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Investigating the Factors Influencing the Use of Cloud Computing

Hussain Alshahrani[1*], Amnah Alshahrani[2], Mohamed Elfaki[1], Saeed Alshahrani[1], Mofadal Alymani[3], and Yazeed Alkhurayyif[4]

[1] Department of Computer Sciences, College of Computing and Information Technology, Shaqra University, Sahqra, Saudi Arabia.

[2] Department of Computer Sciences and Infromation Technology, Applied College, Princess Nourah Bint Abdul Rahman University, Riyadh, Saudi Arabia

[3] Department of Computer Engineering, College of Computing and Information Technology, Shaqra University, Sahqra, Saudi Arabia.

[4] Department of Computer Science, College of Sciences and Humanities, Shaqra University, Sahqra, Saudi Arabia.

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Abstract

Cloud computing technology is a new computing paradigm phenomenon that has recently received a significant attention by several research studies. However, the previous works have concentrated on the adoption of this technology and limited studies focused on the factors influencing the intention to use it. Therefore, the proposed study developed a model to figure out these factors. This study used an online questionnaire to collect data. A total of 712 responses were received. Structural equation modelling was employed by using SmartPLS 3 software to analyse the collected data. The findings of this study indicate that awareness, user readiness, and satisfaction are important factors related to the use of cloud computing, while privacy seems to have no significant influence on the use of this technology.

Thus, this study recommends users to attend courses and workshops to garner knowledge and understanding of cloud computing and hence become appropriately qualified to use it. Moreover, such courses and workshops will provide users with methods and techniques to protect their privacy, which should be given priority attention.

I. Introduction

Cloud computing technology is a new computing paradigm that has recently received a significant attention by several research studies. Indeed, it is one of the emerging topics in the field of information science due to its valuable advantages such as flexibility, massive scalability, global access, reliability, and cost effectiveness [28]. Cloud computing is a sort of computing service that provides IT services such as processing power and data storage on demand. Cloud computing in information technology has spawned a slew of new users' groups and marketplaces in recent years [31]. It makes the use of the Internet flexible,

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* Corresponding Author: Hussain Alshahrani.
Email: halshahrani@su.edu.sa

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on-demand, and dynamically scalable computing infrastructure for a variety of applications using any of the three service delivery models: Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS) [18]. These three service models can be delivered via four deployment models which are private, public, community, or hybrid cloud. Therefore, many organizations are implementing one or more cloud service models to improve their efficiency at a lower cost. Moreover, users have more alternatives with cloud computing because of the model and types of services that are available [2],[8]. Thus, continuous, and systematic innovations are required for organizations to stay cost-effective, efficient, and timely while providing high-quality of services. However, users find some difficulties in adopting a new technology, such as cloud computing. Users are concerned more about data security, choosing the ideal cloud setup, real-time monitoring requirements, reliance on service providers, as well as pricing barriers, cloud management, and data recovery [8]. Recent research has also revealed that a variety of factors and settings influence users and organizations to accept this technology [2], [3]. Given its importance, most of the studies in the literature focused on the adoption of this technology. Based on the authors' knowledge, there is no single study that focuses on the actual use of this technology and the factors influencing this use. Therefore, the goal of this study is to examine the factors influencing the actual use of cloud computing which were adopted from the literature as they have a significant influence on the use of new technologies.

The rest of the paper is structured as follow; the following section reviews the literature related to cloud computing followed by the research model. The fourth section shows the methodology used to conduct this study which contains the methods of data collection and analysis. The final two sections show discussion and conclusion with some future work.

II. Literature Review

A. Cloud Computing

Cloud computing has several definitions. The most widely used definition is that introduced by the National Institute of Standards and Technology (NIST). NIST defines cloud computing as "a set of network enabled services, providing scalable, QoS guaranteed, normally personalized, inexpensive computing infrastructures on demand, which could be accessed in a simple and pervasive way" (p. 139) [49], where QoS stands for Quality of Service. According to [49], the access to it could be in a simple and pervasive way. It provides an effective way for sharing resources and collaborating with groups [18], [38], [22]. NIST identifies five key characteristics of cloud computing which are on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured services [18].

According to [10], cloud computing has four deployment models: private (used exclusively by one user); public (used by public); community (used by two or more users); and hybrid (used as mixture of two or more of other models). Moreover, cloud computing has a number of service models. These models have been identified by large number of studies. Some of these studies argued that cloud computing has three service models. The first model is Software as a Service (SaaS), it allows users to use any software functionality and application that is stored or provided on cloud [51], [4]. The second model is Platform as a Service (PaaS), it allows users to develop applications by using cloud run time environment that provides many services for the users to do so [51], [4]. The third is Infrastructure as a Service (IaaS), it refers to the technical ability to provide any type of computing resources to users [51]. Some studies introduced other service models. For example, [49] and Gai and Li [22] identified a service model called Data as a Service (DaaS), in which data become available to public. Also, Wang and his colleagues [49] identified another service model called Hardware as a Service (HaaS), it enables users to replace, update, and maintain the equipment of their devices. Another service model introduced by [30] called Container as a Service (CaaS), it emerged to solve problems of applications in PaaS environment. Alouffi and his colleagues [4] conducted a systematic literature review on cloud computing security, and they argued that service models in cloud computing are four models, where they combined three models SaaS, PaaS, and IaaS [32], [13] with CaaS [30]. Rajan [55] defined

Function as a Service (FaaS) model as "a software architecture where an application is decomposed into 'triggers' (events) and 'actions' (functions)" (p.531).

B. The Use of Cloud Computing

Cloud computing has been used by business organisations, educational institutions, and individuals [29]. Regarding business organisations, several studies have investigated the adoption of cloud computing in these organisations. For example, Gupta et al. [25] conducted a study to investigate the use and adoption of cloud computing in small and medium enterprises. In their study, they have used technology acceptance model (TAM) to address the objective of the study. They have found that ease of use and convenience are important, followed by security and privacy, then cost reduction. Likewise, [50] has used TAM to investigate the adoption of Software as a Service (SaaS). According to her study, marketing effort, social influence, attitude toward technology, security and trust, innovation, perceived usefulness, and perceived ease of use have a significant influence on this adoption. Borgman et al. [12] have used Technology-Organization-Environment (TOE) theory to explore cloud computing adoption. They found that the technology and organization context factors affect the decision whether organizations adopt cloud computing or not. Gutierrez et al. [26] also used TOE theory to determine the factors influencing managers' decision to adopt cloud computing in the UK. They have used a survey to determine these factors. Their study found that four out of eight factors have a significant influence on managers' decision to adopt cloud computing. These four factors are competitive pressure, complexity, technology readiness and trading partner pressure. Alsharafi et al. [5] identified the factors influencing the continuous use of cloud computing service at the organization level. They have conducted comprehensive literature review. The findings of their study revealed that the most important factors are relative advantage; complexity: perceived security and privacy; compatibility; top manager's support; cost reduction; competitive pressure; its readiness; firm size; vendor support; regulations and government policy; trialability; perceived reliability; perceived availability; uncertainty and perceived trust. In fact, it can be argued that most of the studies that focus on the adoption of cloud computing in organisations found that security and privacy, relative advantage, compatibility, complexity, and ease of use are important factors that influence the adoption of this technology [29].

Regarding educational institutions, the adoption of cloud computing has received a significant attention, particularly during Covid-19 pandemic, where it is used to help students to benefit from its features that can be utilized for their education. There are number of studies which focus on the investigation of the adoption of cloud computing in educational environment. For example, [14] conducted quantitative study to find the role of trust and risk perception on the adoption of cloud computing in German universities. They have applied TAM as theoretical lens for their study. The findings of their study showed that satisfaction and reputation influenced trust, familiarity influenced ease of use, ease of use and trust influenced perceived usefulness, while risk and perceived usefulness influenced intention to use this technology. Arpaci et al. [9] used the Theory of Planned Behaviour (TPB) to investigate the adoption of cloud computing in education. They have found that security and privacy significantly influenced students' attitude towards the use of cloud computing in education.

Cloud computing can also be used by individuals to benefit from its services. Number of studies have focused on user adoption of cloud computing. For example, [34] conducted quantitative study to investigate the factors influencing the adoption of cloud-based e-invoice service in Taiwan. He used the Unified Theory of Acceptance and Use of Technology (UTAUT) to address this investigation. The findings of his study indicated that effort expectation, trust in e-government, social influence, and perceived risk significantly influence the intention of the adoption of this service.

III. Research Model

This study investigates the factors that may influence the use of cloud computing. It will also

concentrate on the most relevant aspects of the situation based on past research, which is summarized in the research model as shown in Fig 1.

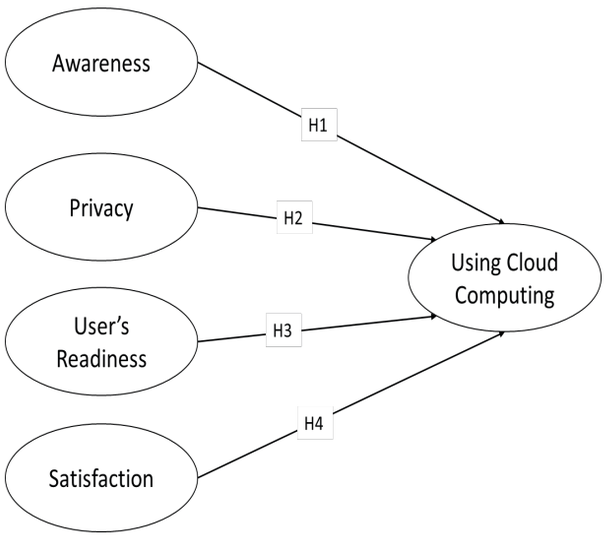

Fig. 1 Research Model.

A. Awareness

A significant aspect in the deliberate use of technologies is recognition, which entails understanding of the technology and its advantages. Lack of information and knowledge of the advantages of using new technologies can be a significant obstacle to accept and adopt these technologies. According to [44] and [45], the lack of knowledge and awareness of the cloud and its services have been recognized as crucial barriers for initial and long-term cloud computing adoption. The ability to learn about cloud computing has been found to be a major factor in SMEs' inclination to use it [47]. Similarly, a lack of understanding of the advantages of choices like SaaS2 has clearly hampered uptake [15].

Thus, awareness is an important determinant of a technology's apparent connection and applicability [33], [6]. In this research, conceptual awareness refers to the degree to which a person is conscious of the cloud computing-based technology services that are available to them and their perceived utility. If invention is not put into practice, it will fail. As a result, it is critical to provide them with access to, and an understanding of, the technology that will assist them. Users should not only be aware of recent technology, but also about the advantages that will result from its use. Users will be encouraged to try to use this technology once they are aware of its benefits. Positive outcomes will also encourage other people to participate. As a result, the following hypothesis is proposed:

H1: Awareness has a significant influence on the use of cloud computing.

B. Privacy

Users' perceptions of how their personal details are used are reflected in their privacy considerations. Cloud computing services provide a variety of services that need sensitive customer data, such as confidential documents and files, to be handled. They also keep track of the users' activities with each other. Users of cloud services are worried about how their personal data is collected, stored, and used by service providers. Users may be hesitant to utilize the system if they believe their data will be disclosed or that they will be traced because of a privacy issue. Users with strong privacy issues believe that disclosing their personal details may expose them to confidentiality issues.

In order to get these consumers to use the service, it may take a higher level of confidence in the system. Users' behaviour goals in various circumstances have been proven to be adversely impacted by privacy concerns [1], [9], [23]. Privacy issues have been proven to have secondary impacts on user activity through the mediating influence of trust, perceived danger, and perceived utility in addition to the direct effect [24]. As a result, the following hypothesis is proposed:

H2: Privacy has a significant influence on the use of cloud computing.

C. User Readiness

User readiness to use new technologies has been defined by number of studies. For example, Parasuraman and Colby [43] have defined readiness for technology as “people’s propensity to embrace and to use new technologies for accomplishing goals in home life at the workplace” (p. 48). Alshahrani and Alghamdi [6] have defined it as the extent to which the user is ready and able to use this new technology.

According to the literature review, the use of new technology can be significantly influenced by the readiness of the users [6], [43], [37], [39], [42]. Ling and Moi [37] have studied students' technology readiness for an e-learning system. Cheon, Lee, Crooks, and Song [16] found that the use of mobile learning is based on the students' readiness to use it. Therefore, in the current study, the following hypothesis can be proposed:

H3: User readiness has a significant influence on the use of cloud computing.

D. Satisfaction

Satisfaction might be defined, in this study, as the extent to which users are satisfied and happy about the use of cloud computing. This satisfaction is a sensation that develops over time because of interactions with the used technology and it is determinant of continued usefulness and confirmation [11]. Several studies found that perceived usefulness and perceived enjoyments were noteworthy predictors of satisfaction [11], [35], [41]. Moreover, several previous research point out that there is a strong relationship between satisfaction and continuance intention to use new technologies [11], [41], [52], [36]. Consequently, the following hypothesis is proposed:

H4: Satisfaction has a significant influence on the use of cloud computing.

IV. Methodology

This study used an online questionnaire to collect data, where it is considered as the most effective approach for collecting data from large numbers of people and from different places [19], [7]. The items in this questionnaire were adopted from previous studies as shown in Table I. These items were measured by 5-point Likert Scale, in which 1 = "Strongly disagree" and 5 = "Strongly agree". The questionnaire started with a brief explanation about the study and its objective followed by the consent form. The participant who has accepted to participate will be transferred to the main parts of the questionnaire. One of these parts has asked for demographic data including gender, age, and education level, while another part of the questionnaire has focused on the main section of this study.

TABLE I
Sources of Measurement Items

Variables	Sources
Awareness	Asikcoy (2018); Mutahar and Danel (2018); Zwilling et al (2020); Alshahrani and Alghamdi (2022)
Privacy	Ofori et al (2016); Riqulne and Roman (2014)
User's Readiness	Cheon et al (2012); Alshahrani and Alghamdi (2022)
Satisfaction	Ofori et al (2016)

The questionnaire was reviewed by an expert in the field before its distribution. Ethical approval for this study has been obtained from the Research Ethics Committee at the College of Computing and Information Technology at Shaqra University (App. Ref: Appl.040102022). The authors have piloted the questionnaire with a small sample (20 participants) of typical respondents to examine the level of reliability. They have found that the value of Cronbach's Alpha is 0.80, which indicates reliability.

The questionnaire was distributed during an online event on cloud computing organized by the College of Computing and Information Technology. The event was attended by 772 participants where 712 participants completed the questionnaire. In terms of gender, 65% of the participants were females, while 35% were males; see Table II. According to Table II, half of the participants (50%) ages ranged from 20 to 29 years, 34% ranged from 30 to 39 years, followed by 8% with age between 40 to 49 years, 6% (below 20 years), and 2% (above 50 years). With regards to the educational level, 60% of the participants have bachelor's degree, 20% have high school degree, 13% have diploma degree, followed by 5% who have master's degree, 1% who have PhD degree, while 1% have a degree less than high school.

With regards of data analysis, the authors used structural equation modelling to test the hypotheses of this study. They used two types of software SPSS (Version 27) and SmartPLS to facilitate this test, results are shown in the following section.

TABLE II
DEMOGRAPHIC INFORMATION

Demographic information	Percent
Gender	
Female	65%
Male	35%
	100%
Educational level	
PhD	1%
Master	5%
Bachelor	60%
Diploma	13%
High school	20%
Others	1%
	100%
Age	
Less than 20	6%
20 to 29	50%
30 to 39	34%
40 to 49	8%
More than 50	2%
	100%

V. RESULTS

This section presents the results of data analysis in this study. These results included descriptive statistics (which have been shown in the previous section), validation tests (construct validity, convergent validity, and discriminant validity), and structural equation modelling. The subsections below show the results of this analysis.

A. Construct Validity

Construct validity is the extent to which the items measure the constructs that these items were designed to measure [27]. This type of validation has started by reviewing previous studies and developing the questionnaire items. Chow and his colleagues [17] argued that the load of questionnaire items must be significant to measure the construct that these items were designed to measure. Therefore, loading and cross-loading of items were conducted in order to make sure that these items were assigned to the appropriate constructs, (see Table III).

B. Convergent Validity

Convergent validity has three procedures for assessment, internal consistency (Cronbach's Alpha); composite reliability; and average variance extracted (AVE) [20]. According to data analysis shown in Table IV, the values of Cronbach's Alpha ranged from 0.738 to 0.852, this means that items are internally consistent. In composite reliability, the values ranged from 0.852 to 0.895, which are higher than 0.70 as recommended by [40]. With regards to AVE, the values ranged from 0.630 to 0.730, which are higher than 0.50. Also, the values of confirmatory factor analysis (CFA) ranged from 0.718 to 0.895, which are higher than 0.70.

TABLE III
LOADING AND CROSS-LOADINGS OF ITEMS

Variables	Code	AW	PR	RU	ST	UCC
Awareness (AW)	AW_1	0.813	0.412	0.417	0.449	0.497
	AW_2	0.823	0.375	0.382	0.406	0.470
	AW_3	0.780	0.423	0.324	0.410	0.406
	AW_4	0.829	0.407	0.385	0.452	0.443
	AW_5	0.718	0.310	0.350	0.362	0.439
Privacy (PR)	PR_1	0.374	0.843	0.512	0.605	0.469
	PR_2	0.365	0.573	0.241	0.365	0.267
	PR_3	0.387	0.872	0.532	0.654	0.493
	PR_4	0.415	0.810	0.537	0.649	0.519
User's Readiness (Readiness to Use (RU))	RTU_1	0.458	0.387	0.816	0.518	0.613
	RTU_2	0.393	0.608	0.836	0.585	0.616
	RTU_3	0.292	0.473	0.779	0.561	0.598
Satisfaction (ST)	ST_1	0.445	0.549	0.607	0.850	0.553
	ST_2	0.444	0.716	0.548	0.860	0.525
	ST_3	0.437	0.617	0.571	0.816	0.561
Using Cloud Computing (UCC)	UCC_1	0.597	0.499	0.579	0.528	0.841
	UCC_2	0.488	0.503	0.670	0.567	0.895
	UCC_3	0.354	0.449	0.651	0.548	0.789

TABLE IV
CONSTRUCTS, ITEMS, AND CONFIRMATORY FACTOR ANALYSIS RESULTS

Constructs and items	Factors Loading	Cronbach's Alpha	Composite Reliability	AVE
Awareness				
AW_1: I am very aware of all the benefits of using cloud computing	0.813	0.852	0.895	0.630
AW_2: I have knowledge on how to use cloud computing effectively	0.823			
AW_3: I am aware of the security and security issues associated with cloud computing	0.780			
AW_4: I am aware of all the advantages of cloud computing	0.829			
AW_5: To what extent are you familiar with the use of cloud computing?	0.718			
Privacy				
PR_1: I do trust the ability of cloud computing to protect my privacy	0.843	0.786	0.861	0.614
PR_2: Privacy issues have no effect on the use of cloud computing	0.573			
PR_3: I feel safe when I save my personal information in the cloud	0.872			
PR_4: To what extent do you trust the use of cloud computing?	0.810			
User's Readiness (Readiness to Use)				
RTU_1: I am very interested in using cloud computing	0.816	0.738	0.852	0.657
RTU_2: I always prefer to use cloud computing to save my files	0.836			
RTU_3: To what extent are you ready to use cloud computing and benefit from its services?	0.779			
Satisfaction				
ST_1: I am very satisfied with all the services provided by cloud computing	0.850	0.795	0.880	0.709
ST_2: I am completely satisfied with the level of security and protection in cloud computing	0.860			
ST_3: To what extent are you satisfied with using cloud computing?	0.816			
Using Cloud Computing				
UCC_1: I use cloud computing effectively	0.841	0.795	0.880	0.711
UCC_2: I will continue to use cloud computing frequently	0.895			
UCC_3: To what extent will you continue to use cloud computing?	0.789			

C. Discriminant Validity

According to Teo and his colleagues [48], "discriminant validity was assessed by comparing the square root of the average variance extracted for a given construct with the correlations between that construct and all other constructs" (p. 1004). Thus, this type of validation focuses on the degree of differences between constructs. This point can be clearly seen in Table V, where the AVE results were higher than 0.50 which indicate that discriminant validity was supported for all the constructs [21].

TABLE V
DISCRIMINANT VALIDITY

Constructs	AW	PR	RU	ST	UCC
Awareness (AW)	0.794				
Privacy (PR)	0.486	0.784			
User's Readiness (Readiness to Use (RU))	0.471	0.604	0.811		
Satisfaction (ST)	0.525	0.744	0.684	0.842	
Using Cloud Computing (UCC)	0.571	0.574	0.751	0.650	0.843

D. Structural Model

The research hypotheses were tested and examined by conducting structural equation modelling. Thus, to conduct this test, PLS algorithm and Bootstrapping from SmartPLS software were used. Fig1 (2 & 3) and Table VI represent the results of this test.

According to the results of the test, there is a significant relation between awareness and the use of cloud computing (β = 0.231, t = 6.423, p = 0.000) which supports the first hypothesis. But the relation between privacy and the use of cloud computing is not significant (β = 0.044, t = 1.083, p = 0.279), which means that the second hypothesis was not supported. With regards to the third hypothesis, concerning the relation between readiness to use cloud computing and using it, the relation was significant (β = 0.520, t = 13.436, p = 0.000). Likewise, the relation between satisfaction of using cloud computing and using it was significant (β = 0.140, t = 2.747, p = 0.006), which supports the fourth hypothesis.

V. Discussion

A. Discussion of the Results

This study investigated the factors that influence the use of cloud computing. These factors included awareness, privacy, readiness to use, and users' satisfaction. The study found that awareness, readiness to use, and satisfaction are important factors related to the use of cloud computing, while privacy seems to have no significant influence on this use.

According to the findings of this study, users' awareness about the features and benefits of using cloud computing can motivate them to use it effectively. Also, their awareness about this technology may lead them to understand how to avoid any harm that might result from using it. This argument is in alignment with number of studies such as [54], [53], and [6], where they have argued that awareness is considered a significant factor influencing the use of new technology. Thus, it is important for

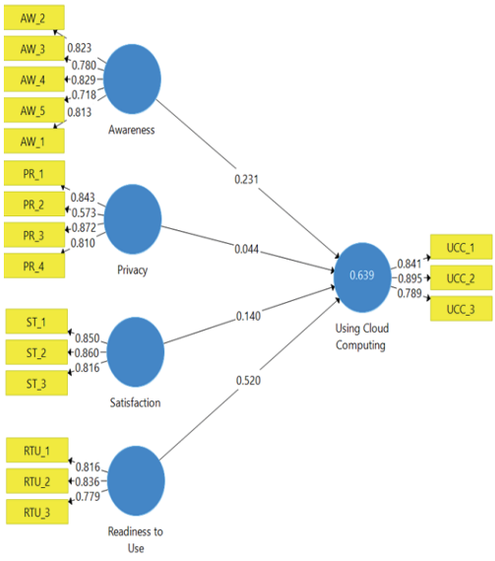

Fig. 2 Path Coefficients Results.

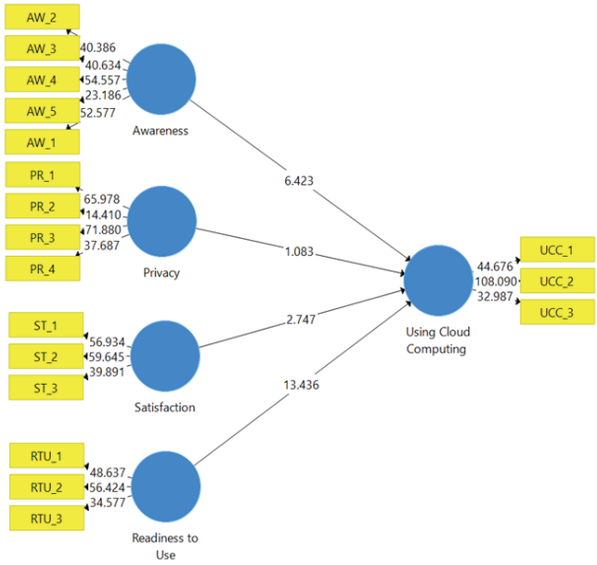

Fig. 3 Path Coefficients T Values.

TABLE VI
Hypotheses Testing

H	Relationships	Path	S. E	T- Values	P Values	Results
H1	Awareness -------> Using Cloud Computing	0.231	0.0013	6.423	0.000	Supported
H2	Privacy ----------> Using Cloud Computing	0.044	0.0015	1.083	0.279	Rejected
H3	User's Readiness (Readiness to Use) ----> Using Cloud Computing	0.520	0.0015	13.436	0.000	Supported
H4	Satisfaction --------> Using Cloud Computing	0.140	0.0019	2.747	0.006	Supported
	Note: S.E: standard error					

individuals to raise their awareness and improve their understanding of this technology, its use, and benefits so that they can use it effectively to utilize these benefits. It should be stated that individuals can raise their awareness about this technology by attending courses and workshops, searching, and exploring how it can be beneficial for them, and then use it successfully.

Another important factor that has significant influence on the use of cloud computing is the readiness of individuals to use this technology. User readiness to use a new technology is considered one of the motivational factors toward using it. This is consistent with [16], where they found that user readiness is a significant factor influencing the use of mobile technologies for learning purposes. In addition, this agrees with the findings reached by [6], where they found that user readiness has a significant influence on the use of password managers. The readiness to use cloud computing can be achieved by knowing and understanding the benefits of the use of this technology and its use method. This knowledge and understanding can be achieved through attending training, workshops, and practicing its use and thus qualify users to use it effectively.

The third important factor was satisfaction towards the use of cloud computing. The findings of this study showed that individuals' satisfaction with the use of this technology has a significant influence on their use. This argument confirms the findings reached by [41], where they argued that satisfaction has a significant influence on the use of mobile social media. Users' satisfaction cannot be achieved unless they use this technology effectively and successfully and figure out how to use it beneficially. Therefore, individuals should use cloud computing to see if it meets their satisfaction or not.

With regards to the last factor, the findings of this study showed that individuals may not be concerned about privacy in the use of cloud computing. Thus, this factor has no significant influence on the use of this technology. These findings are consistent with the findings reached by [41], where they found that privacy has no significant effect on the continuous use of mobile social media. However, it must be mentioned that a study conducted by [46] disagrees with this study, where they found that the use of online retailer is significantly influenced by privacy issues. Although the findings of the current study found that there was no significant influence of the privacy factor on the use of cloud computing, it can be argued that privacy in the use of any online technology is an important issue. Probably, such findings were reached due to the fact that users do not use this technology to store any sensitive information, or due to their unawareness of the importance of privacy issues and what the use of this technology may result in.

B. Implications

The present study leads to several implications. From a theoretical perspective, the study has developed a model by integrating four concepts which are awareness, readiness to use, privacy, and satisfaction, to investigate how these concepts can influence the use of cloud computing. Previous works have concentrated on the adoption of this technology while limited studies focused on the factors that influence the intention to use it. Therefore, the current study developed a model to find the factors that influence the actual use of this technology.

From a practical perspective, the results imply that users need to attend courses and workshops to know and understand how to use this technology effectively and the anticipated results from this use. In fact, this shall qualify them to use it and accordingly it will meet their satisfaction. Finally, users should attach paramount importance to their privacy when using it and should learn how to protect their privacy by attending these courses and workshops.

VII. Conclusion

This study investigated the factors influencing the use of cloud computing. This investigation was addressed by using online questionnaire for collecting data. Obtained data was analysed and summarized using descriptive statistics, and structural equation modelling was used to test the proposed hypotheses in this study. The results of

this study indicated that awareness, user readiness, and satisfaction are important factors related to the use of cloud computing, while privacy seems to have no significant influence on the use of this technology.

In general, it can be argued that users should attend courses and workshops to know and understand how to use this technology effectively and what this use may result in. This should qualify them to use it and accordingly it will meet their satisfaction. Finally, users should attach paramount importance to their privacy when using it and should learn how to protect their privacy by attending these courses and workshops.

In summary, it may be concluded that this study makes a useful contribution to the understanding of the factors influencing the use of cloud computing. However, this study is not free from limitations. The use of the questionnaire-based approach does not provide a deeper understanding of the context of the use of cloud computing; therefore, further qualitative research is required in this area.

For future work, this study recommends some research directions. Researchers might qualitatively investigate how individuals' awareness, readiness, and satisfaction about cloud computing can be improved. They might also investigate privacy issues in the use of cloud computing.

Conflicts of Interest

The author declares no conflicts of interest.

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