Research Article

Quadruple Theories Based Determinants and their Causal Relationships Affecting the Adoption of Community Cloud in Saudi HEI

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The higher education institutions (HEIs) are adopting the new modern cloud computing technique rapidly due to its cost effectiveness, efficient and productive feature. Though cloud computing technology is beneficial to educational sector, it is important to assess their economic benefits, technical, organizational, environmental appropriateness and potential obstacles before adopting the new technology. There are four evaluating theory for adopting the cloud computing technology which are the Technology Organization Environment (TOE), the Technology Acceptance Model (TAM), the Diffusion of Innovation (DOI), and the Institutional (INT). This study has developed a new adoption framework for accepting cloud computing technology for HEIs by integrating the above mentioned theories. This framework is unique from others because no research has been conducted yet on the adoption of community cloud at the organizational level considering the four theory simultaneously. This research has developed 25 hypotheses on the adoption of community cloud computing in HEIs and analyzed those hypotheses using SPSS statistical analysis software. The reliability of the data was tested by utilizing composite reliability and Cronbach’s alpha method. This study have introduced an innovative approach and framework to understand the adoption of the community cloud which will help the decision-makers to build strategies in their organizations for effective adoption of community cloud services.

1. Introduction

Several enterprises are now adopting the new cloud computing technology for its cost effectiveness, efficient and productive feature. The cost savings are achieved as the facilities are also now part of a “rent model” rather than being “centrally hosted.” [1]. Cloud computing has multiple distinct features such as multi-tenancy, pooling of collective resources, greater diversity, competitive resource provision, and facility-based charging, which vary from conventional service computing. Everywhere, it has network connectivity and is seeded and self-organizing.

Saudi universities depend mainly on traditional information and communications technology (ICT) for supporting their educational services [2]. Each university has their own computing facilities that comprise of hardware, software, network, and storage to meet their needs and providing better services. Recently, they have begun adopting cloud computing technology which needs a huge investment. It is not a viable option for individual institutions to adopt cloud services by employing many service providers, deploying various cloud models and manage own computing facilities comprising of hardware and software. This will cause wasting time and more expenses for the organizations. In addition, HEIs are facing many challenges in adopting cloud computing such as data security and privacy [3, 4], resource scheduling [4]. Instead of individual cloud computing, the Community cloud computing will be the best possible solution of the above-mentioned adopting problem. In Community cloud computing, organizations can share the
benefits as well as the expenses for it. Concerning the community model to gain an advantage through risk perception, shared resources [5], and cost savings [6].

All government universities in Saudi follow to the same regulations and are funded by the government. They depend mainly on the Saudi ministry of education for providing the requested budget for its ICT operations. So, Saudi government can impose all Saudi universities to adopt community cloud computing technology which will be controlled by Ministry of Saudi Higher Education. It can be used by the HEIs higher management and the end-user (teachers and students). As a result, it is important to understand about the factors that influence Saudi HEIs’ adoption of the community cloud.

A community cloud is developed when multiple organizations require similar infrastructure and wish to exchange the same. By sharing the infrastructure, organizations thus realize the benefits of cloud computing. The costs of the community cloud users will be less than an individual or one tenant because it spreads over the multiple users in community cloud. The community cloud is, therefore, cost effective although it provides a high level of privacy, policy compliance and security [7].

This study intends to contribute to the body of information surrounding technology adoption. It will provide empirical evidence in the field of community cloud and provide a comprehensive model that integrates four major adoption theories (quadruple theories): the technology-organizational-environmental (TOE) framework, the technology acceptance model (TAM), the diffusion of innovations (DOI), and the institutional (INT) theory to fill the gap in previous literature. By following the theories of acceptance at the organizational level, this research model is based on the TOE, TAM, DOI and INT theories that are in line with the objectives of this report. The goals of this study are to assess major factors contributing to adoption of community cloud in Saudi HEIs and support the decision-makers (management and technical managers) to leverage community cloud in HEIs.

The purpose of this research will be achieved by analyzing the viewpoints of IT and telecommunication experts, clients of cloud computing-supporting devices, the scope of community cloud adoption in Saudi Arabia, the driving factors, and current obstacles to community cloud adoption. The first section of this paper provides an introduction, while the second section contains theoretical background. The research framework and hypothesis will be present in section 3. Result will be explained in Section 4 to meet the research’s goals. The fifth section is Discussion. Finally, the conclusion.

2. Theoretical Background

2.1. Cloud Computing in Saudi Higher Education. With the diffusion of information technology and telecommunication, higher education requires to keep up with development and evolution. The Ministry of Education coordinates Saudi Arabia’s education system, which now includes 25 public and 8 private universities [8]. Since many institutions throughout the world are moving toward gaining e-learning services in their colleges, cloud computing has been implemented in Saudi Arabia for various universities.

Al-Ruitha [9] conducted an empirical study and a survey to examine the present situation of cloud computing adoption in the Kingdom of Saudi Arabia. It has demonstrated that Saudi Arabia is still evaluating technology, with few adoptions, and certainly not at the government level. Future study will focus on analyzing the remaining data from the questionnaire, with a special focus on the adoption obstacles.

Alamri and Qureshi [10] have addressed the need to use cloud computing in higher education in Saudi Arabia to improve the level and find solution for the obstacles facing the learning process. It has also addressed the problems, which they face during the education process. It has provided a roadmap to teachers and students for applying cloud computing in higher education. Firstly, the study introduces the cloud computing courses to prepare students to adopt in cloud computing. Secondly, supports the use of cloud infrastructure for sharing virtual classes, online lectures. Finally, it is measuring cloud computing technology efficiency for all disciplines.

Noor [11] proposed a two-dimensional research framework for motivators and inhibitors to explore the use and approval of cloud computing technology in Saudi Arabia which relied on empirical analysis of numerous data collected from five universities in Saudi Arabia: King Abdul-Aziz University, King Saud University, Imam Muhammad ibn Saud Islamic University, Taibah University, and Umm al-Qura University.

According to his findings, network access and self-service are the two most important factors for Saudi cloud users to use cloud computing, with 51 percent and 23 percent, respectively. Availability, dependability, security, compliance, and privacy are the top five obstacles. This can assist decision-makers when it comes to cloud computing adoption.

In addition, Smart suitcase is a cloud service provided by Princess Noura Bint Abdul Rahman University in collaboration with Microsoft and Saudi Telecommunication Company (STC). Smart suitcases enable effective and efficient communication, information, and data exchange between university faculties and college students [12].

Microsoft has agreed to give a cloud storage service to King Saud University staff. Many capabilities are included in the cloud storage service, including secure and easy file sharing, utilizing a web browser to edit files in Microsoft Office, synchronizing data on your PC’s hard disk, and easily accessing online files stored on cellphones or PCs [13].

2.2. Community Cloud Computing. The community cloud developed from mixing its use scenarios with network computing models, digital ecosystem principles, autonomous management from autonomous computing, and green computing sustainability. It fast emerging as a shifting model in many fields, such as analysis and finance. Many virtual communities developed with community cloud computing technology exchange their resources such as scientific knowledge and software applications for many fields [14].
Many factors influence community cloud applications, including ease of use, quality of service, security, cost, and adequate resource [15]. Nonetheless, as compared to other sectors, such as government and business, the use of community cloud in higher education institutions is still in its early phases.

The article by Aldahwan and Ramzan [16], studied contributes to the field of community cloud computing research by offering a comprehensive review of related trends in concepts, methodology, research framework, architecture, model, and future research directions.

Based on earlier studies, there is a problem to determine the factors impacting the adoption of community clouds in higher education institutions from a decision-makers’ perspective. As a result, more research is needed to determine how important aspects impact the adoption of community cloud in HEIs at the organizational level.

2.3. Technology Adoption Theories. Adoption processes are crucial to the decision-maker (adopter) or the undertaking unit for implementing a new service or concept [17]. According to [18], the acceptance decision of a specific object, in a particular context, by an individual is affected by multiple variables. The HEI is the individual in the present analysis, while cloud computing adoption is the object. After reviewing related studies, it was discovered that several studies have focused on the impact of cloud computing adoption at an individual level ([19–23]); however, To the authors’ best knowledge, there was a lack of sufficient research on community cloud computing at the organizational level [24–26]. The proposed framework combines the four theories used for as discussed by [22–24, 27–33]. Table 1 shows the cloud computing adoption in HEIs.

| Theory | Methodology | Methodology | Methodology | Methodology |
|--------|-------------|-------------|-------------|-------------|
| —      | Survey      | USA         | [19]        |
| TAM    | Survey      | Romania     | [20]        |
| TAM3   | Quantitative method, survey | Thailand | [21]        |
| DOI, TAM | An empirical study, quantitative method, survey | Saudi Arabia | [22]        |
| TOE    | Conceptual model, pilot study | USA | [23]        |
| TOE, TAM | Quantitative research, survey | Quantitative research, survey | [24]        |
| TOE    | Conceptual model, survey | India | [40]        |
| —      | Interviews. | Oman.       | [42]        |
| DOI, FVM | Conceptual model | Oman | [43]        |
| —      | Questionnaire | Saudi Arabia | [44]        |
| —      | Conceptual model | Bangladesh. | [45]        |
| DOI    | Conceptual model, survey | Saudi Arabia | [46]        |
| TOE, DOI | Conceptual model, survey | Indonesia | [47]        |
| TOE, DOI | Survey | Malaysia. | [48]        |
| DOI    | Conceptual model | Ethiopia, | [50]        |
| TOE, FVM, DOI, INT | Conceptual model | Pakistan | [51]        |
| DOI    | Empirical study, focus group | Taiwan | [52]        |
| TOE, DOI, INT | Conceptual model | Malaysia | [53]        |
| This paper | Quantitative method, survey | Saudi Arabia | |
of use; perceived advantage; attitude toward using the system; intent to do activities; and actual usage [37].

2.3.4. Institutional Theory (INT). It discusses how corporations act as institutions in influencing the behaviors and perspectives of the people who work for them [38]. The theory provides insights on the significance of organizational structure and work. It is observed that company decisions are influenced not just by rational production goals, but also by social and cultural considerations [39].

Several current studies have ignored empirical results on the use of cloud computing in HEIs [24, 40]. More research on community cloud adoption at HEIs, as well as a complete description of the factors that influence this process, is needed due to a lack of evidence at the organizational level. Table 1 summarizes the previous cloud adoption literature in higher education institutions, which includes the TOE, DOI, TAM, and INT models. This study is founded on organizational level theories (i.e., TOE, INT, and DOI), which are in line with the aim of this study.

Mapping matrix of past adoption theories and literature-relevant factors, as shown in Figure 1.

### Table 1: Summary of Previous Cloud Adoption Literature

| Ref | Theory | Dependent variables | Technology | Organization | Environment | Human | Advantages | Security |
|-----|--------|---------------------|------------|--------------|-------------|-------|------------|----------|
| [20] | TAM | Cloud adoption | X | X | X | X | X | X |
| [21] | TAM | Cloud adoption | X | X | X | X | X | X |
| [22] | TAM | Cloud adoption | X | X | X | X | X | X |
| [23] | TAM | Cloud adoption | X | X | X | X | X | X |
| [24] | DOI, TAM | Cloud adoption | X | X | X | X | X | X |
| [26] | TOE | Cloud adoption | X | X | X | X | X | X |
| [40] | DOI, TAM | Cloud adoption | X | X | X | X | X | X |
| [42] | DOI, FVM | Cloud adoption | X | X | X | X | X | X |
| [43] | - | Cloud adoption | X | X | X | X | X | X |
| [44] | TOE | Cloud adoption | X | X | X | X | X | X |
| [45] | TOE, DOI | Cloud adoption | X | X | X | X | X | X |
| [46] | TOE, TAM | Cloud adoption | X | X | X | X | X | X |
| [47] | DOI | Cloud adoption | X | X | X | X | X | X |
| [48] | TOE, TAM | Cloud adoption | X | X | X | X | X | X |
| [49] | TOE, DOI | Cloud adoption | X | X | X | X | X | X |
| [50] | TOE, FVM, DOI & INT | Cloud adoption | X | X | X | X | X | X |
| [51] | TOE, DOI | Cloud adoption | X | X | X | X | X | X |
| [52] | TOE, DOI | Cloud adoption | X | X | X | X | X | X |
| [53] | TOE, TAM | Cloud adoption | X | X | X | X | X | X |

Figure 1: Mapping matrices build from quadruple theories (TOE, TAM, DOI and INT) theories.

3. Research Framework & Hypotheses

The TOE framework is a realistic model that can be used as a foundation for the proposed framework with additional contexts to this study. The TOE framework aims to clarify the innovation process at the organization level, considering the three contexts affecting the adoption of innovation in a company - technology, organization, and environment. Moreover, DOI (innovation) theory also taught in mind to
understand the diffusion of innovation. The INT theory describes insight into allowing institutional constraints that may influence technology adoption and innovation, and it implies that organizations are subject to three types of pressures: pressurized/coercive, normative, and mimetic. One of the most popular models for technology adoption is TAM, with two essential factors impacting an individual’s intent to use the new technology. The research framework contains the following context, as shown in Figure 2.

Our research will be guided by the hypotheses listed below, which are based on our suggested conceptual framework model.

H1: Competitive pressure positively influences community cloud adoption in HEIs.

H2: Compatibility positively influences community cloud adoption in HEIs.

H3: University Culture positively influences in the community cloud adoption in HEIs.

H4: Perceived benefits of Quality of Service positively influences in the community cloud adoption in HEIs.

H5: Technology readiness positively affects community cloud adoption in HEIs.

H6: Top management support positively affects community cloud adoption in HEIs.

H7: Cost of IT operations negatively influences community cloud adoption in HEIs.

H8: Training for staff positively influences community cloud adoption in HEIs.
H9: University size positively influences community cloud adoption in HEIs.
H10: Government support positively influences community cloud adoption in HEIs.
H11: External support positively influences community cloud adoption in HEIs.
H12: Coercive pressures positively influence community cloud adoption in HEIs.
H13: Normative pressures positively influence community cloud adoption in HEIs.
H14: Mimetic pressures positively influence community cloud adoption in HEIs.
H15: Perceived usefulness positively influences people’s intention to use a community cloud.
H16: Perceived ease of use positively influences people’s intention to use a community cloud.
H17: Perceived benefits of performance positively influence community cloud adoption in HEIs.
H18: Cost saving positively influences community cloud adoption in HEIs.
H19: Highly automated positively influences community cloud adoption in HEIs.
H20: Adequate resource positively influences community cloud adoption in HEIs.
H21: Privacy risks negatively influence community cloud adoption in HEIs.
H22: Availability positively influences in community cloud adoption in HEIs.
H23: Lower degree of integrity negatively influences community cloud adoption in HEIs.
H24: Lower degree of confidentiality negatively influences community cloud adoption in HEIs.
H25: Loss of governance negatively influences community cloud adoption in HEIs.

4. Result

4.1. Reliability and Validity Test. The composite reliability and Cronbach’s Alpha were utilized for assessing the internal consistency of the model by following the work of Hair Jr, Hult [54]. The constructs’ validity was evaluated using “average variance extracted (AVE)” and “cross-factor loadings.” The findings of the stated constructs’ reliability and validity were represented in Figure 3.

When the value of Cronbach’s Alpha is greater than 0.7, it indicates that the survey data and the constructs’ reliability ensure satisfactory internal consistency [54]. The data revealed that composite reliability and Cronbach’s alpha are both greater than the suggested value of 0.7 for all identified components, indicating that they are more reliable than the recommended level and all items are statistically significant at the 0.01 level. In addition, an acceptable AVE value for each construct is 0.50 [47]. As shown in Table 2, the scale item validity was greater than 0.5 which is above the threshold value. Following convergent validity validation, discriminant validity is the next step. The constructs’ “discriminant validity” [55] was determined by examining their relationships. Figure 3 shows that the square root of AVE for specified constructs was higher than the correlation co-efficient for other latent constructs. As a result, in the evaluation of the measurement model [55], “convergent and discriminant validity” was approved. As a result of the foregoing evaluations, the validity and reliability of the measurement model’s constructs have been acknowledged, and they satisfy the recommended values as given in Table 2.

4.2. Hypothesis Analysis. The mentioned hypotheses have been investigated to see whether they may be linked to one another. The null hypothesis states that there is no statistically significant relationship between two research variables. The alternate hypothesis is that there is a statistically significant relationship between two research variables.
significant relationship between two of the research variables. Hypotheses describing the link between two study variables has been tested. The test of the hypotheses is shown in Table 3.

(i) The null hypothesis states that there is no statistically significant relationship between two research variables.

(ii) The alternative hypothesis states that two of the research variables have a statistically significant relationship.

According to SPSS program results, the null hypothesis will be accepted if the P-value is greater than 0.05. In Table 3, the P-value is less than 0.05 which indicates that the null hypothesis does not satisfy the acceptance criteria and it is rejected. The alternate hypothesis will be rejected if the P-value is greater than 0.05. In Table 3, the P-value is less than 0.05 which indicates that the alternate hypothesis is accepted.

After analyzing the data, it is evident that there is a significant statistical relationship between two research variables.

The correlation coefficient between dependent variable and all independent variables shows that the correlation coefficient is statistically significant because the p-value (Sig.) is less than 0.05 as shown in Table 3. There prevails a substantial relationship between dependent variable and independent variables.

5. Discussion

5.1 Managerial and Theoretical Implications. This research provides a significant contribution to the body of knowledge of community cloud research and the adoption criterion of it in the higher educational institutions.

(i) To the authors’ best knowledge, the existing literature lacks in examining the influencing factors of the adoption of community cloud at the organizational
level in HEIs by incorporating four dominant theories. This study has integrated the TOE, TAM, DOI, and INT theory which is very important for the implementation of community cloud

(ii) This significant study is intended to serve as a starting point for subsequent research on the impact of community cloud adoption in higher education institutions, which will be carried out in the future

(iii) The study can be used by HEI decision-makers to determine whether to embrace community cloud services in their institutions, by tying their knowledge to the study’s goals and deciding before implementing educational community cloud-based projects

(iv) The product model can be applied to comparable technology adoption scenarios as well as other industries

(v) The proposed study’s findings may provide significant information to industry practitioners and community cloud service providers that can be used to manage and sell community cloud initiatives

5.2. Validation and Methodological Implications Approaches

We recommend that the proposed framework should be tested by a pilot study at multiple research universities (RUs). The theoretical approach obtained from this critical study should be implemented and tested at a few higher education institutions to test the suggested framework. As a result, higher education institutions can adopt the created findings or outcomes of this research. Furthermore, empirical experiments on the model are required to validate the connection between adoption theories.

5.3. Future Research and Limitations

The future research can be conducted to evaluate the developed framework and assess its descriptive and analytical capabilities by validating and adopting it to several HEIs. To enhance the performance and provide a good explanation for the independent variables, future studies should critically examine other relations which are not covered by this model. Future research can investigate the impact of community cloud and how it affects HEIs.

The research can be extended in the future to see how the target population’s adoption changes over time and how the determinant factors change. This research might be carried out in various countries to compare the important factors among them.

6. Conclusion

The pre-adoption stage of a conceptual framework based on TOE, TAM, DOI, and INT theories by Saudi HEIs is discussed in this research. This framework aids in finding the characteristics that drive community cloud adoption in HEIs that have not yet adopted community cloud services. It is widely believed that HEIs must adopt community cloud services not just to save money, but also to increase efficiency and effectiveness. This research provides a significant knowledge about the influence of community cloud adoption in higher educational institutions. It will also deliver useful information to institutions and academicians who are interested to utilize the findings of this research in real-life practice. This comprehensive study will also serve as a hypothetical framework for future research on the impact of community cloud adoption in the educational sector at HEIs.

Data Availability

The primary and secondary data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author(s) declare(s) that they have no conflicts of interest.

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