

USING THE UTAUT2 MODEL TO DETERMINE FACTORS AFFECTING ADOPTION OF CLOUD COMPUTING APPLICATIONS

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Abstract

Cloud computing is one of the new technologies likely to have a significant impact on the teaching and learning environment. In this regard, the understanding and prediction of determinants that affect adopting and using of cloud computing by students is becoming an important and challenging subject. Over time, researchers have developed and used several conceptual models to investigate, in general, the factors that determine the adoption of technologies, and one of the most well-known models is Unified Theory of Acceptance and Use of Technology 2 (UTAUT2).

This study aims to adopt this model to examine the key determinants that influence the behavioral intention and use of cloud computing applications in Romania. Thus, in the first part, the paper presents the theoretical coordinates of this model, and, in the second part, the model was tested using Structural Equation Modeling (SEM) by using data collected from 265 students of The Bucharest University of Economic Studies. The Statistical Package for the Social Sciences (SPSS) software and its supplement Analysis of Moment Structures (AMOS) Version 22 were used to analyze the quantitative data and to examine the model relationships. The findings of the research indicate facilitating conditions, hedonic motivation and habit positively influence students' behavioral intention and use of cloud computer applications.

Keywords: cloud computing, Unified Theory of Acceptance and Use of Technology 2 (UTAUT2), Structural Equation Modeling (SEM), applications, Romanian students.

JEL Classification: L86, O33.

Introduction

Cloud computing is a term that describes different situations where computing resources or operations are delivered as a service over a network connection; it is a computational system that is based on sharing physical or virtual hardware or software, removing the need to have these resources in our office or in our home. Cloud computing differs from classic systems by providing some key features, the most important of these being flexibility, reliability, a high level of security, excellent control management and cost-effectiveness (Duan, 2017).

Given the benefits that it can offer to professors and students (such as the ability to share, edit, process, and store large amounts of data, allowing users to use their personal workspace and to create an interactive and digital learning environment, with personalized portfolio and self-service web options for students and faculty staff), cloud computing is an

attractive alternative for the university environment, as is mentioned in various studies (Ashtari and Eydgahi, 2017; Hamidi and Rouhani, 2018).

In this context, testing the students' acceptance toward new technologies, like cloud computing, is a very important process. Over the previous decades many models have been used with this purpose and the latest one is Unified Theory of Acceptance and Use of Technology2 - UTAUT2 (Amponsah, Kobina Panford and Hayfron-Acquah, 2016; Yang, Feng and MacLeod, 2018).

Taking into account the above, our paper aims to present, firstly, the components and mechanism of the UTAUT2 model and, secondly, the applicability of this model in establishing the factors affecting adoption of cloud computing applications, using the results of a research undertaken among Romanian students.

1. Theoretical Background

The initial model UTAUT (Unified Theory of Acceptance and Use of Technology) was developed by Venkatesh et al. (2003) to explain and predict acceptance and use of IT. The key factors of the model were derived from a broad research of other well-established models, including Diffusion of Innovations (DOI) by Rogers (1995), Technology Acceptance Model (TAM) by Davis (1989) and Theory of Planned Behavior (TPB) by Ajzen (1985). UTAUT identifies four key factors, as follows:

- Performance Expectancy - the extent to which the use of technology will provide benefits to consumers in carrying out certain activities;
- Effort Expectancy - the degree of ease or effort associated with the use of technologies;
- Social Influence - the opinions of friends, family and colleagues who can influence the extent to which technology is accepted and used;
- Facilitating Conditions - consumer perceptions regarding available resources and support offered for a certain type of behavior related to the use of technology.

The model is completed with four moderators (age, gender, experience, and voluntariness) related to predicting behavioral intention to use a technology and actual technology use, primarily in organizational contexts. Behavioral intention is often regarded as the predecessor of behavior and can be described as the desire of a person to engage in a particular behavior.

Recently, Venkatesh, Thong and Xu (2012) proposed and tested in a consumer context an extended model, namely UTAUT2 (figure no. 1), which incorporates new constructs, as follows:

- Hedonic Motivation - the pleasure or enjoyment derived from using a technology;
- Price Value - the new variable in the extended model, included because consumers are more price-sensitive than the employees of the companies;
- Habit - the extent to which people tend to conduct behaviors automatically due to learning, previous experiences and past behaviors. Also, this new model is based of removing voluntariness of use as a variable, based on the assumption that consumers act on a voluntary basis.

Compared with the original model, UTAUT2 produced a substantial improvement in the explained variance of behavioral intention, from 56% to 74%, and also a significant improvement in the explained variance of usage, from 40% to 52% (Venkatesh, Thong, and Xu, 2012).

The UTAUT2 model was integrated and applied by researchers in a multitude of studies regarding various user categories (such as employees, consumers, citizens or students) and related to different types of public or private organization, in order to identify the extent to which the factors included in the UTAUT models determine the degree of acceptance and

use of different technologies in various contexts. For example, some research papers aim to determine the degree of acceptance and use of the IT&C and Internet (in general) (Gupta, B., Dasgupta and Gupta, A., 2008), e-Government services (Venkatesh et al., 2011) or mobile applications and technologies (Zhou, Lu and Wang, 2010). Also, some work refer to digital-learning contexts (Pynoo et al., 2011) and others address even the cloud-computing issue (Amponsah, Kobina Panford and Hayfron-Acquah, 2016; Yang, Feng and MacLeod, 2018).

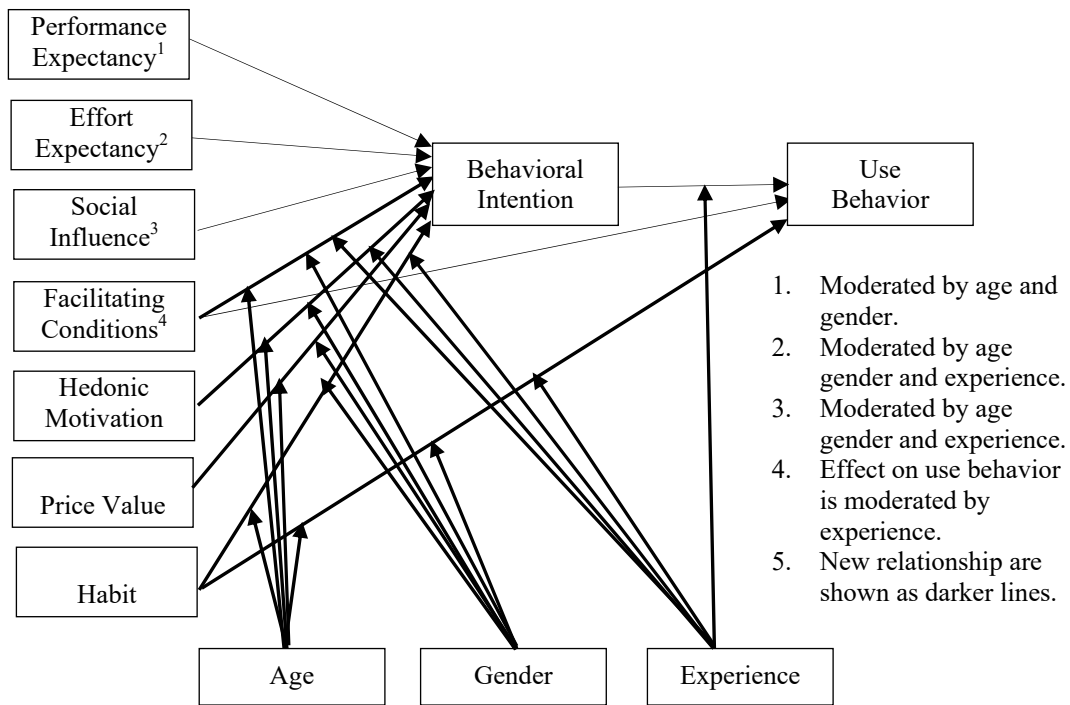


Fig. no. 1 UTAUT2 model

Source: Venkatesh, Thong and Xu, 2012. *Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. MIS Quarterly, 36(1), 157-178, p. 160.*

Some research has also proposed new endogenous or exogenous mechanisms by expanding the UTAUT2 model. For example, Brown, Dennis and Venkatesh (2010) identified a comprehensive set of technology, task, situational and individual and group characteristics relevant to collaboration as predictors of the UTAUT2 predictors.

2. Research Methodology

The main purpose of this study was to investigate the key determinants that influence the behavioral intention and use of cloud computing applications using the UTAUT2 model. This research adopts a sample survey methodology to test the hypotheses of the proposed model. A quantitative survey was conducted between January and March 2019 among the students of The Bucharest University of Economic Studies in Romania. The questionnaire was designed using the UTAUT2 constructs of Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Facilitating Conditions (FC), Hedonic Motivation (HM) and Habit (HT) that affect Behavioral Intention (BI) and Use Behavior (UB) for cloud computing applications. The element of Price Value (PV) was not including in the questionnaire because the most popular cloud computing applications are free for basic usage. Each construct consist of four statements adapted from Venkatesh, Thong and Xu

(2012) and measured using a 6-point Likert scale, ranging from “strongly disagree” to “strongly agree”. Besides that, the questionnaires include four demographic questions about age, gender, year of study and employment status and other two questions about cloud computing awareness and benefits. Empirical data were analyzed using IBM SPSS Version 22 in order to produce descriptive statistics and Confirmatory Factor Analysis (CFA). Structural Equation Modelling (SEM) and Analysis of Moment Structures (AMOS) Version 22 were used to analyze and validate the developed research model.

The hypotheses of the research are the direct relationships between the eight constructs in the proposed model as displayed in Figure no. 1. This set of hypotheses addresses the relationship between independent variables in the proposed research model: PE, EE, SI, FC, HTMH and the dependent variables, BI and UB.

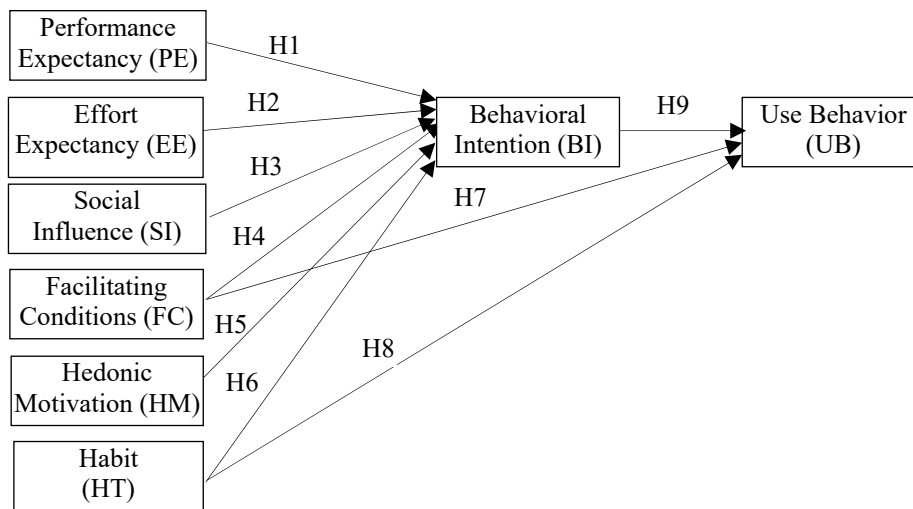


Fig. no. 2 Proposed theoretical model

Source: Adapted from: Venkatesh, Thong and Xu, 2012. *Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. MIS Quarterly*, 36(1), p.160.

The hypotheses of the proposed model were postulated as follows:

- **H1.** PE has a positive influence on BI to adopt cloud computing applications.
- **H2.** EE has a positive influence on BI to adopt cloud computing applications.
- **H3.** SI has a positive influence on BI to adopt cloud computing applications.
- **H4.** FC has a positive influence on BI to adopt cloud computing applications.
- **H5.** HM has a positive influence on BI to adopt cloud computing applications.
- **H6.** HT has a positive influence on BI adopt cloud computing applications.
- **H7.** FC has a positive influence on UB of cloud computing applications.
- **H8.** HT has a positive influence on UB of cloud computing applications.
- **H9.** BI has a positive influence on UB of cloud computing applications.

3. Findings and Discussions

A total of 265 students following bachelor programs from a public university in Romania participated in this study. The results of the survey study revealed that the participants' age ranged from 18 to 33 with a mean age of 20.48 and a standard deviation of 1.422 years. Most of the students were female (64.2%). A third of the respondents (33.2%) were first year students, a quarter (26%) was second year students and the rest (40%) were third year

students. Among all participants, 9.1% declared that they working full time, 26% working part time and 64.9% were unemployed.

Before completing the questionnaire survey, 3.4% of the participants have never heard about cloud computing applications such as Google Drive and G Suite (Docs, Sheets and Slides) and 21.9% of them have heard about it but have never used it. The majority of the respondents (59.6%) use sometimes cloud computing applications and 15.1% use it on a regular basis.

Table no. 1 shows the results of Confirmatory Factor Analysis (CFA) performed to test the model's validity and reliability.

Cronbach's alpha (CA) was used to tests the internal consistency each construct included in this proposed research model. Cronbach's alpha value greater than 0.70 shows that all UTAUT2 constructs have reached a good internal reliability (Taber, 2017).

Table no. 1 Reliability and Validity of the Constructs

Constructs	Cronbach's Alpha (CA)	Composite Reliability (CR)	Average Variance Extracted (AVE)
PE	0.812	0.877	0.641
EE	0.849	0.898	0.688
SI	0.737	0.838	0.569
FC	0.719	0.826	0.543
HM	0.843	0.894	0.68
HT	0.85	0.899	0.69
BI	0.878	0.916	0.732
UB	0.800	0.869	0.624

Convergent validity of the constructs was measured by the Average Variance Extracted (AVE) and Composite Reliability (CR). The acceptable threshold for AVE is 0.50 and for CR 0.70 (Fornell and Larcker, 1981; Bagozzi, 1981). Table 1 show that the AVEs and CRs values for each of the eight constructs of the model exceeds the minimum thresholds indicating high convergent validity.

To evaluate the discriminant validity, the square root of AVE of each latent construct have to be compared with its inter-construct correlation. According to Fornell and Larcker (1981), the AVEs square root should be higher than to the correlation between the constructs in order to satisfy discriminant validity requirement. As shown in Table no. 2, all square roots of the AVEs (in the diagonal) are higher than the correlations between constructs and that indicate adequate discriminant validity of the measurements.

Table no. 2 Discriminant Validity Results

	PE	EE	SI	FC	HM	HT	BI	UB
PE	0.800							
EE	0.449	0.83						
SI	0.495	0.333	0.754					
FC	0.418	0.567	0.410	0.737				
HM	0.416	0.348	0.451	0.274	0.825			
HT	0.428	0.336	0.563	0.299	0.587	0.831		
BI	0.523	0.464	0.577	0.506	0.575	0.645	0.855	
UB	0.353	0.257	0.472	0.323	0.376	0.409	0.464	0.791

Structural equation modelling (SEM), a statistical methodology based on latent variable theory, was used to test the modified UTAUT2 model. SEM provides a basis for hypothesis testing by estimating path coefficients of the fundamental links of the linear relationships among observed and unobserved variables (Byrne, 2001).

Before testing the hypotheses, the proposed structural model was assessed using the goodness-of-fit tests. According to Hair et al. (2014), using three to four fit indices provides adequate evidence of model fit. Three model fit indices were used to determine the overall quality of the model’s fit: the ratio of goodness of fit to degrees of freedom (χ^2/df), Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA). Table no. 3 shows that the values of the model fit indices for the proposed model was in an acceptable range (Hair et al., 2014; Hooper et al., 2008).

Table no. 3 Fit indices for the proposed structural model

Model fit indices	Recommendation	Structural model
χ^2/df	<3.00	1.826
CFI	>0.90	0.912
RMSEA	<0.08	0.056

The values of the standardized path coefficients for the direct relationships in the structural model are illustrated in Figure no. 3.

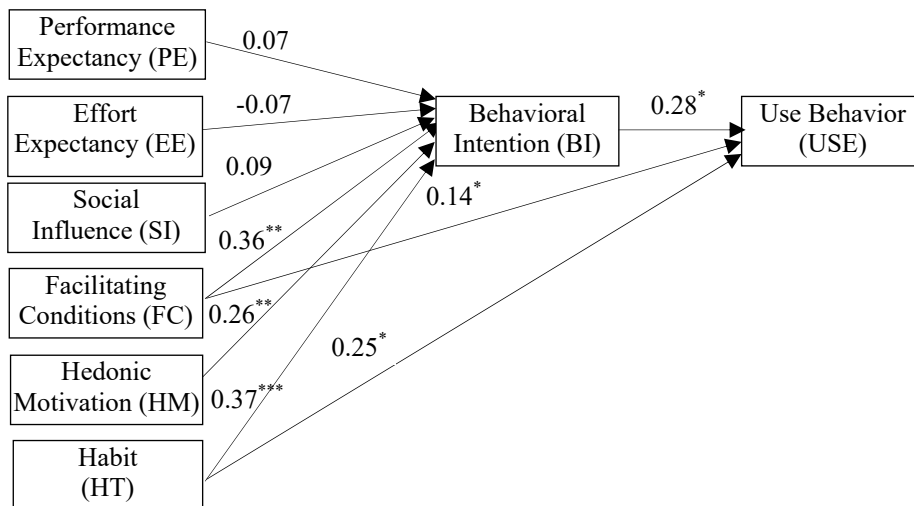


Fig. no. 3 Standardized path coefficients

The results of the final structural model show that the performance expectancy (PE) construct did not significantly influence the behavioral intention (BI) construct ($\beta=0.07$, n.s.), thus H1 was not supported. Second, effort expectancy (EE) did not significantly influence the behavioral intention (BI) construct ($\beta = -0.07$, n.s.), thus H2 was not supported. Third, social influence (SI) did not significantly predict behavioral intention ($\beta =0.09$, n.s.); therefore, H3 was not supported. Fourth, facilitating conditions (FC) positively influenced behavioral intention (BI) construct ($\beta =0.36$, $p < 0.01$), thus providing support for H6. Fifth, hedonic motivation (HM) positively influenced behavioral intention ($\beta =0.26$, $p < 0.01$) therefore, H5 was supported. Sixth, habit (HT) positively influenced behavioral intention ($\beta =0.37$, $p<0.001$), thus providing support for H6. Seventh, facilitating conditions (FC) positively influenced use behavior (UB) construct ($\beta =0.14$, $p < 0.05$), thus providing support for H7. Eighth, habit (HT) positively influenced use behavior ($\beta =0.25$, $p < 0.05$),

thus providing support for H8. Lastly, behavioral intention (BI) positively influenced use behavior ($\beta = 0.28$, $p < 0.05$).

Conclusions

Cloud computing applications provide users access, edit and synchronize their documents, spreadsheets and other digital resources anytime, from anywhere, and using any device. This study adopted the UTAUT2 model to determine the factors influencing Romanian students' behavioral intention and use of cloud computing applications.

The results of the empirical research reveal that six out of the nine relationships between independent and depended variable were supported. The most important factors explaining cloud computer applications adoption and use were facilitating conditions, hedonic motivation and habit. Surprisingly, the other three factors, performance expectancy, effort expectancy and social influence seem to be insignificantly associate with the intention to use cloud computing applications.

The findings of this research have several limitations because the sample size was limited and was focused only on the students from The Bucharest University of Economic Studies. Future research should test the UTAUT2 model on a larger sample size including several types of users in order to provide a better understanding of cloud computing applications acceptance.

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