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Cloud Computing Adoption in Jordanian Universities

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Abstract:
Universities need cloud computing adoption for strategic and competitive goals, generating business value, and at last gaining competitive advantage. This paper reviews the literature regarding cloud computing, and IT governance. This is as an attempt to present valuable and practical guidelines to decision makers to realize the resources and conditions necessary to comprehend the potential values of their IT investments in the existence of cloud computing capabilities. Furthermore, this research presented a research model along with its hypotheses formulation to examine the factors impacting cloud computing adoption in Jordanian universities by using integration of Technology Acceptance Model (TAM) model and Technology-Organizational-Environmental (TOE) framework as adapted from Gangwar et al. (2015) study. In addition, data analysis techniques are then being suggested.

Keywords:
Universities, Cloud Computing Adoption, IT Governance, Technology Acceptance Model, Technology-Organizational-Environmental, Jordan.

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1. Introduction

Cloud computing is a general term that provides services over the Internet. Security and privacy are the two main issues that cloud computing providers consider. Saravana et al. (2015) argued that security issues play a vital role in cloud computing. The cloud services which allow people accessing to their documents whenever they are concern the ways in which that services will be secured. Also, the cloud provides may use customer data, the trade-off between extensibility and security responsibility, virtualization, and the different approaches to provide security and privacy may generate integration challenges (Siani, 2011; Al-Saiyd and Sail, 2013; Shahzad, 2014; Sari and Kurniawan, 2015; Virgile and Yu, 2015). According to Saravana et al. (2015), the revenue of cloud service providers had been increased year by year as companies all around the world is connected through open networks, and these networks are used to transmit information electronically. Consequently, it grows fast.

In addition, organizations consider IT governance to be one of the top influential factors for creating business value and gaining competitive advantage. In 2009, a research group proposed a theoretical model for IT governance and IT business alignment (Beimborn et al., 2009). The proposed model was based on the suggestion by Van Grembergen et al. (2004) that the cores of IT governance mechanism are the strategic alignment and the operational alignment. The authors showed theoretically from governance prospective that combining the key finding from IT governance, IT business and IT value research is the role of top executive support and operational alignment. Executive support derived and strongly correlated with strategy alignment, operational alignment, and IT governance tools and indirectly with business process performance. Moreover, the author indicated empirically the IT governance is mediated the by strategic and operational alignment.

Several researchers (e.g. Weinhardt et al., 2009; Lombardi and Dipietro, 2011; Marston et al., 2011; Furuichi and Yamada, 2014; Olaru, 2014; Sinjilawi et al., 2014; Simamora and Kom, 2015) emphasized that one of the most essential advantages offered by cloud computing is the reduced cost. Cloud computing radically lowers the cost of entry especially for smaller firms trying to benefit from compute-intensive business analytics that were solely available to the largest ones. Alijani et al. (2014) the researchers, who defined cloud computing as the process of allowing users to access available services through the internet, tried to help small businesses to decide whether or not cloud computing is efficient for their operation. They focused on the benefits that would be gained if small businesses use the system and they have mentioned the special characteristics of such computing. A survey was developed to collect and analyze data, the results show that 59% of the small businesses that use cloud computing are satisfied, 34% determined that cloud computing a solid information management facility, and 55% agreed that is cost effective.

According to Buyya et al. (2009), cloud is a parallel and distributed computing system consisting of a collection of inter-connected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources

based on service-level agreements established throughout cooperation between the service provider and consumers. Erturk and Maharjan (2014) suggested that cloud computing and virtualization are new but indispensable components of computer engineering and information systems. The study related to this article indicated that teaching cloud computing reduces overall IT costs through the consolidation of systems besides results in reduced loads and energy savings in terms of the power and cooling infrastructure. Indeed, Guo and Zheng (2015) stated that users of cloud services themselves relying on some internet information resources which lie on some nodes like computing resources, software resources, data resources and management resources. These services should be allocated based on a demand driven, user dominant, on-demand services, no centralized control, and users do not care where the server. Thus, the parallel computing and virtualization technology has become the core support technology after the concept of cloud computing was proposed.

However, potential challenges related to cloud computing occur such as security, service availability, lack of interoperability standards, complex structure and compatibility issues, cloud computing adoption, and competitiveness of cloud computing and trading partner support for cloud services (Feuerlicht et al., 2011; Low et al., 2011; Lin and Chen, 2012; Alshamaila et al., 2013; Gangwar et al., 2015). Furthermore, since both of TAM model and TOE framework are considered widely in the literature related to technology adoption studies for successfully predicting and explaining users' intentions to adopt existing and new technologies, this research will use them to examine the determinants of cloud computing adoption. Indeed, TAM and TOE are considered as commonly used models for measuring acceptance level of customer for emerging systems. Although many studies examine the applicability and convergence of TAM in the literature review and meta-analysis, there is no any study that attempt to use TAM in a co-citation analysis. Therefore, Hsiao and Yang (2011) used a co-citation analysis to study its intellectual structure and determine the main trends of TAM. Based on certain statistical analyses which include factor analysis, multidimensional scaling, and clustering analysis; three main trends were identified: task-related system, e-commerce systems, and hedonic systems. The authors expected that these finding may offer benefits for both academic and practical fields and considered as benchmarks for future research of TAM field to classify the emerging new technologies to which trend are follow. Consequently, the current research will examine several technological, organizational, and environmental variables which will impact the adoption of cloud computing in universities by implementing both TAM and TOE models.

This paper is organized as follows. It begins with the literature review regarding cloud computing and its importance. Then, the research methodology used for the study is provided. Next, research model and hypotheses formulation also discussed. After that, data analysis techniques and the conclusions are then addressed.

2. Literature Review

In general, executives are unable to influence each other very well (Williams and Miller, 2002). CIOs (Chief Information Officers) are the head of technology and the source of technology innovation. A study was conducted to understand how Irish CIOs persuade

the technology innovation and IT-business alignment within an organization (Enns et al., 2012). The results proved that most CIOs persuade other executives to maintain technology innovation that improve IT-Business alignment. On the other hand, some other CIOs were unable to do so, which increase the gap between CIOs and executives. Based on the results of their study, the authors suggested some important behaviors and practices for CIOs to decrease and increase the connection. They recommend CIOs to encourage technological innovations and improve IT-business alignment with other executives by maintaining partner wisely, gathering the right data, and soliciting others to Influence and communicating appropriately. Consequently, top management support is crucial when adopting new technologies such as the use of cloud computing applications.

Cloud computing is an attractive model to companies; it eliminates the cost and the required small resources to start with. According to the National institute of standards and technology (NIST), the definition of cloud computing has been recognized as a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction (Subashini and Kavitha, 2011; Shahzad, 2014). Armbrust et al. (2010) defined cloud computing as the applications delivered as services over the Internet and the hardware and system in the data centers that supply these services in which the services themselves referred to as Software as a Service (SaaS). According to Karajeh et al. (2014), Guo and Zheng (2015) and Saravana et al. (2015), cloud computing offers many services such as infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS). The capability provided to the customer of IaaS is raw storage space, computing, or network resources with which he/she can run and implement an operating system, applications, or any software that they select. In PaaS, the cloud providers supply the hardware and a toolkit in which a number of supported programming languages help to build higher level services. In the case of SaaS, the applications are usually easily reached through a thin client interface, such as a web browser. Joseph et al. (2014) stated that cloud computing types include private, public, hybrid, and community. The private cloud is devoted to a single organization in providing the different services necessary for its working. Cloud stack, Rackspace, Red Hat cloud are examples of private cloud providers. The public cloud is meant for organizations sharing their resources or diverse infrastructure, softwares and platforms with the public, besides sharing of resources and storage could take place over the internet. Some of the public cloud service providers include Bluelock, Microsoft, Google, HP and Dell Inc. Hybrid cloud model arranges the use of both public and private cloud, which includes scaling across various clouds. The exploitation of hybrid cloud may well necessitate the need for an on-premise and off-premise resources. The hybrid cloud providers include Voxen, VMware and Western Digital. Community cloud is defined as a subclass of public cloud in which various resources and services like softwares, platforms and infrastructures can be shared among various users. Intel Corporation and Cisco are some of the service providers for community cloud.

Zissis and Lekkas (2012), Lemoudden et al. (2013), Sandholm and Lee (2014), Varalakshmi et al. (2014), and Guo and Zheng (2015) argued that the main concern of cloud

computing is the safety issue. Specifically, challenges for enterprise applications regarding cloud computing security imply lacks of trusted access control, standards, cipher text retrieval and processing, data exists and reusability, data privacy, virtual security technology, and denial of services. In addition, the researchers stressed that in order to solve these safety problems of cloud computing then joint efforts of information security from technical and non-technical perspectives from academia, industrial circle, enterprise, government and related departments, are all needed. Sehgal et al. (2011) argued that information security can be considered by taking into account three functions, which are access control, secure communications, and protection of private data. While access control contains the initial entrance by a user and the reentry of that user or the access of additional users; the secure communication comprises any transfer of information among any of the users. Also, the protection of private data includes storage devices, processing units, and yet cache memory. Kim and Lee (2015) indicated that as security vulnerability and privacy invasion by malicious attackers or internal users can happen, various security items become essential such as confidentiality; authentication; availability; calculation efficiency; collusion resistance; forward secrecy; and backward secrecy.

Lemoudden et al. (2013) stated that vulnerabilities that are relevant in the cloud usually concern the provider; among them are insufficient security audit options, lack of standard security controls regarding audit and logging certification, and continuous security monitoring. Furthermore, the researchers argued that both defense in-depth and honey pot are the foremost practical types of defense strategies in the cloud services. The first defense strategy is based on the idea that individual security controls are typically incomplete or otherwise not sufficient, thus exploiting several techniques to decrease the risk when particular component security is compromised or faulty. The honey pot strategy aims to setup a decoy system that appears to have several vulnerabilities for easy access to its resources; and should be set up in a similar manner to those of the production servers in the firm, and to be loaded with numerous fake files, directories, and other information that may look real. In turn, the decoy system will lead the hacker to believe that they have gained access to important information and to collect data, whereas the honey pot collects information about the intruder and the source of the attack. This is to monitor the intruders and learn from their moves in order to find how they monitor and exploit the system; and finally to prevent them in a legitimate way.

Initially, Oppenheim (2012) suggested various questions to be asked of cloud service suppliers with the purpose of a potential client can take a clear decision and avoid unpleasant surprises. These include who (both within and outside the service supplier) will be able to see my information; who owns and controls your infrastructure, is this outsourced to any third party; where are the infrastructure elements located; can I see a copy of your reliability/availability/downtime reports; what service levels are guaranteed, e.g., availability, time taken to resolve a problem, and what compensation do you offer if you fail to fulfill that; have you ever had security breaches in the past, and If yes you should ask for more details; do I have a contact name within your organization in case of any problems; will you abide by the local relevant data protection act; will you pay damages if a breach of the act occurs which is your fault; what assurances can you

give that data protection standards will be maintained even if the data we supply is stored in a country with weak, or no data protection laws, or where government inspection powers are very wide ranging; how easy would it be to migrate my data to a competitor service once this contract ends; can you guarantee that it will be in a usable format; who is responsible for ID management and access control in your company; what are the names of your employees responsible for handling our data; what security policies, technology and systems do you employ, and what national or international standards do they comply with; do I get any rights of refusal before you make changes to the services that affect my data; will you use my organization's name or type of data given to you on any of your advertising; what special measures will you take regarding data we tag as confidential; could we have a free trial with some non-sensitive data before committing ourselves; are you willing to include clauses in the contract relating to ensuring there is no unauthorized loss or destruction of data; can you provide us with routine backups of all our data stored on your cloud; will you guarantee to inform us if you become aware of any data security breach that affects or involves our data; and most important, to what degree your contract negotiable.

Sari and Kurniawan (2015) argued that five important and essential properties to use cloud computing in knowledge management systems including security information when it is exchanged; access to knowledge from anywhere; storage space is specific; the speed of access to knowledge; and standard of service cost and authorized personnel access at the same time. In addition, the most important use of cloud computing features in knowledge management should consider if the team able to access knowledge by owning an email; the ease of knowledge management and ability to create backup copies of the information in the event of loss; and if the establishing new branches have access to company data more easily without the need for complex systems. According to cloud computing characteristics, cloud computing has been adopted for managing the labs to assist maintenance and network management. Thus, Ibrahim and Ameen (2015) presented the possibilities of using cloud computing as a solution to expand work efficiency at Taiz University Computer Center and Information Technology labs which equipped with hardware and software resources; in the hope that their results could be the guideline for all universities in Yemen to use the cloud computing. The researchers found that cloud computing impacts managing the resources for Taiz University in numerous areas such as daily education operations, supporting staff, and distributed management system which in turn can considerably reduce load, leveraging efficiencies. In addition, students can work on the cloud, cooperate with their team members, share knowledge, and access their homework anywhere, at home or from the labs.

Arango et al. (2014) argued that the development of information technology helped to improve and facilitate the water distribution system and here the researchers focused on the use of cloud computing to support decision making in water distribution system. The characteristics of cloud computing was the main factoring in development the water distribution system. In addition to the wide range of benefits, cloud computing provides four deployment models to the water companies, and they can select the model that better suits their requirements. Private cloud: The cloud infrastructure is provisioned for exclusive single organization; Community cloud: Cloud infrastructure provisioned for

exclusive specific community of consumers. Public cloud: Infrastructure provisioned for open use by the general public. Hybrid cloud: Composition of two or more distinct cloud infrastructures (private, community, or public). For the case of the water industry, hybrid cloud approach has several advantages among others because of the flexibility it provides to keep information inside the proprietary IT infrastructure of companies besides using some public infrastructure.

Caytiles and Lee (2012) and Shahzad and Hussain (2013) argued that with the broad development in mobile applications and advancements in cloud computing, few years later a new growth happened in the form of mobile cloud computing by providing a platform where mobile users make use of cloud services on mobile devices. However, the users of mobile cloud computing are still less than expectations because of the associated risks in terms of security and privacy issues such as data theft risk; privacy of data belongs to customers; violation of privacy rights; loss of physical security; handling of encryption and decryption keys; security and auditing issues of virtual machines; lack of standard to ensure data integrity; and services incompatibility because of different vendors involvement. Also, there are some attacks which are probable at end user mobile device such as device data theft; virus and malware attacks via wireless devices; and mis-use of access rights. Nevertheless, some common information security issues of cloud computing could be used as a protection methods including system security of server and database; networking security; user authentication; data protection; and system and storage protection techniques.

3. Research Methodology

The goal of the research is to examine the factors impacting cloud computing adoption in Jordanian universities by using integration of Technology Acceptance Model (TAM) model and Technology-Organizational-Environmental (TOE) framework as adapted from Gangwar et al. (2015) study. Eleven constructs will be measured using closed-end five-point Likert scale items, with scales ranging from 1= “strongly disagree” through 3= “neither agree nor disagree” to 5= “strongly agree”. Indeed, survey questionnaires will be used for data gathering from the universities those have implemented cloud computing, specifically from top and middle-level IT managers. Thus, judgmental sampling technique will be used in this research. Table 1 shows the measured constructs and the items measuring each construct.

Table 1: Constructs and Measurement Items

Construct	**Measurement Items**
Relative Advantage (RA)	RA1: Using cloud computing, we pay only for what I use. RA2: Using cloud computing, we are able to scale up our requirement when required. RA3: Using cloud computing, we can access information from any time from any place. RA4: Using cloud computing, we need not administer my IT infrastructure.

	RA5: Performance of cloud services does not decrease with growing user base. RA6: Using cloud computing, we can access share resources placed on cloud. RA7: Using cloud computing, we need not maintain my IT infrastructure.
Compatibility (CM)	CM1: In case of any incompatibility issue, we ask cloud service provider to offer integrated services. CM2: Cloud services are compatible with existing technological architecture of my company. CM3: Customization in cloud-based services is easy. CM4: The changes introduced by cloud computing are consistent with existing practices in my company. CM5: Cloud computing development is compatible with my university's existing format, interface, and other structural data. CM6: We incur re-training cost in case of non-customizable cloud-based services. CM7: There is no difficulty in importing applications/ data from cloud services. CM8: There is no difficulty in exporting applications/ data to cloud services.
Complexity (CY)	CY1: Cloud computing is flexible to interact with. CY2: Using cloud computing exposes me to the vulnerability of computer breakdowns and loss of data. CY3: When we use cloud computing, we find it difficult to integrate my existing work with the cloud-based services. CY4: When we perform many tasks together, using cloud computing takes up too much of my time.
Organizational Competency (OC)	OC1: My company hires highly specialized or knowledgeable personnel for cloud computing. OC2: We have sufficient technological resources to implement cloud computing – unrestricted access to computer. OC3: We have sufficient technological resources to implement cloud computing – high bandwidth connectivity to the internet. OC4: We allocate a percent of total revenue for cloud computing implementation in the company.
Top Management Support (TM)	TM1: Our top management exhibits a culture of enterprise wide information sharing. TM2: The company's top management provides strong leadership and engages in the process when it comes to information systems company. TM3: My top management is likely to consider the adoption of cloud computing as strategically important.

	TM4: My top management is willing to take risks involved in the adoption of cloud computing.
Training and Education (TE)	TE1: My level of understanding was substantially improved after going through the training program on cloud computing. TE2: My company provided me complete training in using cloud computing. TE3: The training gave us confidence in use of cloud computing.
Perceived Usefulness (PU)	PU1: Using cloud computing allows me to manage business operation in an efficient way. PU2: Using cloud computing allows me to increase business productivity. PU3: Using cloud computing enables allow me to accomplish my organizational task more quickly. PU4: The use of cloud computing services improves the quality of business operation. PU5: Using cloud computing advances my competitiveness.
Perceived Ease of Use (PE)	PE1: The procedure of using cloud computing is understandable. PE2: It is easy for us to learn using the cloud computing. PE3: It is easy to make use of cloud computing.
Trading Partner Support (TP)	TP1: Our agreement with cloud service providers ensures that they have high availability architecture, and tested platform and applications for readiness of services. TP2: Our Organization ensures that cloud provider considerably invest in security controls and monitoring of access to the contents. TP3: We check whether the cloud service provider has policy for handling personally identifiable information. TP4: We ensure that cloud vendors implement strong access and identity management to ensure unauthorized access to cloud computing.
Competitive Pressure (CP)	CP1: We are aware of cloud computing implementation in our competitor organizations. CP2: We understand the competitive advantages offered by cloud computing in our industry.
Adoption Intention (AI)	AI1: Overall I think that using cloud computing services is advantageous. AI2: Overall, I am in favour of using the cloud computing services.

4. Research Model and Hypotheses Formulation

Since this research will examine the cloud computing adoption in Jordanian universities, the hypotheses are formalized as below:

H1: The higher the level of relative advantage, the greater influence on perceived usefulness.
H2: The higher the level of relative advantage, the greater influence on perceived ease of use.

H3: The higher the level of compatibility, the greater influence on perceived usefulness.
H4: The higher the level of compatibility, the greater influence on perceived ease of use.

H5: The lower the level of complexity, the greater influence on perceived usefulness.
H6: The lower the level of complexity, the greater influence on perceived ease of use.

H7: The higher the level of organizational competency, the greater influence on perceived usefulness.
H8: The higher the level of organizational competency, the greater influence on perceived ease of use.

H9: The higher the level of top management support, the greater influence on perceived usefulness.
H10: The higher the level of top management support, the greater influence on perceived ease of use.

H11: The higher the level of training and education, the greater influence on perceived usefulness.
H12: The higher the level of training and education, the greater influence on perceived ease of use.

H13: The higher the level of ease of use, the greater influence on perceived usefulness.

H14: The higher the level of ease of use, the greater influence on cloud computing adoption.
H15: The higher the level of perceived usefulness, the greater influence on cloud computing adoption.

H16: The higher the level of trading partner support, the greater influence on cloud computing adoption.
H17: The higher the level of competitive pressure, the greater influence on cloud computing adoption.

5. Data Analysis Techniques

The current study will use two main statistical tools to analyze the survey data. Regarding the survey analysis methods, a general descriptive analysis will be conducted by applying SPSS version 22, to obtain a summary about the respondents' demographic characteristics by using the response means, frequencies, and standard deviations, alongside initial data examination such as reliability tests. Then, the data will be analyzed

by using the Structural Equation Modeling (SEM) method, with AMOS software version 20, which involves confirmatory factor analysis (CFA) and structural model analysis.

Indeed, in order to describe the responses and thus the attitude of the respondents toward each question they were asked in the survey, the mean and the standard deviation were estimated. While the mean shows the central tendency of the data, the standard deviation measures the dispersion which offers an index of the spread or variability in the data (Sekaran and Bougie, 2009). In other words, a small standard deviation for a set of values reveals that these values are clustered closely about the mean or located close to it; a large standard deviation indicates the opposite. Also, SEM can be divided into two sub-models: a measurement model and a structural model. While the measurement model defines relationships between the observed and unobserved variables, the structural model identifies relationships among the unobserved/latent variables by specifying which latent variables directly or indirectly influence changes in other latent variables in the model (Byrne, 2001). Furthermore, the structural equation modeling process consisted of two components: validating the measurement model and fitting the structural model. While the former is accomplished through confirmatory factor analysis, the latter was accomplished by path analysis with latent variables (Kline, 2005).

6. Conclusion

Based on literature review, the research model of this study will be examined in the Jordanian context. Moreover, the data required for this study will be collected from public universities in Jordan through a questionnaire distributed to them. Furthermore, the contributions of this study will be useful for both academia and practitioners. From the academic perspective, this study aspires to fill the gap of the incomplete causal chains between several technological, organizational, and environmental variables in gaining cloud computing adoption and the role of new methodological approaches that capture the nature of IT investment decisions such in exploiting cloud computing methods.

In addition, the current study will not only provide a holistic review of the extant literature on cloud computing, but it will also be the first research of its nature to test the causal chain of technological, organizational, and environmental variables on cloud computing adoption by using integration of Technology Acceptance Model (TAM) model and Technology-Organizational-Environmental (TOE) framework. In addition, from the industry practitioner's perspective, this study will be of interest to IT managers and business managers in terms of their real relationships among them and their employees, and to achieve the best practices for managing electronic collaborations in the universities they work for. IT and business senior management also need to recognize the appropriate mechanisms in which they may well transform their IT preferences into operational decision making. Consequently, the expected findings could provide useful and practical guidelines to IT managers and business managers to understand the resources and conditions required to realize the potential values of their IT investments in terms of cloud computing usage.

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