The Validity and Reliability Evaluation of Instruments for Cloud Computing Acceptance Study

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Abstract— **Online data storage technology over the cloud network has become an option for many organizations, even for personal use. The benefits of cloud computing enable many organizations, including the public sector, to use this technology to provide the best service experience. However, there is an issue with the implementation of cloud-based applications when their usage is less than the number of applications offered. Therefore, a study on the acceptance of cloud computing in the public sector should be conducted. This paper aims to evaluate the validity and reliability of the instrument for cloud computing acceptance in Malaysian public sectors. The developed instruments are analyzed through validity and reliability phases. The validity analysis phase involves two stages of face validity and expert validity. The Content Validity Index (CVI) is used, and the feedback of the panel is considered in improving the items used. The reliability phase was conducted by performing an analysis to evaluate Cronbach 'alpha for each item and also testing using Exploratory Factor Analysis (EFA). The final instrument contained 71 items of 5-point Likert scale multiple-choice options, classified under 15 variables. As a result, this instrument is successfully validated and are reliable to be used in the actual data collection.**

Keywords- content validity; face validity; cloud computing; acceptance; public sector

I. INTRODUCTION

Storing data, deploying and sharing information through the cloud network has become a new phenomenon nowadays. Cloud computing technology has given users a new option to use shared application resources and platforms online. Cloud computing is an innovative technology with dynamic scalability and usage of virtualized resources as a service through the internet, is regarded as potential solutions to advancing modern organisations' IT competitiveness and performance [1].

The use of cloud computing depends on the choice of architecture divided into three types, public, private and hybrid. These three deployment models provide three service models namely infrastructure as a services (IaaS), platform as a service (PaaS) and software as a service (SaaS) as described by the National Institute of Standards and Technology (NIST) [2]. The facilities offered by cloud computing help many organizations and individuals manage data and information in a virtual data centre. However, according to [3], the use of cloud computing at the individual level is relatively new, even though this technology is widely used in many organizations.

In the public sector in Malaysia, there are government cloud-based applications available. However, reports from service providers show unsatisfactory usage rates [4]. Therefore, a present study to evaluate users acceptance in the public sector was conducted.

The acceptance of cloud computing among individuals is influenced by many factors such as benefits, savings, mobility, security, trust, workplace requirements and social influence [5]. Many studies have been conducted to investigates the influences factors that drive a person to accept or reject innovation. Among them are [6] who have applied Technology-Organisation-Environment (TOE) theory in assessing cloud computing acceptance in the public sector in Malaysia. Similarly, studies by [7] and [8] that measure consumer acceptance of cloud technology in e-Government and higher education institutions.

The study by Farah [9] which adopted Unified Theory of Acceptance and Use of Technology (UTAUT) in her study in Pakistan showed significant effects of factors such as performance expectancy, effort expectancy, social influence, habit, and hedonic motivation on the adoption of mobile banking technology. Also, [10] shared the same results and revealed that compatibility, innovativeness and security factors also influence consumers in determining their acceptance of new technology. Thus, from the analysis of the previous studies, this study has listed variables that will be used in the study of cloud computing acceptance among the public sector in Malaysia.

II. METHODOLOGY

This study uses the approach adopted by [11] to develop an instrument and validate the instrument. There are four main phases practised: (i) instrument development, (iii) translation of the questions, (ii) instrument validity, and (iii) pilot study. The first phase is the design and development of the instrument, which is based on literature reviews,

preliminary studies and related reports. Theories such as Technology Acceptance Model (TAM), Diffusion of Innovations (DOI), Theory of Reasoned Action (TRA), and UTAUT were analysed as the foundation for the selection of variables in this study based on the thematic analysis performed.

Next is a translation. Translation into local languages is one of the ways to help research participants provide accurate answers. The third phase is the validity of the instrument. This phase involves two validation processes - face validity and content validity. The final phase in determining the reliability of this study is conducting a pilot study to complete the validity and reliability process of the instrument.

A. Instrument Development

This instrument contains three sections, namely; (A) Profile Respondent, (B) Information on Cloud Computing Services Usage, and (C) Acceptance on Cloud Computing. A total of 16 constructs consisting of three dimensions were included in the proposed model of this study [12]. Dimension (1) Technological. It consists of six variables, namely performance expectancy, effort expectancy, compatibility, security, trust, and mobility. Dimension (2) Human contains four variables, namely IT knowledge, top management support, social influence, and awareness. Dimension (3) Technology Readiness Index (TRI) contains four core variables, namely optimism, innovativeness, discomfort, and insecurity. The other two constructs, namely behavioural intention, and use behaviour are to measure the tendency and actual use of technology.

The initial questionnaire contained 86 items of measurement. This research applied the Likert scale format to measure the items in the survey instrument. A five-point Likert scale "1 = strongly disagree, 2 = disagree, 3 = not sure, 4 = agree, 5 = strongly agree" was used for all measurement items, which is same as to the originally adapted measurements.

B. Translate of the Questionnaire

The survey was translated from English to Bahasa Malaysia to facilitate respondents' understanding of the questionnaire. This study uses the method proposed by [13], which is a one-way or expert translation. Therefore, this study has been using professional and certified translator services from the Malaysian Institute of Translation & Books *(Institut Terjemahan dan Buku Malaysia)*.

C. Face Validity of the Questionnaire

Face validity is the degree to which a measure appears to be related to a specific construct, in the judgment of non-experts such as test-takers and representatives of the legal system [14]. In order to examine the face validity, the dichotomous scale can be used with the categorical option of "Yes" and "No", which indicate a favourable and unfavourable item, respectively. According to [15], the procedural suggest evaluated by two (or more) independent judges. Therefore, in the study of 10 respondents were invited and performed face validity procedures. The participants comprise IT, and non-IT users, public sector agency IT officers, academicians, and university students.

D. Expert Content Validity of the Questionnaire

In this study, the content validity test suggested by [16] will be performed by the expert to validate the instrument. A study by [17] proposed a panel of five to ten experts is considered sufficient to evaluate the items of measurement. Therefore, in this study, eight experts were chosen for the content validity test based on their knowledge and education background, interest area, experience, and skill related to this research.

The experts were asked to evaluate the relevancy of each item by providing their rating for each item based on three scales: 1=Not relevance, 2=Relevant, 3=Very relevant [18]. Besides, the experts are also asked to provide any comments or feedback on any construct measurement.

Quantitative analysis includes Content Validity Ratio (CVR) and Content Validity Index (CVI) calculation applied to measure the validity of the survey items [14]. CVR is an item's statistic indicating the usefulness of item measurement to be accepted or rejected. CVR and CVI offer practicality in terms of time and cost, and also, it is quick and easy to perform [19]. According to Lawshe [20], CVI was calculated for each measurement item by the CVR calculation. Based on the total number of experts, which is eight, minimum CVR of 0.75 is required to accept the measurement item to be retained in the survey. Next, CVI was calculated for each dimension using the same formula as the CVR but at the dimension level.

E. Pilot Study

The pilot study represents a study of the feasibility of the main study. A trial run or small-scale study is carried out by conducting large-scale research, and this is a means of pre-testing the suitability of the specific research instrument to be used [21]. The pilot study in the present research was made use of 133 participants and had two main aims. The first aim is to improve the quality of questions. The second was to test the comprehension of the respondents as well as provide clarity to the actual administered survey [22].

Reliability analysis using Cronbach's alpha (α) was performed to analyse a pilot study. Hinton et al. [23] have suggested four cut-off points for reliability, which includes excellent reliability (0.90 and above), high reliability (0.70-0.90), moderate reliability (0.50-0.70) and low reliability (0.50 and below). Although reliability is vital for study, it is not sufficient unless combined with validity [14].

For further ensuring the instrument validity, the validity and the un-dimensionality of the scales were assessed using Exploratory Factor Analysis (EFA) [24] with principal component factor analysis and varimax rotation was conducted. For each scale, adequacy for factor analysis (Kaiser-Meyer-Olkin [KMO] and Bartlett's test of sphericity) and factor loading were examined. KMO and Bartlett's test of sphericity is examined to check whether the data set is appropriate for factor analysis.

III. RESULT

Through two validity sessions conducted, face validity and content validity, several improvements to the instrument were made based on the results and recommendations.

A. Face Validity

In general, participants provided positive comments on the instrument being evaluated and some feedback that needed attention. Among the answers are, need to improve the language used, reduce the number of items, need to do correction in sentence structure and double-barrel questions.

B. Content Validity

Expert evaluations show that all constructs are accepted as part of this research model. However, some items were dropped as a result of the calculation performed using the CVR method. Table I illustrates the CVI value for each construct, a number of initial-items and overall survey validity, indicating that the validity of the survey instrument was achieved at 90% of CVI. There are some feedbacks from experts such as the need to improve language, need to split the double-barrel questions and remove the duplicate or overlap questions.

TABLE I. CVI OF THE SURVEY INSTRUMENT

Variable	*N* of Initial-Items	*N* of Accepted Items	CVI
Performance Expectancy	4	4	1.00
Effort Expectancy	5	5	1.00
Compatibility	6	5	0.83
Security	7	6	0.86
Trust	7	4	0.57
Mobility	5	5	1.00
IT Knowledge	6	5	0.83
Top Management Support	6	6	1.00
Social Influence	5	4	0.80
Awareness	6	4	0.67
Optimism	6	4	0.83
Innovativeness	5	5	1.00
Discomfort	5	5	1.00
Insecurity	6	5	0.83
Behavioural Intention	4	4	1.00
Use Behaviour	3	3	1.00
Actual Use	3	3	1.00

Overall CVI = 0.90

C. Pilot Study

Table II, III and IV indicate descriptive statistics of the analysis result using EFA from the pilot study test data set. The result of the EFA with Keyser–Meyser–Olkin (KMO) and Bartlett's test, total variance explained, factor analysis, descriptive statistics shows the excellent internal quality of the scale. The KMO value of 0.848 is the present study indicates the adequacy of the sample size [25].

As an inspections and interpretations procedure done by [25], the Scree plot in Fig. 1 shows that 15 components should be analysed. The statistic in Table III shows that the cumulative percentage of the variance of 34.3% and a total of 15 components (factors) having an eigenvalue > 1. According to [26], factor loadings should be at least 0.50 and ideally 0.70 or higher. Table IV highlighted that the factor loadings are greater than 0.50. Furthermore, items with lower loading factor (low reliability) will be dropped (COM1, SEC6, TRU4, INN5 and USE3).

TABLE II. DESCRIPTIVE STATISTICS

KMO and Bartlett's test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.848
Bartlett's Test of Sphericity	Approx. Chi-Square	7476.825
	Df	2211
	Sig.	.000

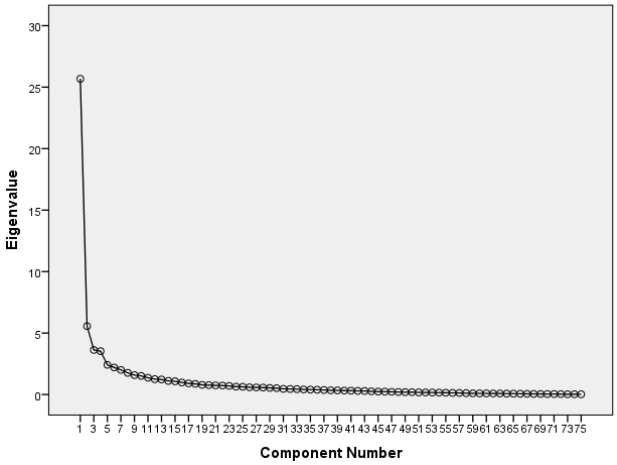

Figure 1. Scree plot

The value of Cronbach's alpha for all constructs is more than 0.7, indicate an excellent internal quality of the scale [27]. It is highly reliable and appropriate to be used for the actual data collection process. The mean of each item turned out to be close to three, the median on a five-point scale.

TABLE III. DESCRIPTIVE STATISTICS

Total Variance Explained						
Factor	**Initial eigenvalues**			**Extraction sums of squared loadings**		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	25.016	34.269	34.269	25.016	34.269	34.269
2	5.551	7.604	41.873	5.551	7.604	41.873
3	3.575	4.897	46.769	3.575	4.897	46.769
4	3.422	4.687	51.457	3.422	4.687	51.457
5	2.391	3.275	54.732	2.391	3.275	54.732
6	2.172	2.975	57.707	2.172	2.975	57.707
7	1.926	2.638	60.345	1.926	2.638	60.345
8	1.648	2.257	62.602	1.648	2.257	62.602
9	1.557	2.133	64.735	1.557	2.133	64.735
10	1.503	2.058	66.793	1.503	2.058	66.793
11	1.355	1.856	68.649			
12	1.228	1.682	70.331			
13	1.210	1.658	71.989			
14	1.061	1.454	73.443			
15	1.041	1.426	74.869			

Extraction Method: Principal Component Analysis.

Table IV also depicts the value of coefficient of variation (CV) for each item indicates the consistency of the respondents. According to [28], the CV value approaching zero is better which shows the data items are more consistent.

TABLE IV. DESCRIPTIVE STATISTICS

Variable & Item	λ	Mean	SD	CV
Performance Expectancy (α = 0.711)				
PER-1	0.541	4.23	0.714	0.17
PER-2	0.517	4.19	0.770	0.18
PER-3	0.504	4.17	0.761	0.18
PER-4	0.622	4.11	0.775	0.19
Effort Expectancy (α = 0.715)				
EFF-1	0.633	4.23	0.714	0.17
EFF-2	0.731	4.21	0.697	0.17
EFF-3	0.563	4.08	0.739	0.18
EFF-4	0.732	4.00	0.759	0.19
EFF-5	0.563	4.08	0.697	0.17
Compatibility (α = 0.711)				
COM-1 (dropped)	0.263	4.07	0.730	0.18
COM-2	0.501	4.11	0.731	0.18
COM-3	0.503	4.07	0.730	0.18
COM-4	0.522	4.09	0.753	0.18
COM-5	0.531	4.05	0.742	0.18
Security (α = 0.915)				
SEC-1	0.733	3.84	0.777	0.20
SEC-2	0.661	3.83	0.863	0.23
SEC-3	0.801	3.83	0.818	0.21
SEC-4	0.740	3.85	0.812	0.21
SEC-5	0.662	4.10	0.706	0.17
SEC-6 (dropped)	0.416	3.63	0.949	0.26
Trust *(α = 0.701)*				
TRU-1	0.790	3.94	0.736	0.19
TRU-2	0.598	3.88	0.749	0.19
TRU-3	0.739	3.90	0.757	0.19
TRU-4 (dropped)	0.404	3.84	0.767	0.20
Mobility (α = 0.701)				
MOB-1	0.677	4.22	0.742	0.18
MOB-2	0.777	4.26	0.737	0.17
MOB-3	0.721	4.24	0.730	0.17
MOB-4	0.558	4.27	0.676	0.16
MOB-5	0.774	4.18	0.787	0.19
IT Knowledge (α = 0.793)				
ITK-1	0.646	3.91	0.733	0.19
ITK-2	0.571	3.91	0.753	0.19
ITK-3	0.640	3.83	0.939	0.24
ITK-4	0.525	3.72	0.891	0.24
ITK-5	0.579	3.91	0.783	0.20
Top Management Support (α = 0.862)				
TOP-1	0.673	4.13	0.712	0.17
TOP-2	0.650	4.02	0.783	0.19
TOP-3	0.777	3.80	0.795	0.21
TOP-4	0.682	3.95	0.772	0.20
TOP-5	0.768	3.82	0.860	0.23
TOP-6	0.769	3.96	0.763	0.19
Social Influence (α = 0.744)				
SOC-1	0.593	3.95	0.772	0.20
SOC-2	0.547	3.80	0.776	0.20
SOC-3	0.595	3.83	0.809	0.21
SOC-4	0.576	3.93	0.818	0.21
Awareness (α = 0.719)				
AWA-1	0.585	3.93	0.800	0.20
AWA-2	0.625	3.76	1.001	0.27
AWA-3	0.675	3.83	0.909	0.24
AWA-4	0.719	3.85	0.909	0.24
Optimism (α = 0.754)				
OPT-1	0.730	4.26	0.626	0.15
OPT-2	0.665	4.19	0.709	0.17
OPT-4	0.673	4.20	0.736	0.18
OPT-5	0.678	4.36	0.711	0.16
Innovativeness (α = 0.812)				
INN-1	0.567	3.65	0.809	0.22
INN-2	0.851	3.64	0.873	0.24
INN-3	0.696	3.68	0.858	0.23
INN-4	0.666	3.98	0.802	0.20
INN-5 (dropped)	0.414	3.71	0.840	0.23
Discomfort (α = 0.709)				
DIS-1	0.716	3.06	0.983	0.32
DIS-2	0.845	2.84	1.029	0.36
DIS-3	0.806	2.86	1.122	0.39
DIS-4	0.749	3.00	1.094	0.36
DIS-5	0.743	3.16	0.928	0.29
Insecurity (α = 0.824)				
INS-1	0.508	3.35	1.039	0.31
INS-2	0.678	2.95	1.100	0.37
INS-3	0.784	3.26	1.112	0.34
INS-4	0.842	3.05	1.072	0.35
INS-5	0.803	3.24	1.102	0.34
Behavioural Intention (α = 0.728)				
BEH-1	0.768	4.32	0.713	0.16
BEH-2	0.788	4.20	0.783	0.19
BEH-3	0.722	4.31	0.751	0.17
BEH-4	0.692	4.23	0.745	0.18
Actual Use (α = 0.839)				
USE-1	0.550	4.11	0.819	0.20
USE-2	0.577	4.01	0.848	0.21
USE-3 (dropped)	0.373	3.98	0.900	0.23

α = Cronbach's alpha, λ = Factor loadings

IV. DISCUSSION

This study established the face and content validity of questionnaires designed to assess the acceptance of cloud computing for Malaysian public sectors. The face validity shows some weaknesses that need to be addressed in the survey. Among the emphasis are the sentence structure and the language that the respondent can easily understand. The feedback received is considered appropriate.

The CVI used in this study indicates the validity of the survey instrument was achieved at 90% (74 out of 86 items were judged content valid by the content experts). The CVI value exceeded the expected minimum CVI of 0.80 [19] and thus showed an adequate content valid instrument. All the comments and corrections suggested by the experts been considered for revision. At the end of the validity process, study instrument was prepared with 16 constructs and 74 items for the pilot study purposes.

Although internal reliability Cronbach' alpha for all constructs and items exceeded 0.7 as recommended, descriptive analysis from EFA suggested only 15 constructs and 71 items as the final instrument. Construct security and trust are merged and four items are dropped due to low factor loadings value.

V. CONCLUSION

This study has undergone several stages in assessing the reliability and validity of each proposed variable and item. Through the process of developing questions through past research and expert confirmation. CVR and CVI analyzes were used to determine the relevant and essential items for each variable. The data collected through the pilot study were analyzed to assess the purification and EFA scale.

Value of Cronbach's alpha > 0.7 and factor loadings > 0.5 were used in this study.

The new instrument has been found to demonstrate an adequate and acceptable measurement performance needed for a future descriptive study to assess the acceptance of cloud computing for the Malaysian public sector. This survey appeared to have an adequate validity and reliability test can be further arranged for the next steps and conduct the rest of the actual data collection and analysis.

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