FACTORS HINDERING CLOUD COMPUTING IN PUBLIC UNIVERSITIES IN KENYA: A CASE OF JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY

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ABSTRACT

The rapid occurrence, prevalence and potential impact of cloud computing has ignited a significant amount of concern amongst IS and IT industry and research. Cloud computing is mainly used by the administrative staffs leaving out the majority of the stakeholders out in the utilization of this innovative platform. The objective of this study was to evaluate factors hindering cloud computing in public universities in Kenya a case of JKUAT. The specific objectives were: evaluate the effects of cloud security on adoption of cloud computing in JKUAT; establish the effects of system Interoperability on adoption of cloud computing in JKUAT; assess the effects of cloud computing reliability on adoption of cloud computing in JKUAT; and determine the extent to which regulatory frameworks have affected the adoption of cloud computing in JKUAT. The study adopted a descriptive research design. The target population consisted of 1751 staff out of which 70 of them are managers of JKUAT. A sample size of 175 respondents was used in the study. The study concludes that cloud security affects the adoption of cloud computing at JKUAT. The study further concludes that cloud computing reliability affects the adoption of cloud computing at JKUAT. The study recommends that services should not be limited to those only available through mobile devices but extend to computers. The study also recommends that organizations should participate in systems standardization. Cloud computing offers major benefits, even if some areas are cause of concern but learning institutions will ultimately benefit from using the cloud.

Key Words: *Cloud Computing, Public Universities, Jomo Kenyatta University of Agriculture and Technology*

INTRODUCTION

Cloud computing is the offering of computing resources over the internet. It is a growing and latest mode of delivering computing services online, which are controlled by third parties at secluded locations as, indicated by Rima, Choi and Lumb (2009). With the increased demand for data centers such as power utilization, cooling structure, infrastructure, space, competent IT experts and day-to-day running costs, cloud computing is developing as a vital shift and a changing model on the way services are brought in IT due to its financial and operational gains to businesses. Cloud services permit persons and businesses to utilize technological systems via the internet from distant sites. There has been an increasing level of internet connection and this rising amount of data has resulted to numerous providers and particularly data centers to implement larger infrastructures with dynamic load balancing (Hayes, 2008). Distributing and duplicating data when demand arises, resource utilization is found to be drastically enhanced. In addition, web server hosts portray images of pertinent consumers who demand some level of accessibility across numerous servers and direct requests in accordance to interchange load.

Cloud Computing (CC) as an up-and-coming technology is acknowledged by institutions and individuals for a number of possible applications. In the dawn of an era in which low-cost

ownership of IT was possible, companies preferred IT infrastructures where vendors assume most of the risks of failure while increasing ease of use (Strassman, 2003). The world has witnessed technology explosion in the field of computing and information technology and these developments have spurred research interested in predicting and explaining the adoption and use technology (Venkatesh, 2003). Reviews of literature on technology adoption show that research concerning technology adoption has been done for close to three decades (Agarwal & Prasad, 1999). A study by Daniel (2010) on mobile technology and business in the United States found that 95% of the respondents were generally aware of the cloud computing concept and believe that its role and significance will increase in the next five years. A survey on cloud computing awareness by Market Connections (2008) on US defence / military and Federal government unearthed that cloud utilization is poised for rapid gains as awareness of cloud computing growth.

Another research conducted by Gartner on cloud market in 2009 shows that as at 2009, the cloud service market was $46.4 billion and was estimated to reach $150.1 billion by 2013 while Forrester (2011) forecasts $241 billion by 2020. Similarly, according to Mime Cast (2010), majority of organizations (51%) in UK and USA using some form of cloud computing service and the levels of satisfaction amongst these organizations is high. Eugen (2012), in his study on Enhanced Virtual E-Learning Environments Using Cloud Computing Architectures asserted that Cloud computing technologies have changed the way applications are developed and accessed and thus Educational institutions can take advantage of cloud applications to provide students and teachers with free or low-cost alternatives to expensive, proprietary productivity tools.

STATEMENT OF THE PROBLEM

Several issues have been raised from literature pertaining to the adoption of cloud computing in universities in developing countries. Well known issues relate to financial constraints, where low income developing countries have difficulties escaping the low technology equilibrium to enter into the realm (Addo, 2001), and lack of human capacity (Lee, 2001). The application of cloud computing requires human capabilities to manage the technologies. However, apart from these known issues, the use of cloud computing in higher learning institutions like JKUAT is facing other challenges like technology and content. Content development is a critical area too often overlooked thereby affecting the implementation of cloud computing. The lack of appropriate educational content particularly in universities poses a challenge. Secondly, technology not replacing traditional classroom has been another challenge. Fears, anxiety and concern that lecturers have about change need to be addressed if cloud computing is to be realized.

However, institutions that have fully embraced cloud computing enjoy several benefits including the interaction between students and lectures irrespective of time and location, , improvement of quality and efficiency of distance learning, faster online response to assignments and class work and, easy sharing of content. Besides, cloud computing is now to the point of being a very stable

technology that can be relied on. Since all the data, content and information stored in the cloud usually requires authentication (ID and password), security is always assured and unauthorized parties cannot gain access. Ability of the information to be Shared also affects the utilization of cloud computing. Both the students and lecturers are able to work on an instructional assignment with their colleague, which enhances collaboration. It is in this light that the current study sought to evaluate factors hindering cloud computing in public universities in Kenya, with JKUAT as a case study of JKUAT.

GENERAL OBJECTIVE

The general objective of this study was to evaluate the factors hindering cloud computing in public universities in Kenya, case study of JKUAT.

SPECIFIC OBJECTIVES

1. To evaluate the effects of cloud security on adoption of cloud computing in JKUAT
2. To establish the effects of system Interoperability on adoption of cloud computing in JKUAT
3. To assess the effects of cloud computing reliability on adoption of cloud computing in JKUAT
4. To determine the extent to which regulatory frameworks have affected the adoption of cloud computing in JKUAT

LITERATURE REVIEW

Adoption of Cloud Computing in Learning Institutions

Computing services on-demand is gradually modifying the way information system services are developed, scaled, maintained and paid for (Yazn et al, 2013). The adoption of SaaS model is already high by enterprises of all sizes. But according to the Yankee Survey (2010) the two other areas of cloud computing; PaaS and IaaS are taking longer to develop. Cloud computing involves hosting ICT infrastructure, software applications, and other computing services into cloud servers and being accessed via the Internet. The institutions can only pay for services based on usage the same way as utility services, such as water, electricity, gas, and telephony (Buyya, Yeo, Venugopal, Broberg, & Brandic, 2009; Carroll, Merwe & Kotzé, 2011).

The evaluation of extent of adoption of cloud computing to embrace education is growing very fast, more and more institutions are migrating their computing services into the cloud. This is further facilitated by existence of cloud service providers that provide several cloud services for free or at a discount rate to educational institutions (Alshuwaier, Alshwaier & Areshey, 2012). The support and involvement of these companies in educational field has attracted dozens of institutions all over the world to enhance both on campus, distance, and blended learning. In fact, there are already several successfully deployments of cloud services in education in US, UK,

Asia, and Africa. Some few examples of such institutions in the US are: North Carolina State University (Chandra & Borah, 2012; Mokhtar, 2013), Colorado State University (Herrick, 2009), University of California, and Washington State University (Sultan, 2010).

Cloud Security

Cloud security involves protecting the confidentiality and integrity of data and ensuring data availability (Schneiderman, 2011). A security breach is an incident in which an organization loses information, personal records or other sensitive data (Bishop, 2003). However, with the convergence of storage and computing in a shared multi-user environment, cloud computing heightens concerns of security. Identity management has remained a challenge in the cloud environment for a long period of time (Cervone, 2010). The lack of a mature security and identity management standard implies that organizations will be reluctant to adopt a solution that lacks unified identity provisioning and credential management (Martins, 2010). Moving to the cloud adds new layers of complexity for securing data and will thus influence the firms' decision to adopt the innovation.

The loss of data and breach of privacy in the cloud can cause major disruption in the business operations of an organization. This is even worse in case of small organizations that could not afford alternative measures such as maintaining legacy systems in case of cloud failure. Subashini & Kavitha (2010) highlighted security issues that arise on each layer of the cloud-computing environment. Privacy is still one area of security that concerns CSPs (Bristow, Dodds, Northam & Plugge, 2010) and more so for the consumers and it is a threat to the success of cloud computing. When considering how to secure public versus private cloud architectures, the security concerns are more different than common.

Krautheim in his work on cloud security discusses a more secure framework where the client and the provider share the securing aspects due to the involvement of many players. Taylor in Computer Law & Security Review elaborates his research on digital forensics which favor clouds since much dispersed digital resources makes a nightmare on investigations especially when various jurisdictions are included. Due to the newness of cloud technology, very little research has been ongoing and most are just scratching the surface as the technology permeates.

The Cloud poses a big threat to incumbent software giants. These incumbents will neither be willing to cede their market to the Cloud nor quickly move away from their lucrative software-licensing model, Therefore it is expected that they would use their expertise, power and money to delay adoption of Cloud computing model until they are able to offer their own offerings on this new platform (Staten, Yates, Gillet, Saleh & Dines, 2008). And even if these software giant's come up with their cloud solutions, it is important to note that the licensing model they use for commercial software is not suitable for cloud computing (Armbrust et al., 2009). To mitigate this challenge these companies would have to come up with a licensing structure that fits this new IT provisioning paradigm.

System Interoperability

Although cloud-based offers are proliferating on the web and competition among cloud computing services is in full swing, the rules and standards governing cloud computing are not yet sufficiently mature to provide customers with conditions of use ensuring that they will not experience situations of blockage or dependency vis-à-vis the cloud computing providers. Indeed, the data formats and interfaces of the applications used by a cloud computing provider cannot necessarily be used by the customer or by another provider (Subashini & Kavitha, 2010).

In recent years, several international cables have made landfall on each side of the continent, favoring the growth of telephone and Internet traffic and the emergence of an ever-increasing number of data centres. This development, initially driven by the very rapid expansion of mobile telephony, has been boosted by the high-capacity requirements stemming from the introduction of broadband technology (Rima, Choi &Lumb, 2009). The resulting data exchanges on the different networks call for ever-expanding data storage capacities – something that can only be managed virtually, via the web. However, all of this is not without problems, be they problems which hinder the normal operation of existing data centers or development of new ones. Most rural communities in developing economies lack basic infrastructure such as roads, telecommunications, electricity, and water (Kauffmann, 2009).

Cloud Computing Reliability

Reliability of cloud computing provides IS/IT system and solution architects, developers, and engineers with the knowledge needed to assess the impact of virtualization and cloud computing on service reliability and availability. Internet courage in developing economies is still a challenge due to lack of infrastructure, in this case telephone network coverage, for dial-up internet, which does not cover most of the under developed communities such as rural areas (Jansen & Richardson, 1999). When they contract for cloud services, such as applications, software, data storage, and processing capabilities, organizations can improve their efficiency and their ability to respond more quickly and reliably to their customers' needs.

Cloud must provide services to many users at the same time; the scheduling strategy should be developed for multiple tasks (Sedayao, 2008). In cloud computing processing is done on remote computer hence there are more chances of errors, due to the undetermined latency and lose control over computing node. Hence remote computers should be highly reliable. This is reason why a cloud computing infrastructure should be fault tolerant as well scheduling properly to performing tasks. Internet World Statistics (2011) states that, Africa has 15% of the world population but it accounts for 5.7% of internet users in the world. Overall, cloud computing brings new aspects in computing resource management: infinite computing resources available on demand for the perspective of the end users; zero up-front commitment from the cloud users; and short-term usage of any high-end computing resources.

With the technology uptake still low many application developers have shied away from the Cloud thereby reducing the variety of "everyday" enterprise applications available (Bhattacharjee, 2009). This lack of all critical applications on the Cloud may make companies hesitate to move their operations to the Cloud. An aggressive campaign by the large Intemet companies that have invested as Cloud providers to promote Cloud computing and standardization of APIs could attract more application developers into the Cloud. On 23 July 2009 the 17,000km SEACOM undersea fibre-optic cable went live; it provides broadband connectivity to a number of African countries (BBC, 2009). In the meantime internet cafés are the primary means of accessing internet in these under developed communities and they are playing a significant role in bridging the digital divide.

Regulatory Frameworks

The complex and extensive legislation in question provides for the exercise of coercive measures in connection with law enforcement and national security (Unwin et al., 2010). Despite the fact that a number of questions remain unanswered in the areas of governance and regulatory conformity with respect to cloud computing, this new mode of IT resource utilization is developing at a rapid and sustained pace, chiefly on account of its ease of use and direct service accessibility via the Internet, and above all to the productivity gains and cost savings it enables. It is a fact that the cloud computing environment, although relatively recent, assigns due importance to good governance and to the integrity of systems and data.

Cloud computing concept embodies a whole range of service types (IaaS, PaaS, SaaS, NaaS, CaaS) and several possible operational models (public and private Cloud), making it difficult to fix on a process or specific approach that it would suffice to apply in order to meet the regulatory requirements. Nevertheless, cloud computing technology is constantly evolving, and questions relating to the conformity and alignment of the cloud computing environment with best practices in terms of enterprise governance are addressed by experts at the international level, with solutions being delivered on a regular basis (Tedre et al., 2010).

The other regulators can be Global International Organizations, like WTO, ITU, OECD) which are based on a written constitution, and under the membership there is a possibility to achieve written multilateral agreements. These agreements go into the law-force through member states, and the governments will have the power to enforce the rule. Other type is the government based regulation, which is part of the country governance. The role and scope of the government based regulation depends on the administrative culture of the country: idea of the role of government in general, habit to fulfill the legal orders, and imposition of penalties. The government may also - as a punishment - exclude the market player from the limited resources like frequency band or other ones (Winkler, 2011). The self regulation of the smaller organizations is part of the cohesion they build up among themselves. The rules should serve the common goals and interests to gain business or social benefits or prevent some risks and losses. Where connectivity

to the international telecommunication network is concerned, Africa has seen the arrival of several international cables on each side of the continent and the emergence of an increasing number of shared data processing centres.

RESEARCH METHODOLOGY

The study adopted a descriptive survey research design. A descriptive study is concerned with establishing the what, where and how of a phenomenon (Cooper & Schindler, 2003).The study population constituted 1751 staff out of which 70 of them are managers of JKUAT. The primary research data was collected from the employees using a questionnaire. Data analysis was done with the help of software programme SPSS version 21 which is the most current version in the market and microsoft excel to generate quantitative reports.

RESULTS AND FINDINGS

Cloud Security on adoption of Cloud Computing in JKUAT

On whether human resources policies at JKUAT promote adoption of cloud computing, 7.2% indicated to no extent, 36% to a moderate extent, 21.6% to a great extent while 35.2% to a very great extent. On cloud computing ensures confidential information is not accessed by everybody, 2% indicated to no extent,14.4% to a little extent , 14.4% to a moderate extent,28.8% to a great extent while 35.2% to a very great extent. On data integrity is guaranteed on adoption of cloud computing, 36% to a little extent, 27% to a moderate extent, 14.4% to a great extent while 21.6% to a very great extent.

On access of data on cloud computing posses a great challenge to its adoption, 7.2% to no extent, 14.4% to a moderate extent,49.6% to a great extent while 28.8% to a very great extent. On the extent cloud services availability has limited its adoption at JKUAT, 14.4% indicated to no extent,14.4% to a little extent , 20.8% to a moderate extent,28.8% to a great extent while 21.6% to a very great extent. On the extent fear of loss of data has limited adoption of cloud computing at JKUAT, 7.2% indicated to no extent, 7.2% to a little extent, 13.6% to a moderate extent,43.2% to a great extent while 28.8% to a very great extent. This findings imply that the need for cloud computing security standards is important and urgent and it‘s hindering growth of cloud computing. Cloud computing present specific challenges to privacy and security. Subashini & Kavitha (2010) highlighted security issues that arise on each layer of the cloud-computing environment. Privacy is still one area of security that concerns CSPs (Bristow, Dodds, Northam & Plugge, 2010) and more so for the consumers and it is a threat to the success of cloud computing. When considering how to secure public versus private cloud architectures, the security concerns are more different than common.

On the extent to which cloud security affected the adoption of cloud computing at JKUAT. A majority 35.2% of the respondents indicated that cloud security affected the adoption of cloud

computing at JKUAT to a very great extent, 28.8% to a moderate extent, 21.6% to a great extent while 7.2% to a little and no extent, respectively. This findings imply that while Cloud computing continues to remain one of the most captivating technological innovations across the globe; it is still the most feared in developing countries.

System Interoperability on Adoption of Cloud Computing in JKUAT

On the extent users have been equipped with adequate cloud computing knowledge,28.8% indicated to no extent, 21.6% to a little extent , 28.8% to a great extent while 20.8% to a very great extent. On whether cloud computing is highly compatible with other systems in the organization, 14.4% to no extent, 14.4% to a moderate extent, 14.4% to a great extent while 56.8% to a very great extent. On whether cloud computing is highly compatible with existing hardware infrastructure in the University, 7.2% indicated to no extent, 7.2% to a little extent , 14.4% to a moderate extent,42.4% to a great extent while 28.8% to a very great extent.

On the extent to which handling a dispute between the provider of cloud computing and the University has hindered adoption of cloud computing, 43.2% to no extent, 7.2% to a little extent, 42.4% to a great extent while 7.2% to a very great extent. On whether the University has technical capacity to support cloud computing adoption, 14.4% to little extent, 7.2% to a moderate extent, 35.2% to a great extent while 43.2% to a very great extent.

On whether there is a high level of awareness among JKUAT community on cloud computing, 7.2% to no extent, 21.6% to little extent, 14.4% to a moderate extent, 20.8% to a great extent while 36% to a very great extent. On whether lack of proper knowledge on cloud computing posed a challenge in adoption of cloud computing, 7.2% to little extent, 28% to a moderate extent, 21.6% to a great extent while 43.2% to a very great extent. These findings imply that although cloud-based offers are proliferating on the web and competition among cloud computing services is in full swing, the rules and standards governing cloud computing are not yet sufficiently mature to provide customers with conditions of use ensuring that they will not experience situations of blockage or dependency vis-à-vis the cloud computing providers.

Cloud Computing Reliability and Adoption of Cloud Computing at JKUAT

On the extent to which cloud computing ensured virtualization of operations, 21.6 % indicated to a moderate extent, 50.4 % to a great extent while 28% to a very great extent. On whether cloud computing can be accessed from anywhere with the right access authority, 21.6 % indicated to a moderate extent, 14.4 % to a great extent while 64 % to a very great extent.

On whether cloud computing presents more chances of error because data is processed in a remote computer, 21.6% indicated to no extent, 21.6% to a moderate great extent, 21.6% to a great extent while 35.2% to a very great extent. On whether there is limited infrastructure to

allow remote access to cloud computing, 14.4% indicated to no extent, 7.2% indicated to little extent ,14.4% to a moderate great extent, 28% to a great extent while 36% to a very great extent.

On whether the service of Cloud Computing provided by Google Inc., (e.g. an e-mail service - Gmail) at the University is less expensive than the old system, 28% of the respondents indicated to a moderate great extent, 21.6% to a great extent while 50.4% to a very great extent. On whether the cloud computing helps to reduce the expenses that go to buy hardware, servers, software or maintenance, 14.4% of the respondents indicated to a little extent, 7.2% to a moderate great extent, 35.2% to a great extent while 43.2% to a very great extent. These findings imply that to give services to end-users a cloud computing environment should be reliable & should manage to give output in minimum amount of time. To migrate to the Cloud enterprises have to be prepared to incur not only the cost of migrating data and application but also the cost of restructuring their organizations to fit this new computing paradigm (Bhattacharjee, 2009). To mitigate against this the large Cloud providers could leverage their economies of scale to offer competitive prices that will entice enterprises to counter these switching costs.

Regulatory Frameworks and Adoption of Cloud Computing

On whether cloud computing is consistent with the requirements financial reporting of the University,7.2% of the respondents indicated to no extent, 7.2% of the respondents indicated to a little extent, 50.4% indicated to a moderate extent, 21.6% to a great extent while 13.6% to a very great extent. On whether cloud computing does not compromise the quality of information in the University, 14.4% of the respondents indicated to a little extent, 21.6% indicated to a moderate extent, 28% to a great extent while 36% to a very great extent. On whether cloud computing conform to the regulations of the ICT board in Kenya, 7.2% of the respondents indicated to no extent, 14.4% of the respondents indicated to a little extent, 21.6% indicated to a moderate extent, 20.8% to a great extent while 36% to a very great extent.

On whether cloud computing does not compromise the information of the University, 14.4% of the respondents indicated to a little extent, 28.8% indicated to a moderate extent, 35.2% to a great extent while 21.6% to a very great extent. On whether cloud computing has a clear dispute resolution plan, 14.4% of the respondents indicated to no extent, 7.2% of the respondents indicated to a little extent, 28.8% indicated to a moderate extent, 28% to a great extent while 21.6% to a very great extent. On whether cloud computing meets the service level agreement on information provision in Kenya, 14.4% of the respondents indicated to no extent, 7.2% of the respondents indicated to a little extent, 28.8% indicated to a moderate extent, 28% to a great extent while 21.6% to a very great extent. On whether cloud computing technology is an attractive technological option to the University, 7.2% of the respondents indicated to a little extent, 20.8% indicated to a moderate extent, 43.2% to a great extent while 28.8% to a very great extent. On whether the university Focuses on new IT system projects, which aim to

increase the efficiency and quality of services provided for the beneficiaries, 7.2% of the respondents indicated to no extent, 7.2% of the respondents indicated to a little extent, 14.4% indicated to a moderate extent, 36% to a great extent while 35.2% to a very great extent.

On whether the university focuses on new IT system projects, which aim to increase students satisfaction, 14.4% of the respondents indicated to a little extent, 28.8% indicated to a moderate extent, 35.2% to a great extent while 21.6% to a very great extent. On whether the university focuses on new IT system projects, which aim to increase data confidentiality and information policies, 7.2% of the respondents indicated to no extent, 14.4% of the respondents indicated to a little extent, 21.6% indicated to a moderate extent, 21.6% to a great extent while 35.2% to a very great extent. These findings imply that cloud computing technology is constantly evolving, and questions relating to the conformity and alignment of the cloud computing environment with best practices in terms of enterprise governance are addressed by experts at the international level, with solutions being delivered on a regular basis.

REGRESSION ANALYSIS

Table 1: Model Summary

Model	R	R Squire	Adjusted R Squire	Std.Error of the Estimate	
1	0.816	0.666	0.649	0.261	3.455

R-Square (coefficient of determination) is a commonly used statistic to evaluate model fit. R-square is 1 minus the ratio of residual variability. The adjusted R2, also called the coefficient of multiple determinations, is the percent of the variance in the dependent explained uniquely or jointly by the independent variables. From the model above 64.9% of factors hindering cloud computing adoption in institutions can be attributed to the predictor factors in the model. This shows that 35.1% of factors hindering adoption of cloud computing among public universities is determined by other factors not in the model that should be researched on.

Table 2: Analysis of Variance (ANOVA)

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	10.214	4	2.553	14.716	3.455
Residual	6.533	120	0.054		
Total	16.747	124			

The probability value of 3.455 indicates that the regression relationship was highly significant in predicting how cloud security, system interoperability, cloud computing reliability and the regulatory framework hinder the adoption of cloud computing in institutions of higher learning.

The F critical at 5% level of significance was 2.5252 since F calculated is greater than the F critical (value = 14.716), this shows that the overall model was significant.

Table 3: Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	3.625	0.339		10.703	.000
Cloud security	0.450	0.121	0.379	3.732	.000
System Interoperability,	0.046	0.129	0.044	0.361	.019
Cloud Computing Reliability	0.244	0.134	0.207	1.827	.071
Regulatory Framework	-0.159	0.116	0.146	-1.368	.074

The regression equation above has established that taking all factors into account (Cloud security System Interoperability, Regulatory Framework and Cloud Computing Reliability) constant at zero, adoption of cloud computing will be at 3.625. The findings presented also show that taking all other independent variables at zero, a unit increase in cloud security would lead to a 0.450 increase in the adoption of cloud computing. Further, the findings shows that a unit increases in System Interoperability would lead to 0.046 increases in the adoption of cloud computing. In addition, the findings show that units increase in Cloud Computing Reliability would lead to a 0.244 increase in adoption of cloud computing. The study also found that a unit increase in the Regulatory Framework would lead to a 1.529 decrease in the adoption of cloud computing. Overall, cloud security had the greatest effect on adoption of cloud computing. This notwithstanding, all the variables were significant as the P-values were less than 0.05. Therefore, the universities should devote more effort in the cost sharing as it was found to have the most significant effect on the growth of academic alliances among public universities in Kenya.

CONCLUSIONS

From the findings, the study concludes that cloud security affects the adoption of cloud computing at JKUAT. This is to mean that with the convergence of storage and computing in a shared multi-user environment, cloud computing heightens concerns of security. Identity management has remained a challenge in the cloud environment for a long period of time. The study further concludes that cloud computing reliability affects the adoption of cloud computing at JKUAT. Reliability of cloud computing provides IS/IT system and solution architects, developers, and engineers with the knowledge needed to assess the impact of virtualization and cloud computing on service reliability and availability.

The study also concludes that cloud regulatory frameworks affect the adoption of cloud computing at JKUAT. The complex and extensive legislation in question provides for the

exercise of coercive measures in connection with law enforcement and national. Finally, the study concludes that cloud system interoperability affects the adoption of cloud computing at JKUAT. Although cloud-based offers are proliferating on the web and competition among cloud computing services is in full swing, the rules and standards governing cloud computing are not yet sufficiently mature to provide customers with conditions of use ensuring that they will not experience situations of blockage or dependency vis-à-vis the cloud computing providers.

RECOMMENDATIONS

For Universities to maximize cloud computing benefits, the study recommends that services should not be limited to those only available through mobile devices but extend to computers. This is true for services offered by IaaS for instance, were appropriate devices might be personal computers not only mobile devices, hence the need to provide these devices and connectivity capacity. The study also recommends that organizations should participate in systems standardization. Standardization is always the interest of the main industrial players, when they are at least three or more in a market segment. They have a common interest to achieve interfaces to connect subsystems in order to sell their own products to others customers too. The addressable market is growing in case of standardized systems and products.

Cloud computing offers major benefits, even if some areas are cause of concern but learning institutions will ultimately benefit from using the cloud. For such organizations to consider adopting the cloud, the study further recommends that there is a need to address the infrastructure problem which to larger extent is the responsibility of government. To ensure that more and more learning institutions embrace the cloud security system ,cloud service providers should provide several cloud services for free or at a discount rate to educational institutions. The support and involvement of these companies in educational field will therefore attract dozens of institutions all over the world thus enhancing both on campus, distance, and blended learning.

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