it offers institutions the choice of adopting cloud services via a subscription-based technique. As CC has grown into a mature technology and is being rapidly adopted in many HEIs across the world, the continuance use of this innovative technology has become a challenge. HEIs can switch vendors if they perceive greater benefits elsewhere and discontinuance use threatens the lasting utility of cloud services. Current research trends on CC have sought to study the technology's acceptance or adoption; however, only little research has been conducted on investigating the continuance in an organizational context. To address this gap, this research established a positivist quantitative-empirical study to understand the factors that influence CC continuance use in HEIs. This understanding is vital because it yields implications about maintenance, retirement and switching decisions, which ultimately can affect work performance, system effectiveness and return on technology investments. Given the absence of a strong organizational-level continuance theory and drawing on prior literature in organizational level continuance, this research developed a CC Continuance Model (i.e., C³M). The C³M was developed by extending and contextualizing the information systems (IS) continuance model through integrating the established theoretical lenses of the IS success model, the IS discontinuance model, and the technology-organization-environment framework. The Average

Congruency Percentage was verified and validated by five panels of experts. A pilot study was conducted through a survey, and based on the proposed conceptual model, which indicated that the research instrument is both reliable and valid. Using a purposive sampling method, data were collected from 140 ICT decision-makers of the Malaysian public HEIs and analyzed using Structural Equation Modelling based on the Partial Least Squares. The findings indicated that the C³M achieved an acceptable fit with the data and specifically 12 out of 14 hypotheses were met. The empirical evidence also indicated that the continuance intention can be predicted by technology, organizational, environmental, and other contextualized factors, explaining 85.2 % of the dependent variables' variance. Subsequently, this research introduces an Implementation Framework to evaluate the organizational level continuance of CC in HEIs. The appropriateness and importance of the components in the Implementation Framework were validated by five experts from academia and industry. Based on these findings, a prototype called CC Continuance Checklist Tool (i.e., C⁴T) was developed and evaluated to validate the research model (i.e., C³M). A user acceptance test using the Perceived Usefulness and Ease of Use instrument was conducted and demonstrated the overall feasibility and acceptability of the prototype. The proposed model is unique in terms of contribution and updating the existing literature in the area of organizational level continuance and its relation to IS continuance. A major contribution of the study is the provision of new theoretical and practical insights that help IT decision-makers in HEIs to continue or discontinue their CC service and showed their relative impact on continuance. It is hoped that these insights will facilitate IT decision-makers to optimize resource use in HEIs, or when commissioning and marketing CC projects. Additionally, the decision-makers could utilize this model for the evaluation of other IT or IS continuance use processes.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

**MODEL TAHAP KESINAMBUNGAN ORGANISASI BAGI
PENGKOMPUTERAN AWAN UNTUK INSTITUSI PENGAJIAN
TINGGI**

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Pengkomputeran awan, sebagai generasi teknologi pengkomputeran terkini dalam revolusi industri ke-empat, telah menjadi piawaian utama perkhidmatan dan penyampaian sumber. Pengkomputeran awan di Institusi Pengajian Tinggi mempunyai kelebihan dalam landskap inovasi terkini dengan mengambil kira tawaran pilihan untuk adaptasi perkhidmatan pengkomputeran awan melalui teknik yang berasaskan langganan. Oleh kerana pengkomputeran awan telah menjadi teknologi yang matang dan diadaptasi dengan pantas di kebanyakan institusi pengajian tinggi di seluruh dunia, kesinambungan penggunaan teknologi inovatif ini telah menjadi satu cabaran kepada penyedia perkhidmatan pengkomputeran awan. Secara umumnya, penerokaan penyelidikan sistem maklumat dijalankan pada tahap pengguna individu, walau bagaimanapun, penyelidikan ke atas teori penerokaan organisasi masih lagi asing. Secara terperinci, gaya penyelidikan terkini mengenai pengkomputeran awan berusaha mengkaji penerimaan atau adaptasi teknologi; namun, kajian masih terbatas dan hanya menumpukan kepada kesinambungan penggunaan, terutamanya pada peringkat persekitaran organisasi. Bagi menangani jurang ini, kajian kuantitatif-empirikal bersifat positif yang mapan bagi mengkaji konstruk yang mempengaruhi kesinambungan penggunaan pengkomputeran awan di Institusi Pengajian Tinggi (IPT) telah dilaksanakan. Seterusnya, berdasarkan kajian literasi terdahulu dalam kesinambungan penggunaan di tahap organisasi, penyelidikan ini membangunkan Model Tahap Kesinambungan Pengkomputeran Awan (iaitu, C³M). C³M telah dibangunkan

dengan memperluas dan mengikut konteks model kesinambungan sistem maklumat (SM) melalui pengintegrasian dan pembinaan teori lensa bagi model SM yang berjaya iaitu, model nyah-kesinambungan SM, dan kerangka kerja teknologi-organisasi-persekitaran. Purata Peratusan Congruency (ACP) telah disahkan dan divalidasi oleh lima orang panel pakar. Satu kajian rintis dilakukan melalui tinjauan, dan berdasarkan model konseptual yang diusulkan, yang menunjukkan bahawa instrumen kajian adalah boleh dipercayai dan sah. Dengan menggunakan kaedah persampelan bertujuan, data dikumpulkan daripada 140 pembuat keputusan ICT di Institusi Pengajian Tinggi Awam (IPTA) Malaysia dan dianalisis menggunakan Structural Equation Modelling (SEM) berdasarkan Partial Least Squares (PLS). Penemuan kajian menunjukkan bahawa C^3M mencapai kesesuaian dengan data yang dapat diterima dan secara khusus 12 daripada 14 hipotesis telah dipenuhi. Bukti empirikal juga menunjukkan bahawa niat kesinambungan dapat diramalkan oleh teknologi, organisasi, persekitaran, dan faktor-faktor kontekstual yang lain, menjelaskan 85.2% dari varians pemboleh ubah adalah bersandar. Seterusnya, penyelidikan ini memperkenalkan Rangka Kerja Pelaksanaan (IF) untuk menilai kesinambungan pengkomputeran awan di IPT. Kesesuaian dan kepentingan komponen dalam Rangka Kerja Pelaksanaan telah disahkan oleh lima pakar dari akademik dan industri. Berdasarkan penemuan ini, satu prototaip yang dinamakan Cloud Computing Continuance Checklist Tool (iaitu, C^4T) telah dibangunkan dan dinilai untuk mengesahkan model penyelidikan (iaitu, C^3M). Ujian penerimaan pengguna menggunakan instrumen Jangkaan Kebergunaan dan Kemudahan Menggunakan (PUEU) telah dijalankan dan telah menunjukkan keseluruhan kebolegunaan dan penerimaan kepada prototaip. Model yang dicadangkan adalah unik dari segi sumbangan dan tambahan kepada kesusasteraan sedia ada dalam bidang bagi kesinambungan peringkat organisasi dan perkaitannya dengan kesinambungan SM. Sumbangan utama kajian ini adalah kepada pembentuk teori baru dan pandangan praktikal yang membantu pembuat-keputusan Teknologi Maklumat (TM) di IPT sama ada untuk menyambung atau menghentikan perkhidmatan pengkomputeran awan dan menunjukkan impak relatif kesinambungan tersebut. Diharapkan pandangan ini akan memudahkan pembuat-keputusan TM untuk mengoptimalkan penggunaan sumber di IPT, atau apabila pentauliah dan pemasaran projek pengkomputeran awan. Tambahan lagi, pembuat-keputusan boleh memanfaatkan model ini bagi menilai kesinambungan penggunaan TM atau SM yang lain.

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

ACP	Average Congruency Percentage
CA	Cronbach's Alpha
CC	Cloud Computing
CCCU	Cloud Computing Continuance Use
CMB	Common Method Bias
COV	Coefficient of Variation
CR	Composite Reliability
CV	Convergent Validity
ECM	Expectation-Confirmation Model
ECT	Expectation-Confirmation Theory
GCP	Google Cloud Platform
HEIs	Higher Education Institutions
IaaS	Infrastructure as a Service
ICT	Information Communication Technology
iDEC	Information Development Center
IF	Implementation Framework
IPMA	Importance-Performance Matrix Analysis
IR 4.0	Fourth Industrial Revolution
IS	Information Systems
ISC	IS Continuance
ISD	IS Discontinuance
ISS	IS Success

IT	Information Technology
LV	Latent Variable
MAPITA	Pengaruh-Pengaruh ICT IPTA
MOOC	Massive Open Online Course
NIST	National Institute of Standards and Technology
PaaS	Platform as a Service
PLS	Partial Least Squares
PUEU	Perceived Usefulness and Ease of Use
SaaS	Software as a Service
SEM	Structural Equation Modelling
SLR	Systematic Literature Review
SRS	System Requirements Specification
TAM	Technology Acceptance Model
TOE	Technology-Organization-Environment
TPB	Theory of Plan Behaviour

CHAPTER 1

INTRODUCTION

1.1 Background

Cloud Computing (CC) is increasingly becoming a springboard for digital innovation and organizational agility (McConnon and Chowdhury, 2020). Higher Education Institutions (HEIs) are facing problems with the increasing of participants, growing need of Information Technology (IT) and infrastructure, education quality provision, and affordable education services (Alexander, 2008; Katz, 2008; González-Martínez et al., 2015). With the high rate at which IT technology changes, resource management optimization is a key concern for HEIs (Sultan, 2010), not least because on-premise systems can only operate effectively when they receive adequate initial funding and resources, as well as dedicated and systematic maintenance regimes (Salim et al., 2015; Son et al., 2014).

HEIs looking to compete in the new world need a flexible yet comprehensive digital transformation blueprint that integrates various technologies across the institution with CC being at its foundation. CC, as the current generation in computing technology of Fourth Industrial Revolution (IR 4.0), has emerged as the main standard of service and resource delivery (Mell and Grance, 2011). Thus, CC has become not only an excellent alternative for HEIs but also a necessary solution to support cost reduction, quality improvement, and through this educational sustainability (Vaquero, 2011) by providing the required infrastructure (IaaS), Platform (PaaS), and storage and software as a service (SaaS) (Sultan, 2010). Accordingly, CC has been adopted rapidly in both private and public organizations, including HEIs (Sultan, 2010; González-Martínez et al., 2015).

However, while the subscription model of cloud services contributes to the growth of the overall market and makes it accessible for HEIs, a new set of challenges has arisen. This research addresses one such challenge that HEIs, as well as the cloud service providers, face. The possibility of making such a decision to discontinue a cloud service provider is exacerbated by the low cost of switching between applications (Sukanesh and Kanmani, 2014) and in general the competitive markets (Son et al., 2014). Therefore, the conceptualization of CC service in HEIs changes to a decision on ‘continuance,’ rather than ‘adoption’.

Moreover, in subscription models offered via cloud-based education systems, HEIs can switch vendors if they perceive greater benefits elsewhere. Thus, it is essential to understand the conceptual differences between adoption and continuance (Dubey and Wagle, 2007). Hence, research on CC continuance has practical and artifact-specific motivations.

1.2 Motivation

As CC has become the main paradigm of resource and service delivery (Mell and Grance, 2011), it has been adopted rapidly in both private and public organizations, including HEIs (Sultan, 2010; González-Martínez et al., 2015). CC ranks fifth in the list of the most-used utilities after gas, electricity, water, and telephone systems (Rodríguez Monroy et al., 2012). The International Data Corporation conducted a CC tracking poll and indicated that, by 2022, USD 370 billion worth of cloud services would be in use. This number corresponds to a 22.5% compounded annual growth rate for five years (IDC, 2019).

To answer the question of what motivates HEIs to use CC service in their institutions, we have conducted a systematic literature review to reveal the positive elements behind the adoption of CC technology along with any interesting motivations in the existing research. As a result, CC offers many benefits to HEIs that include, but are not limited to, readily accessible online applications, flexible learning environments, mobile learning support, availability of more specialized computer software applications, cloud-based computing, cost reductions in hardware and operations, reduce the costs of software, collaborative working, virtualization, and quality of service.

1.3 Problem Statement

CC in HEIs is acquiring much importance in the contemporary innovation landscape considered that it offers institutions the choice of adopting CC services via a subscription-based technique (Sultan, 2010; González-Martínez et al., 2015; Ogunlolu and Rajanen, 2019; Hussein Alghushami et al., 2020). Continued use of CC is highly critical to a HEI's long-term viability (Ding, 2018). Besides, the subscription model of cloud services contributes to the growth of the overall market and makes it accessible for HEIs. While CC is a subscription-based model, a new set of challenges have emerged: a) HEIs can switch vendors if they perceive greater benefits elsewhere. The possibility of making such a decision in HEIs to discontinue a cloud service provider is exacerbated by the low cost of switching between applications (Dubey and Wagle, 2007) and in general the competitive markets (Son et al., 2014). And b) discontinuance use threatens the lasting utility of cloud services (Veit et al., 2017; Walther et al., 2018). Discontinuation of a CC service too early can result in significantly decreased return-on-investment (Robey et al., 2002) and a delayed decision can significantly obstruct operational efficiency (Recker, 2016) and damage reputation (Overby, 2005). Thus, understanding the influencing factors is vital because it yields implications about maintenance, retirement and switching decisions, which ultimately can affect work performance, system effectiveness and return on technology investments (Recker, 2016). Because the CC is a subscribed service, the continuance of this service in HEIs

requires organizational decision rather than individual decision (Dwivedi et al., 2011).

Furthermore, IS continuance research has been undertaken at the individual user level; however, theoretical research organizational continuance is still scarce (Walther et al., 2018; Alismaili et al., 2020). Precisely, current research trends on CC have sought to study the technology's acceptance or adoption; however, little research attention has been given to the continuance use, particularly at organizational-level setting (Jia et al., 2017; Ashtari and Eydgahi, 2017; Obal, 2017; Al-Sharafi et al., 2019). In the context of HEIs, past research has also reported that evidence on the continuance of CC at the individual and organizational level is scarce. The difference in organizational or individual context is that organizational continuance decisions are often made by IS executive decision-makers or others in the organization who may not be intense users of the service in question (Walther et al., 2018), in which a strong influence may be attributed to factors that are insignificant for individual users (e.g., lowering organizational costs) (Furneaux and Wade, 2011; Recker, 2016).

The IS continuance (ISC) Model has been extensively used to address the continuance phenomenon in the IS field, however, the main concern of the ISC is that it was developed to examine IS individual-level continuance of technology, whereas this study examines IS organizational-level continuance use. In addition, the ISC model offers technology-level factors; hence, it is imperative to incorporate new constructs and relationships that capture the complex nature of organization-level decisions (Dwivedi et al., 2011). Therefore, we extended the IS continuance model (Bhattacharjee, 2001) using constructs from dominant models in innovation organization-level Information Systems (IS) continuance research which are IS success model (DeLone and McLean, 1992; DeLone and McLean, 2003) (i.e., net benefits, system quality, and information quality) and IS discontinuance model (Furneaux and Wade, 2011) (i.e., technical integration, system investment, and competitive pressure). To keep our research model coherent and relevant, we identified additional contextual constructs from the literature as constructs to predict continuance use of CC in educational context (i.e., collaboration and regulatory policy). To structure our model, we took a technological-organizational-environmental approach by applying the lens of the TOE framework (Tornatzky et al., 1990) to our research model (i.e., Technology context: net benefits, system quality, information quality, and technical integration; Organizational context: system investment, and collaboration; and Environmental context: regulatory policy, and competitive pressure). The research model is grounded at the organizational level of analysis (Rousseau, 1985), and the analysis object is an individual CC.

Therefore, answering the following research questions was an apparent motivation for this research to be conducted:

- (i) What factors influence the organizational level continuance of CC in HEIs?
- (ii) How to ensure the organizational level continuance of CC in HEIs?

1.4 Research Objectives

This research hopes to achieve the following objectives:

- (i) To identify the factors that influence the organizational level continuance of cloud computing in Higher Education Institutions.
- (ii) To propose an organizational level continuance model of cloud computing for Higher Education Institutions.
- (iii) To evaluate the organizational level continuance model of cloud computing for Higher Education Institutions through model implementation and prototype development.

1.5 Scope of Study

The purpose and scope of this research are to analyze the continuance use rather than the adoption of CC in the context of HEIs. To achieve this, an organizational-level rather than an individual-level perspective was undertaken.

This research was conducted based on developing a theoretical model to explain the continuance of CC in HEIs. The foundations of the constructs proposed for the theoretical framework are based on the literature as well as expert reviews.

For the purpose of this study, the definition of CC proposed by National Institute of Standards and Technology (NIST), which regards CC as the set of aspects that are common across all CC services (Mell and Grance, 2011). Hence, CC relates to the applications and shared services involved in the surveyed institutions through subscription-based models, whereby shared data servers or application activities are accessed. Furthermore, the unit of analysis (i.e., a basic element of observation indicating who or what the researcher has generalized) (Long, 2004) is the organization, and the organization-level phenomenon will be observed by individuals involved in organizational CC subscription decisions at an organization (Long, 2004).

This study is based on positivism empirical research and focuses on HEIs which already adopted CC services. The participants were limited to the Malaysian Public HEIs that have already adopted CC service. The Public University ICT Directors Council (known as MAPITA or Majlis Pengarah-Pengarah ICT IPTA), which consists of the ICT directors representing the twenty Malaysian public universities, was contacted. The size of the population is sufficient to reflect the entire Malaysian HEIs. The proposed framework is then validated by a prototype to evaluate the continuance of CC in HEIs.

1.6 Significance of Study

CC has emerged as the main standard of service and resource delivery; and grown into a mature technology for digital innovation and organizational agility (Mell and Grance, 2011; McConnon and Chowdhury, 2020). According to the International Data Corporation, US\$ 370bn will be used in CC by 2022 (IDC, 2019). Therefore, CC has become not only an excellent alternative but also, an essential solution for HLIs.

CC in HEIs is acquiring much importance in the contemporary innovation landscape considered that it offers institutions the choice of adopting CC services via a subscription-based technique. Discontinue of a CC service can result in significantly decreased return-on-investment (Robey et al., 2002) and a delayed decision can significantly obstruct operational efficiency (Recker, 2016) and damage reputation (Overby, 2005). Thus, understanding the influencing factors is vital because it yields implications about maintenance, retirement and switching decisions, which ultimately can affect work performance, system effectiveness and return on technology investments (Recker, 2016). What factors would make an institution continue or discontinue its subscription is yet to be fully understood. This study evaluated the salient constructs that an institution takes into consideration when deciding to continue or discontinue cloud-based service and showed their relative impact on continuance. Hence, this study has made the following contributions:

1.6.1 Theoretical Contribution

Given the presently accelerated CC adoption rate, we assert that continuance of CC should be a crucial topic of discussion in the IS literature. Hence, the IS continuance phenomenon assumes greater importance and warrants the following contributions.

- (i) One of the most contributions of this research constitutes to the body of knowledge within IS field surrounding continuance phenomenon.
- (ii) The proposed research model accounted for 85.2 % of the variance, which is higher than previous studies in the same domain.
- (iii) the study contributes to developing the literature in the best-available organizational-level continuance models for HEI settings, as well as other similar domains.
- (iv) The proposed research model could be used to assess the continuance of other disruptive technologies in the education sector.

1.6.2 Practical Implication

Considering the practical implication perspective, this study explains the potential effect on practitioners, CC service providers, and decision-makers.

- (i) First, cloud technology is among a core topic in the contemporary computing era, in which the observed findings related to the model's constructs may be valuable for the practitioners. As a case in point, the specific weightings linked to the model's constructs can serve as a set of guidelines that may be used by software vendors to retain their clients. Furthermore, the weights may also be utilized by the clients to pilot routine evaluations concerning the continuance of a particular CC service. Additionally, the model measures the constructs from the reflective and formative perspectives provide additional benefit from a practical viewpoint.
- (ii) Second, the constructs of the model may be employed for a longitudinal evaluation that facilitates client organizations to identify the 'pain-points'. At the same time, cloud service providers should specify clear instructions or a navigation platform that facilitates easy and smooth operation of services for the users in HEIs. Thus, effort in this direction can facilitate higher usage of cloud technology.
- (iii) Finally, this study suggests the potential effects on decision-makers. The findings of the study will facilitate IT decision-makers to optimize resource use in HEIs, or when commissioning and marketing CC projects. Additionally, the decision-makers could utilize this framework for the evaluation of other IT/IS continuance use processes.

1.7 Thesis Organization

This study comprises of eight chapters. A brief description of each chapter is presented as follows:

Chapter 1 presents the overview and background of the research. Particularly, it presents the problem statement, research objectives, research scope and significance of the study.

Chapter 2 analysis the concepts and details out the systematic literature (SLR) review undertaken for the purpose of analyzing existing research on adopting and using CC in HEIs as well as the IS life cycle and related models on IS continuance and highlights the research gap in CC continuance in HEIs.

Chapter 3 explains the methodology and data analytical techniques carried out in this study. This chapter is established on positivism research approach, quantitative method and survey design. The methodology of this study is also discussed.

Chapter 4 discusses the model development and the development of the hypothesized model which includes the structural and measurement models. This chapter also discusses the pilot study findings.

Chapter 5 presents the in-depth analysis of the empirical evaluation of the theoretical model. Specifically, it describes the assessment of measurement and structural model, blindfolding and predictive relevance of model using the Partial Least Square (PLS) of Structural Equation Modeling (SEM) approach.

Chapter 6 discusses on the model implementation. This includes the implementation framework as well as the prototype development with detailed steps involved in the development which includes the initial analysis, functional specifications, prototype construction and prototype implementation.

Chapter 7 presents detailed discussion on the findings of this study. This includes the significance of the relationships between proposed constructs, evaluation of proposed model and implementation framework, hypothesis results and overall research results.

Chapter 8 presents the theoretical and practical contributions of this research. Directions for future work based on the limitations are also addressed in this study.

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