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Factors of Cloud Computing Adoption by Small and Medium Size Enterprises (SMEs)

Fahad Badr Al-Ameen Nasser[1], Mohammad Saaed Jawad[2]

Post Graduate Centre, Limkokwing University of Creative Technology[1,2]

Abstract: The main objective of this study is to determine the factors influencing cloud computing adoption by Small and Medium-sized Enterprises (SMEs). Based on two dominant theories in the field of diffusion of innovation, a conceptual model is proposed. In order to test the model empirically, an online survey was designed and launched. Decision makers of 101 SMEs agreed to participate in this survey. In order to evaluate the internal, convergent, and discriminant validity of the instrument, factor analysis and reliability tests were performed. Logistic regression is employed to test our hypotheses. The results of regression reveal that decision maker's knowledge about cloud computing is the main influential factor in decision making about its adoption.

Keywords: Cloud Computing, SMEs, Adoption

I. INTRODUCTION

Small and Medium-sized Enterprises (SMEs) significantly contribute to each nation's Gross Domestic Product (GDP) and its labour market. Therefore, proposing strategies and developing new systems are not only beneficial for SMEs, but also for the economy as a whole. According to Tan et al. [1], using appropriate Information and Communication Technologies (ICT) helps SMEs become more efficient and productive; however, SMEs do not have access to enough resources (e.g. financial resources). Cloud computing, which is an alternative to deploying applications and systems on-premises, helps SMEs tackle many issues such as the high cost and risk that are involved in IT projects. According to [5] cloud computing has four advantages: 1) Data storage are secure; the teams of the backend Cloud are so professional that manage data also protect them from different attacks of viruses and cracks. 2) The different application can be supported by cloud computing. 3). The share of data and applications are easy. 4) Thousands of servers exist in Cloud, which has strong storage and computing ability. By considering the advantages and key challenges of cloud computing adoption, it is clear that cloud computing adoption is still as a question for some organization. The organization avoiding adopting cloud computing but due to advantages, they are in favour to move cloud computing adoption. Amazon, Google, Microsoft, IBM contributing in terms of cloud computing. According to International Data Corporation (IDC) 53% of Asian organizations already applying some of the cloud computing services, and remaining 47% of the organizations have decided to adopt Cloud services [9].

II. LITERATURE REVIEW

SMEs are vital players of each market. One strategy which has been proven to enhance SMEs' ability to compete against larger companies is the use of appropriate Information and Communication Technologies (ICT) [1]. Although adopting new technologies helps SMEs gain a competitive advantage, it usually involves high costs. Cloud computing, as a new computing paradigm, offers many advantages to companies, especially smaller ones. Flexibility, scalability, and reduced cost are just some of many advantages that cloud computing offers to SMEs. To date, there is no universal definition for cloud computing. Perhaps the most accurate definition of cloud computing is the one offered by the National Institute of Standards and Technology (NIST). They de- defined cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models." [2] Following the success of cloud computing, the new cloud-based delivery model of cloud computing has emerged. These cloud computing solutions are market to offer similar functionality as their on-premise counterparts, but the infrastructure (software, computational power, hardware etc.) is provide on-demand by the vendors in a pay-per-use model. As with cloud computing, this new cloud computing delivery model gains success increasingly growing its market share. Most companies at least consider a cloud-cloud computing solution and this trend were illustrates by [11] where approximately 70 per cent of the CFOs stated that they would consider using a Cloud-based version of their cloud computing. Cloud computing Report quantifies the momentum of cloud-cloud computing as it revealed that the market share of cloud-based cloud computing systems has

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grown from 6 percent to 18 percent just in one year, from 2011 to 2012 (Panorama Consulting) [10]. As the market moves to a cloud environment, traditional cloud computing providers are also force to develop their own cloud-based solutions, otherwise they risk losing market shares to the emerging Cloud computing software vendors such as Netsuite and Plex. However, a question that still appears to lack a clear answer is whether cloud computing is a viable solution for companies of all sizes.

III. THEORY REVIEW

The conceptual framework that is proposed in this research originated from two well-known theoretical frameworks in this field of study, which are Diffusion of Innovation (DOI) theory developed by Rogers [30-31] and the Technology, Organization, Environment (TOE) framework proposed by Tornatzky and Fleischer [32]. Diffusion of Innovation Theory (DOI) is a theory that tries to discover the factors that influence the spread of a new idea or technology in a society [31]. Rogers [30] defined diffusion of innovation as "the process by which an innovation is communicated through certain channels over time among the members of a social system". Any idea, process, product, or technology constitutes an innovation, as long as it is perceived as new by individuals. Rogers [30] argues that each innovation has different attributes that influence its diffusion in society. Relative advantage, compatibility, complexity, trialability, and observability are the five key attributes of innovation. DOI does not take into account the environmental and organizational aspects of the context; therefore, in this study, I used the Technology Organization Environment (TOE) framework, which takes into account other aspects of enterprises' context.

IV. RESEARCH MODEL AND HYPOTHESES

In order to study the adoption of cloud computing by SMEs, a conceptual model is proposed. According to this model, twelve variables influence the decision to adopt cloud computing, which is depicted in Figure 1. All factors except complexity have a positive influence on the adoption of cloud computing. A very important study by Tornatzky and Klein [33] reveals that relative advantage, complexity, and compatibility are the characteristics of innovation that have the most influence on the adoption of an innovation. Based on the model, 12 different hypotheses have been proposed. Chau and Hui [34] argue that the size and structure of SMEs force them to rely on external parties. In this context, external support is defined as "The perceived importance of support offered by cloud providers". The first hypothesis is:

H1: Higher levels of perceived external support from cloud providers positively affects the likelihood of cloud computing adoption by SMEs

Competitive pressure is the level of competition among firms within the specific industry in which the company operates [35]. The following hypothesis is developed:

H2: Businesses that operate in more competitive environments are more likely to adopt cloud computing.

Having enough knowledge about an innovation is the first step in the adoption process. Therefore, in the context of cloud computing, the following hypotheses have been developed:

H3: Decision Makers' knowledge about cloud computing is positively related to the decision to adopt cloud computing.

H4: Employees' knowledge about cloud computing is positively related to the adoption of cloud computing

Innovativeness is defined as "the level of decision-makers' preference to try solutions that have not been tried out; and therefore, are risky" [34]. Hypothesis 5 is:

H5: Decision Makers' innovativeness is positively related to the adoption of cloud computing.

According to Thong [35], information intensity is defined as "the degree to which information is present in the product or service of a business". The following hypothesis is related to this construct:

H6: Information intensity is positively related to the adoption of cloud computing

An advantageous technology is one that enables companies to perform their tasks more quickly, easily, and efficiently. Moreover, it improves the quality, productivity, and performance of the company. The following hypothesis below is formulated:

H7: Decision makers' perception of the relative advantage of using cloud computing is positively related to cloud adoption

A technology that is difficult to understand, and whose use is considered to be complex, is less likely to be successfully adopted. Therefore, the following hypothesis is developed:

H8: The perceived level of complexity of the cloud computing has a negative impact on the adoption of cloud computing.

In this research, compatibility is defined as "the degree to which cloud computing is perceived as consistent with the existing values, past experience, and needs of companies". The related hypothesis is as follows:

H9: High levels of compatibility between cloud computing and a company's norms and technologies have a positive influence on cloud adoption.

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We believe that the opportunity to use cloud computing on a trial basis positively influences the adoption of cloud computing; therefore, the next hypothesis is:
H10: a Higher level of trialability has a positive influence on the adoption of cloud computing
In this study, the cost of cloud computing is defined as "the degree to which decision makers perceive the total cost of using cloud computing to be lower than other computing paradigms". In the context of cloud computing the next hypothesis is:
H11. Decision makers who perceive cloud computing as being less costly than other computing paradigms are more likely to adopt cloud computing
In the context of cloud computing, security is defined as the security of the service, data centres, and media. It also takes into account the privacy and confidentiality of the companies' data. Therefore, in the context of cloud computing:
H12: The more secure that decision makers perceive cloud computing to be, the more they are willing to adopt cloud computing.

V. RESEARCH METHODOLOGY

Data collection procedure of this research is based on a survey. We developed a questionnaire which was reviewed and modified by a panel of experts, consisting of three ITM professors and four PhD students. We used Qualtrics to develop our online questionnaire. The responses to our questions were captured on a 5-point Likert-type scale. The survey was sent to more than 500 decision makers. The response rate of 20% left us with 101 completed questionnaires. Both adopter and non-adopter companies were asked to participate in this survey. In order to assure the quality of the responses, several quality assurance (QA) questions were added to the questionnaire. The questions asked of participants were adapted mainly from papers already published in this field. In addition to the standard questions, we also developed some questions that are specific to the context of cloud computing.

VI. RESULT

The analysis of hypotheses was based on the examination of the standardized paths. The path significance levels were estimated using the bootstrapping method (300 samples). The results of the analysis are summarized in Table 7. For the full sample, an examination of R2 as a descriptive measure shows that security concerns and cost savings explain 44.9% of the relative advantage of cloud computing. For the full sample, the hypothesis of cost savings as a predictor of the relative advantage of cloud computing (H1a) is confirmed ($p < 0.01$), and the hypothesis of security concerns (H1b) ($p > 0.10$) is not confirmed. The hypotheses for relative advantage (H1) ($p < 0.05$), complexity (H2) ($p < 0.10$), technology readiness (H4) ($p < 0.01$), top management support (H5) ($p < 0.01$), and firm size (H6) ($p < 0.01$) are also confirmed for the full sample. Compatibility (H3), competitive pressure (H7), and regulatory support (H8) are not statistically significant for the full sample. In our model, the indirect effect of cost savings in cloud computing adoption is the path coefficient of cost savings to explain relative advantage multiplied by the path coefficient of relative advantage to explain cloud-computing adoption. For the full sample, this equates to 0.099 (0.644*0.154), and the results of our analysis indicate that the indirect effect of cost savings is statistically significant ($p < 0.05$). Based on a similar analysis, our findings indicate that the indirect effect of security concerns is not statistically significant ($p > 0.10$) for the full sample. The research model explains 38.1% of cloud-computing adoption. The findings indicate that the research model is significant in explaining the adoption of cloud computing by firms.

The examination of R^2 as a descriptive measure for the industry-specific sub-samples shows that security concerns and cost savings explain 44.6% and 42.9% of the relative advantage of cloud computing for the SMEs, respectively. For the samples, the hypothesis of cost savings as a predictor of the relative advantage of cloud computing (H1a) is confirmed ($p < 0.01$). The hypothesis of security concerns (H1b) ($p > 0.10$) is not confirmed for either of the sub-samples. For the following findings are noteworthy. Hypotheses for relative advantage (H1) ($p < 0.01$), technology readiness (H4) ($p < 0.05$), and firm size (H6) ($p < 0.01$) are confirmed. Complexity (H2), compatibility (H3), top management support (H5), competitive pressure (H7), and regulatory support (H8) are not statistically significant. The indirect effect of cost savings for the SMEs sample is 0.227 (0.645*0.351) and is statistically significant ($p < 0.01$), whereas the indirect effect of security concerns is found to be not statistically significant. This indicates that cost savings not only explains relative advantage but also that it indirectly influences cloud-computing adoption. The research model explains 36.1% of cloud-computing adoption among SMEs organizations. For the and for the complexity (H2) ($p < 0.05$), compatibility (H3) ($p < 0.10$), technology readiness (H4) ($p < 0.01$), top management support (H5) ($p < 0.01$), and firm size (H6) ($p < 0.05$) are confirmed. The relative advantage (H6), competitive pressure (H7) and regulatory support are not statistically significant. For the indirect effect of cost savings is 0.053 (0.627*0.085) and 0.007 (0.079*0.085) for security concerns. The results indicate that cost savings and security concerns are not statistically significant ($p > 0.10$) for the SMEs. The research model explains 40.8% of cloud computing adoption among firms SMEs organizations

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Table1: Summary of Hypothesis Testing

Hypothesis Statement		Result
H1	Compatibility will positively influence cloud computing adoption.	Supported
H2	Relative advantage will positively influence cloud computing adoption	Supported
H2a	Cost savings will positively influence the relative advantage of cloud computing	Supported
H2b	Security concerns will negatively influence the relative advantage of cloud computing.	Not Supported
H3	Firm size will positively influence cloud computing adoption.	Supported
H4	Top management support will positively influence cloud computing adoption	Supported
H5	Cloud Knowledge will positively influence cloud computing adoption	Supported
H6	Technological readiness will positively influence cloud computing adoption.	Supported
H7	Complexity will negatively influence cloud computing adoption.	Not Supported
H8	Competitive pressure will positively influence cloud computing adoption.	Supported
H9	Regulatory support will positively influence cloud computing adoption	Supported

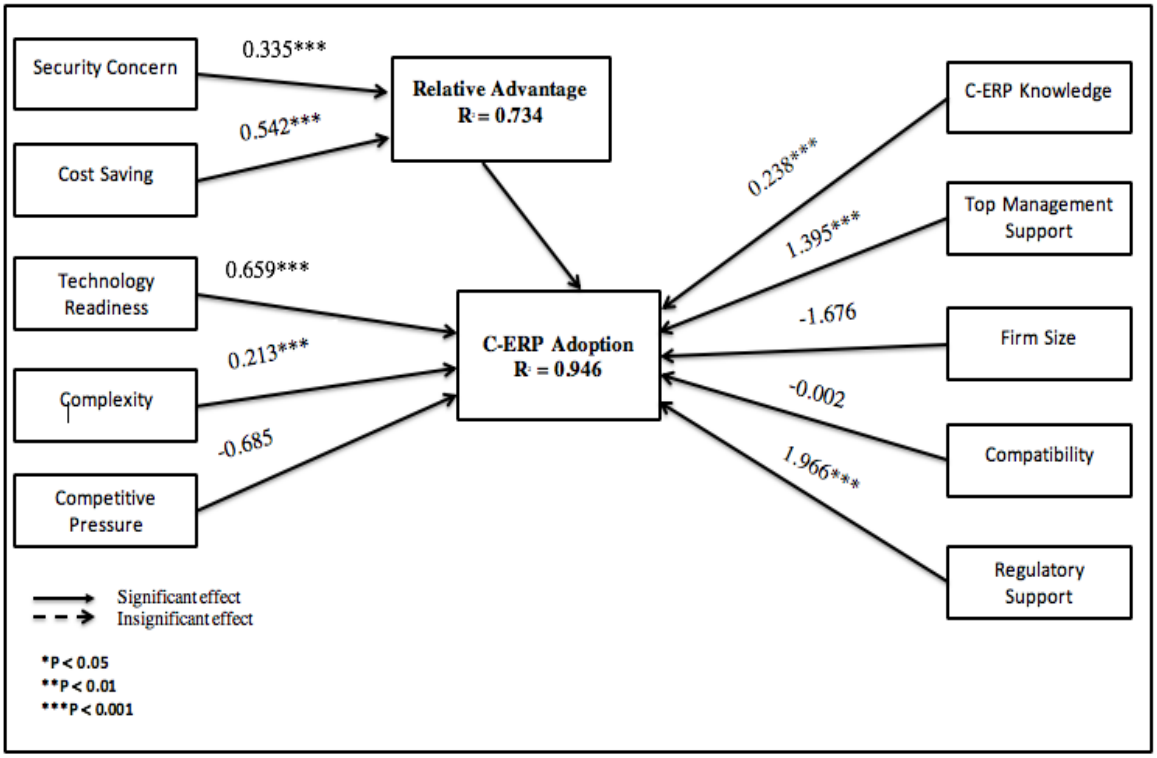

Figure1: Structural Model

VII. DISCUSSION

This study employed a method that is a quantitative approach to achieve its research objectives. This section summarises the accomplishments with the study depending on the research objectives. To recall, the primary and second objectives of this study were to explore and assess the factors of cloud-computing adoption by SMEs. In the type with this, the researcher examined the existing literature about cloud-computing adoption, TOE framework, and Innovation faculties theory (DOI). In details, the TOE frame and DOI suggested for having a model for cloud-computing adoption by SMEs. Educating literature also implied that cost-savings, relative advantages, compatibility, technology readiness, security concern, government support, competitions pressure, regulatory support and cloud-computing knowledge would be the factors on cloud-computing adoption by SMEs. This study provides an insight into the factors influences the adoption of cloud-computing by SMEs and clinic these issues among Saudi services SMEs. This study made an integrated conceptual model that has been developed from the literature review and also enriched and examined using qualitative study, respectively. This research is anticipated to contribute to a method, hypothesis, and training.

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VIII. LIMITATIONS AND FUTURE STUDIES

This research has some limitations, because of which the results cannot be generalized to all SMEs. Our main limitation is related to sample size. Sample size becomes problematic because, in order to get significant results, there should be at least 10 observations per each group of the dependent variable. Having eight different variables, our ideal sample size is 160, which is well beyond our actual sample size. Moreover, our sample is selected from North American companies. The results of this research are thus only applicable to SMEs located in North America. Moreover, the data is not restricted to a specific industry; this is problematic because each industry has its own characteristics and requirements. Performing further research in this field is highly recommended. Cloud computing is a new phenomenon; not many studies have been conducted in this field. The same study may be replicated using larger sample sizes and in different industries. Performing a longitudinal study would also prove useful.

CONCLUSION

Similar to any innovation, the diffusion of cloud computing depends on various factors. In this research, we not only study the technical aspects of cloud computing, but also others such as environmental, organizational, and managerial factors. For this purpose, a conceptual model is proposed and empirically tested. The proposed model is developed based on two well-known theoretical frameworks in the field of technology adoption, which is: DOI developed by Rogers [30], and the TOE framework developed by Tornatzky and Fleischer [32]. Based on the research model, a set of hypotheses were proposed. In order to empirically test the model, we asked decision makers of SMEs to participate in an online survey. After the internal validity of the items was checked, factor analysis was performed. At this stage, some of the items were deleted. Removing these items left us with nine different factors.

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