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Effects of Security and Privacy Concerns on using of Cloud Services in Energy Industry, an Oil and Gas Company: A Case Study

Alireza Poorebrahimi
Department of Information Technology Management Islamic Azad University, Science & Research Branch of Tehran, Iran, Email: poorebrahimi@gmail.com
Fatemeh SoleimaniRoozbahani
Department of Information Technology Management Islamic Azad University, Science and Research Branch of Tehran, Iran, Email: fa.solaymani@gmail.com

ABSTRACT

The topic of ''the cloud'' has attracted significant attention throughout the past few years. It allows resource sharing that includes software, platform and infrastructure by means of virtualization. Cloud Adoption in Oil & Gas companies have approached cloud with caution, but they are increasingly deploying cloud services. Energy companies have carefully weighed whether they should opt for a public cloud versus a private one, and which applications are fit for deployment via the cloud. For the most part, the industry has opted to use cloud for generic purposes. Generic business functions like payroll process and procurement are being run through the cloud, along with customer relationship management, likely through software-as-a-service offerings that have become well-known. Security is as much of an issue in the cloud as it is anywhere else. Different people share different point of view on cloud computing. Some believe it is unsafe to use cloud. Cloud vendors go out of their way to ensure security. This paper aims to understand the effects of security and privacy concerns on educational use of cloud services. This proposed a research model based on Ajzen's (1991) Theory of Planned Behavior (TPB). Following the TPB, the research developed a model, which posits that staff attitudes predicted by security and privacy perceptions and behavioral intentions are predicted by attitudes towards using cloud services. The Model was assess the based on the data collected by means of survey questionnaires. Results supported the proposed model, validating the predictive power of the TPB.

Keywords - **Cloud services; Privacy; Security; Energy Industry, Oil and Gas.**

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I. INTRODUCTION

Information Technology (IT) has been adding significant benefits to various aspects of people's life, either in terms of convenience or comfort or entertainment [1]. In other side, the present competitive environment, companies are wondering how to reduce their IT costs while increasing their efficiency and agility to react when changes in the business processes are required. Cloud Computing is the latest paradigm to optimize the use of IT resources considering "everything as a service" and receiving these services from the Cloud (Internet) instead of owning and managing hardware and software assets [2]. Cloud computing is a pervasive computing paradigm that has revolutionized how computer infrastructure and services are delivered [3]. Cloud computing has been widely adopted by enterprises in their business application in the last decade [4]. Cloud computing has been propounded as a paradigm shift in the delivery of information technology (IT) resources and services. It has been dubbed by proponents of the technology as the fifth utility after water, electricity, gas, and telephone utilities [2]. The topic of ''the cloud'' has attracted significant attention throughout the past few years [5, 6, 7] and, as a result, academics and trade journals have created several competing definitions of cloud computing [8, 9]. Despite the lack of consensus about definitions, however, there is broad agreement on the growing demand for cloud computing. Some estimates suggest that spending on cloud-related technologies and services in the next few years may climb as high as $42 billion/year [10]. Roster et al. [11] identify three of the more commonly cited reasons for migrating functions and capabilities to the cloud: Cost reduction, Deployment flexibility, Speed to implement [12].

Some industries—most notably, the financial services and telecommunications sectors—have been relatively quick adopters, while others have approached the cloud more cautiously and slowly [12].

Despite the compelling case for moving towards cloud computing, the upstream oil & gas industry faces several technical challenges—most notably, a pronounced emphasis on data security, a reliance on extremely large data sets, and significant legacy investments in information technology infrastructure—that make a full migration to the public cloud difficult at present [13]. Oil and gas companies have approached cloud with caution, but they are increasingly deploying cloud services. Energy companies have carefully weighed whether they should opt for a public cloud versus a private one, and which applications are fit for deployment via the cloud. For the most part, the industry has opted to use cloud for generic

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purposes. For example, cloud is being used or considered for infrastructure such as data backup and archiving and data storage (raw data, backup, archiving, email storage). Generic business functions like payroll process and procurement are being run through the cloud, along with customer relationship management, likely through software-as-a-service offerings that have become well-known. Another fairly generic application is for collaborative applications such as email, group calendaring, and messaging. Entrepreneurial independent upstream oil and gas companies primarily involved in unconventional shale gas and tight oil initiatives have adopted cloud to perform these functions. Because of security considerations, the oil and gas industry generally prefers private cloud over public cloud for core applications [14].

Despite the compelling case for moving towards the cloud, however, the absorption of these technologies and services has been uneven [12].

Most oil and gas companies are balancing the opportunities versus the risks in considering whether to adopt cloud technologies. On the one hand, cloud enables increased collaboration and can result in decreased operational costs due to reduced infrastructure investments, quick deployment, and flexibility of use. That said, security concerns persist over cloud deployment. IT security remains the number one priority for the industry, and many CIOs have had doubts about the security of the cloud and the ability of cloud providers to offer data privacy.

However, there is evidence that the industry is becoming more receptive to cloud technologies. Cloud will likely be used in less-sensitive applications. Collaboration is becoming critical for many O&G companies, due to skills shortage, internationalization of operations, and growing importance of collaborative work with business partners. Sensitive information needs to be shared with stakeholders, remote teams, suppliers, and JV partners to maximize productivity and knowledge transfer. Deployment of cloud-based solutions for document management would enhance the collaborative experience and allow the O&G companies to eliminate decentralized systems with a central repository across multiple locations and business units.

However, there are also concerns and issues to be solved before Cloud Computing spreads across the different industries [2]. However, some challenges still need to be addressed such as security and privacy issues [15, 16].

Cloud Computing security is the major concern to be addressed nowadays. If security measures are not provided properly for data operations and transmissions then data is at high risk [17]. Since cloud computing provides a facility for a group of users to access the stored data there is a possibility of having high data risk. Strongest security measures are to be implemented by identifying security challenge and solutions to handle these challenges [18].

The paper proceeds as follows. In the second section, the literature on studies of cloud computing adoption and use has been reviewed. The next sessions have been allot to the research methods and the results of data analysis. Finally, discussion of the research findings and their implications are provided along with the limitations of the study.

II. LITERATURE REVIEW

Cloud computing has recently received increasing attention in information systems and computer science disciplines [19]. Movahedisefat et al. [20] proposed one of the most pervasive and fundamental challenges for organizations in demonstrating policy compliance is proving that the physical and virtual infrastructure of the cloud can be trusted—particularly when those infrastructure components are owned and managed by external service providers. The next frontier in cloud security and compliance will be to create transparency at the bottom-most layers of the cloud by developing the standards, tools, and linkages to monitor and prove that the cloud's physical and virtual machines are actually performing as they should [20]. Pearson [21] claims some core traditional mechanisms for addressing privacy (such as model contracts) are no longer flexible or dynamic enough, so new approaches need to be developed to fit this new paradigm. He assess how security, trust and privacy issues occur in the context of cloud computing and discuss ways in which they may be addressed [21].

Yu et al. [17] addressed the problem of simultaneously achieving fine-grainedness, scalability, and data confidentiality of access control open issue by, on one hand, defining and enforcing access policies based on data attributes, and, on the other hand, allowing the data owner to delegate most of the computation tasks involved in fine grained data access control to untrusted cloud servers without disclosing the underlying data contents [17]. Popović [22], discussed about the security issues, requirements and challenges that are faced by cloud service providers during cloud engineering [22]. Sabahi [23] discussed about the security issues, reliability and availability for cloud computing. He also proposed a feasible solution for few security issues [23]. Liu introduced some cloud computing systems and analyzes cloud computing security problems and its strategy according to the cloud computing concepts [24]. It is obvious as the enthusiasm for utilize the cloud is very high, the concerns about its challenges, particularly its security, is high, therefore the security is a factor which affects the using cloud computing.

III. RESEARCH METHODOLOGY

Theory of planned behavior (TPB), a prominent reasoned action model, its conceptual foundation, its intellectual

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history, and the research it has generated. From its roots in propositional control and expectancy theory, the TPB From its roots in propositional control and expectancy theory, the TPB. According to the theory, intention is the immediate antecedent of behavior and is itself a function of attitude towards the behavior, subjective norm, and perceived behavior control; and these determinants follow, respectively, from beliefs about the behavior`s likely consequences, about normative expectations of important others, and about the presence of factors that control behavioral performances [25]. In TPB, beliefs that are specific to each situation are antecedent to attitude. The theory does not assume that beliefs that apply in one context also apply in other contexts. Likewise, TPB taps the important control variables for each situation independently and is more likely to capture situation specific factors [26]. Security and privacy perception is significant predictors of attitude towards using the cloud services in an Energy Industry can be considered in the model.

In an attempt to ensure content validity and face validity, the survey instrument was developed based on questionnaire items that had been successfully used in prior studies. The factors which play a fundamental role in the model include: Security and privacy, Attitude, Behavioral intention. Security refers to the degree to which students believe that cloud services are secure platforms for storing and sharing sensitive data. Attitude towards using technology is defined as students' overall affective reaction to using cloud service [27]. Behavioral intention refers to the degree to which a student has formulated conscious plans to use or not use cloud services in the future [28].

Based on the factors, the hypothesizes are:
H1. Perceived security and privacy will have a positive influence on attitude.

H2. Attitude will have a significant positive influence on behavioral intention.

H3. Behavioral intention will have a significant positive influence on use of cloud services in Energy Industry (Fig 1).

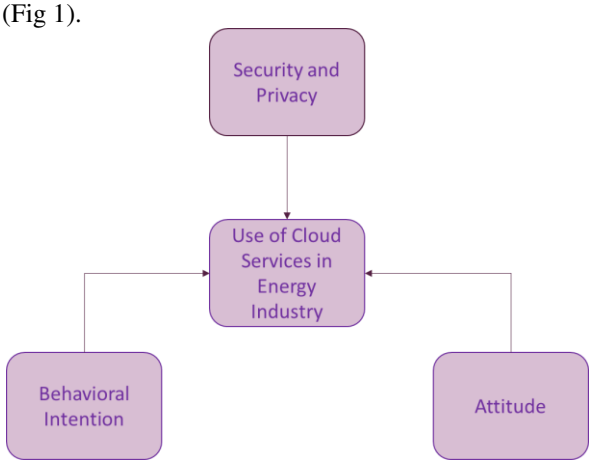

Fig 1. Model of Research

IV. METHODOLOGY

Based on the feedback from expert panel, modifications were done on the survey instrument. The instrument has total 16 Likert items, including 5 items for security-privacy, 4 items for use, 4 items for behavioral intention, and 3 items for attitude. Participants were asked to indicate their level of agreement using a five-point scale ranging from ''strongly agree'' to ''strongly disagree.''

In total, 50 randomly selected members of an Oil and Gas company (which wants to be anonymous). However, 5 questionnaires were discarded from data set.

Prior to conducting factor analysis, data set was checked for suitability for factor analysis. After the data set was checked for factorability, 19 items were subjected to factor analysis. We conducted an exploratory factor analysis using principal components extraction to test construct validity of the scale. Based on the results of the exploratory factor analysis, 3 questionnaire items were omitted from the scale. The Bartlett's test of Sphericity indicated that the measures for four latent constructs were interdependent and the KMO measure of sampling adequacy was well above the minimally accepted level of .50. On the basis of a scree plot of eigenvalues, a one-factor solution appeared to be most appropriate for each measurement. For each measurement, total variance explained ranged between 49.74 and 74.95, which are all much higher than acceptable value of .40 for measures with one factor Moreover, each measurement item has a factor loading above .71 and communality value above .50. Factor loadings, which are all much higher than acceptable value of .40, ensure that factor structures are robust. The corrected item-total correlation coefficients ranged from .49 to .80, indicating acceptable to high homogeneity of the items.

V. DISCUSSION AND FINDINGS

This paper extends Ajzen's (1991) Theory of Planned Behavior (TPB) to explain and predict educational use of cloud services by pre-service teachers. Following the TPB, we developed a research model, which posits that student attitudes predicted by security and privacy perceptions and behavioral intentions are predicted by attitudes towards using cloud services. The findings supported the proposed model, validating the predictive power of the TPB. The findings stressed the importance of security and privacy variable, which add to the explanatory and predictive power of the model, in predicting attitudes towards using cloud services, justifying the integration of this variable within the TPB framework.

The study hypothesized that security and privacy have a positively significant influence on staffs` attitudes towards using cloud services. The results, along with previous studies, support this hypothesis. This study has shown that security and privacy perceptions have a significant influence on attitude. Security variable has been found in

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prior studies as a significant predictor of adoption behavior, for example Salisbury et al. (2001) found that perceived security is a strong predictor of intention to purchase online. Zhu et al. (2006) found that security perception has a significant effect on e-business adoption. Dillon et al. (2010) found that security issues have an important role in hindering cloud computing. Lin and Chen (2012) argued that challenges of cloud computing are security and standardization. More recently, Park and Kim (2014) found that user acceptance of mobile cloud services is largely affected by security, perceived mobility, quality of service, connectedness, and satisfaction.

The results of the study supported assumptions of Theory of Planned Behavior that we based our study on. This suggests that the assumptions of this theory can be used to explain the nature of educational use of similar technologies. The present study may also contribute to the literature since the study on oil and gas industry use of cloud services is limited. The security and privacy variables were found to be a strong determinant of oil and gas industry use of cloud services. Therefore, these variables should be taken into account in future researches on use of similar technologies. Moreover, the results demonstrated that attitude has a stronger effect on oil and gas industry use of cloud services than behavioral intention. Thus, future studies may focus on the effect of attitude on oil and gas industry use of such services to develop a more parsimony model that efficiently predicts usage.

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Biographies and Photographs

Professor Alireza Poorebrahimi, has obtained Ph. D. degree in Industrial Management from SRBIA University in 1993. His research fields are Network Security Management, Passive Defense, Cloud Computing, e-Banking and e-Commerce. He is appointed as a Professor in the SRBIA University, Deptt. of Management.

Miss.Fatemeh Soleimani Roozbahani has obtained B.S. degree in Nuclear Physics from Shahid Chamran University in 2009, and has obtained Master degree in Information Technology Management summa cum laude with a cumulative GPA of 19.76 [out of 20] amongst the graduates of this major who had been graduated in 2011 from Farabi University. Presently she is pursuing Ph.D. in Information Technology Management in SRBIA University. Her research fields are Information Business Intelligence, Deep Learning, Cloud Computing, and Security in Computer Networks. She is appointed as a Lecturer in Azad University, Deptt. of Information Technology.