Vol 6, No 2, 2014 ISSN: 1309-8047 (Online)

IDENTIFYING THE DETERMINANTS OF CLOUD COMPUTING ADOPTION IN A GOVERNMENT SECTOR – A CASE STUDY OF SAUDI ORGANISATION

Majed Alsanea
Northumbria University
PhD student
E-mail: majed.alsanea@northumbria.ac.uk

David Wainwright
Northumbria University
Professor
E-mail: david.wainwright@northumbria.ac.uk

─Abstract ─

The adoption of Cloud Computing technology is an essential step forward within both the public and private sectors, particularly in the context of the current economic crisis. However, the trend is struggling for many reasons. The purpose of this study is to establish the foundations for the development of a framework to guide government organisations through the process of transferring to Cloud Computing technology. The main aim of this research is to evaluate the factors affecting the adoption of Cloud Computing in the government sector by conducting a multiple case study of Saudi government organisations, and to develop a Cloud Computing adoption framework. Investigating and identifying the main factors affecting the adoption of Cloud Computing is done by examining the literature and by conducting a mixed-method investigation. The most significant concerns are Service Quality, Usefulness, Security, Complexity, Cost, Organisation Size, IT Infrastructure Readiness, Senior Management Support, Feasibility, Trust, Organisation Culture, Organisation Structure, Privacy Risk, Direct Benefits, Indirect Benefits, Culture, External Pressure, Industry Type, Government Support, and Regulatory Concerns. This study will apply the TOE (Technology-Organisation-Environment) framework and the Iacovou model to obtain improved knowledge, to better determine the most suitable Cloud

Vol 6, No 2, 2014 ISSN: 1309-8047 (Online)

Computing adoption factors. These models form the conceptual framework for this study. Two phases are performed in order to collect the required data: firstly, a questionnaire-based survey; secondly, interview-based case studies approach. The data and hypothesis are analysed and tested using descriptive statistics, AHP, multi-regression and Pearson Correlation. SPSS is used to analyse the collected data and all statistics and figures are extracted from this software. The initial results show some of the main factors that could affect the adoption of Cloud Computing, and show the relationship between the dependent and independent variables which indicate the positive and negative impact.

Key Words: *Cloud Computing, Public Sector, Technology Adoption, IS innovation theories*
JEL Classification: O31, O32, O33, O38

1. INTRODUCTION

1.1. Cloud Computing Technology

Cloud computing technology is a new concept in the computing world and refers to the emergence of a new computing paradigm (Vaquero et al., 2008, Cegielski, 2012, Buyya et al., 2009). Cloud Computing has emerged as an innovation with the potential for major disruption within the IT field (Castells, 2001). The future of computing lies in Cloud Computing technology, where the main objective is reducing IT costs while increasing productivity, availability, reliability and flexibility, and minimising response time (Brian, 2008).

1.2. Research Background

There is a lack of exploratory studies that explain the diffusion and adoption of Cloud Computing technology, and which consider how changeable Cloud Computing technology is and how quickly it transfers. It is therefore the purpose of this study to lay the foundations for the development of a framework to guide

Vol 6, No 2, 2014 ISSN: 1309-8047 (Online)

government organisations in the move to Cloud technologies. The various factors affecting the adoption of Cloud Computing that have emerged from previous studies can all be categorised in the organisational, technological, or environmental domains. Thus it is feasible to apply the technology-organisation-environment (TOE) framework and the Lacovou model to understand the determining factors affecting the adoption of Cloud Computing. Most previous studies have shown the importance of the technological factors affecting Cloud Computing adoption. However, the influence of environmental, technological and organisational factors varies between different industrial contexts. As a result, it is essential to identify and evaluate the key determinants of the adoption of Cloud Computing in different contexts in order to obtain a better understanding of Cloud Computing adoption. In this case, we will focus on the government sector.

1.3. Cloud Computing Technology Definition

The most widely-used definition of Cloud Computing is '…a model for enabling convenient, on-demand network access to a shared pool of configurable Computing resources (e.g. networks, servers, storage, applications, and services) that can be provided quickly and released with minimal management effort or service provider interaction' (Peter and Tim, 2010). A further definition suggests that 'It basically refers to the delivery of information technology (IT), including software, via the public internet or private networks based on Web standards (2012).

1.4. Evaluation Of The Need For Cloud Computing Adoption

The main objective of Cloud Computing technology is to reduce organisations' infrastructure costs and to provide these organisations with control over their datacentres. One of the advantages of Cloud Computing is a lower requirement for skilled manpower, which is already in short supply in South East Asia and similar parts of the world (Luftman and Zadeh, 2011). This is also a very environmentally friendly set-up (Armbrust et al., 2010). In general, Cloud Computing reduces ICT capital expenses such as maintenance, technical support, power and energy, infrastructure equipment, and manpower cost.

Vol 6, No 2, 2014 ISSN: 1309-8047 (Online)

2. THEORETICAL BACKGROUND

2.1. IS innovation Adoption Theories and Models

The knowledge provided by Informational Systems (IS) innovation in adopting and diffusing is built upon theoretical foundations in marketing, medicine, sociology, economics and psychology (Gatignon and Robertson, 1989). Research on Informational Systems employs a number of theories. Here emphasis is laid upon only theories of technology adoption. Table 2.1.1 shows a list of the most important IS theories and models.

Table 2.1.1 : Theoretical models and frameworks for examining factors affecting information systems (IS) innovations adoption and diffusion.(Oliveira et al., 2011)

Theory	Level	Previous Studies
Technology-organisation-environment (TOE) framework	Organisation	(Oliveira and Martins 2010a), (Oliveira and Martins 2009),(Lin and Lin 2008),(Oliveira and Martins 2008),(Liu 2008),(Pan and Jang 2008),(Teo et al. 2006),(Zhu et al. 2006b),(Zhu and Kraemer 2005),(Zhu et al. 2003),Scupola (2003),Wu et al. (2003),(Kuan and Chau 2001)
Theory on Diffusion of Innovation (DOI)	Organisation	(Li and Li),(Zhu et al., 2006),(Hsu et al., 2006),(Bradford and Florin 2003),Bradford and Florin (2003), Mustonen-Ollila and Lyytinen (2003),Armstrong and Yokum (2001) Beatty et al.(2001) ,(Eder and Igbaria 2001),(Beatty et al. 2001),(Thong 1999),Agarwal and Prasad (1997),(Cooper and Zmud 1990)
Institutional theory	Organisation	Gibbs and Kraemer (2004) Chatterjee et al.(2002) Scott (1995)

Vol 6, No 2, 2014 ISSN: 1309-8047 (Online)

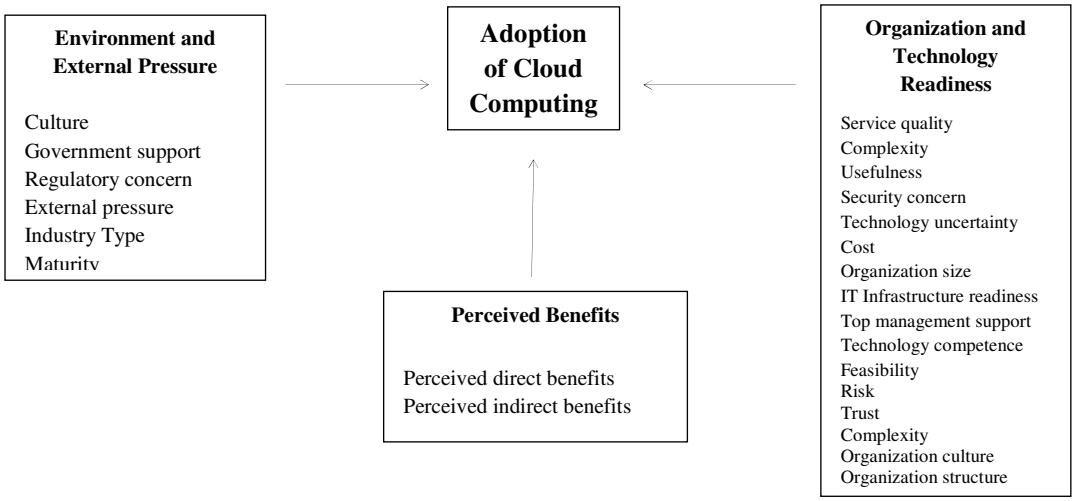
		King et al. (1994) Abrahamson and Rosenkopf (1993)
Lacovou et al. (1995) Model	Organisation	(Oliveira and Matins 2010b),(Hsu et al. 2006)
Technology acceptance model (TAM)	Individual	Grandon and Pearson (2004), Igbaria el al. (1997)
Theory of planned behaviour (TPB)	Individual	Workman, M. (2005) , Riemenschneider and McKinney (2001)

2.2. An Integrative Conceptual Framework

The TOE framework comprises of a sound theoretical structure, and includes practical sustenance, and the probable submission to IS implementation (Oliveira et al., 2011).The TOE framework comprises of the environmental framework (not contained in the DOI theory), it enhances the ability to describe intra-corporation invention implementation; hence, we observe that this model is most suitable and comprehensive. Here the conceptual framework which is proposed by combining three IS models. It consists of three main constructs or domains as shown in Figure 2.2.1: Construct No. 1: Organisation and technology readiness is used in the TOE model in Iacovou et al., 1995). Construct No. 2: Environment and external pressure, is used in the TOE model in (Iacovou et al., 1995). Construct No. 3: Perceived benefits, is used only in the Iacovou et al., 1995) model.

Vol 6, No 2, 2014 ISSN: 1309-8047 (Online)

Figure 2.2.1: The proposed conceptual model for Cloud Computing adoption at organisation level, integrated TOE framework and lacovou et al. model.



2.3. The Proposed Research Model and Hypotheses of Cloud Computing Adoption

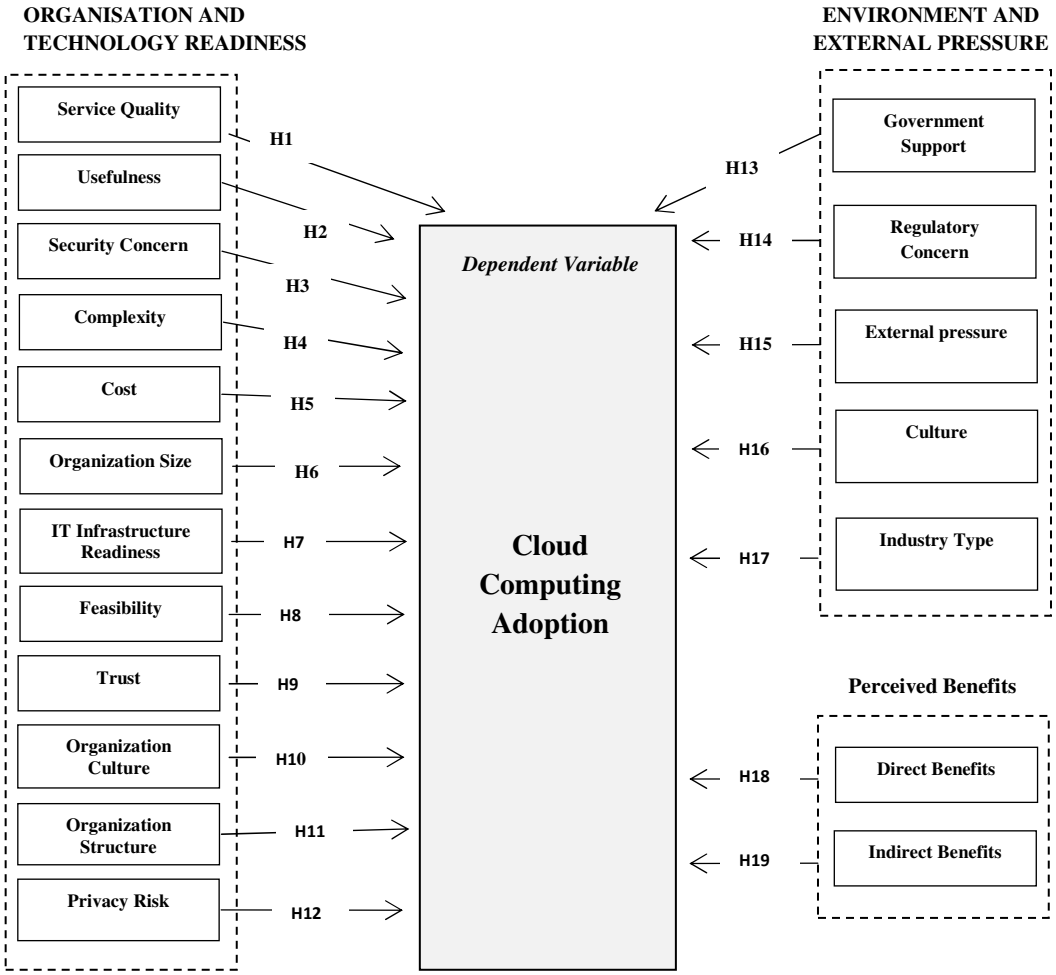
Based on the literature, a number of factors are proposed in this study. These are Service Quality, Usefulness, Security, Complexity, Cost, Organisation Size, IT Infrastructure readiness, Senior Management Support, Feasibility, Trust, Organisation Culture, Organisation Structure, Privacy Risk, Direct Benefits, Indirect Benefits, Culture, External pressure, Industry Type, Government Support, and Regulatory Concern. These factors have been established in the literature as salient predictors of technology acceptance. Therefore, the hypotheses that need to be tested are as follows: H1: Service Quality has a positive and significant effect on Cloud Computing adoption. H2: Usefulness will have a positive and significant effect on Cloud Computing adoption. H3: Security will have a positive and significant effect on Cloud Computing adoption. H4: Complexity will have a negative and significant effect on Cloud Computing adoption. H5: Cost will have

Vol 6, No 2, 2014 ISSN: 1309-8047 (Online)

a negative and significant effect on Cloud Computing adoption. H6: Organisation Size will have a positive and significant effect on Cloud Computing adoption. H7: IT Infrastructure Readiness will have a positive and significant effect on Cloud Computing adoption. H8: Feasibility will have a positive and significant effect on Cloud Computing adoption. H9: Trust will have a positive and significant effect on Cloud Computing adoption. H10: Organisation Culture will have a negative and significant effect on Cloud Computing adoption. H11: Organisation Structure will have a positive and significant effect on Cloud Computing adoption. H12: Privacy Risk will have a positive and significant effect on Cloud Computing adoption. H13: Government Support will have a positive and significant effect on Cloud Computing adoption. H14: Regulatory Concern will have a negative and significant effect on Cloud Computing adoption. H15: External pressure will have a positive and significant effect on Cloud Computing adoption. H16: Culture will have a negative and significant effect on Cloud Computing adoption. H17: Industry Type will have a positive and significant effect on Cloud Computing adoption. H18: Direct Benefits will have a positive and significant effect on Cloud Computing adoption. H19: Indirect Benefits will have a positive and significant effect on Cloud Computing adoption. Figure (2.3.1) shows the proposed model for Cloud Computing adoption.

Vol 6, No 2, 2014 ISSN: 1309-8047 (Online)

Figure 2.3.1: Cloud Computing Adoption Model



Vol 6, No 2, 2014 ISSN: 1309-8047 (Online)

3. RESEARCH METHODOLOGY

3.1. The Strategy of Research

Using multiple cases helps to internally validate and cross-check findings through conducting a comparative analysis of the case findings(Yin, 2003). During any kind of research, it has been witnessed that case study research method is the most useful, common and qualitative research method used in information systems researchers (Orlikowski and Baroudi, 1991, Alavi and Carlson, 1992). For this study a mixed-method research design is used. A survey questionnaire and interview-based approach are used to achieve the research objective. A multi-case study approach is utilised in this research. (Stuart et al., 2002)(Stuart et al. 2002) suggest that one to three cases is sufficient, four government organisations are chosen. The sample size of this study is 100 respondents, comprised of IT managers and senior management decision makers who have the power to make decisions about the adoption of Cloud Computing technology within their organisation. The data is analysed by using the Statistical Package for Social Science (SPSS). In addition, the Person-Coloration, Multi-Regression and AHP techniques are used to analyse the data, specify the relevant factors, and identify the relationship between the dependent and independent variables. This study is divided into two phases: Phase 1, using the quantitative method, questionnaire-based survey; and Phase 2, using the qualitative method, interview-based case study approach.

3.2. Questionnaire design, survey protocol, and interview approach

The data collection is conducted in two phases in order to collect the required data. For phase one, the study uses a quantitative survey questionnaire in order to achieve the objective of this research. The questionnaire was developed on the basis of the research literature and consists of three parts. The first part is related to the participant data. The second part is designed to cover all the factors that affect Cloud Computing adoption. The third part is designed to test the relationship between factors and the importance of each, and a five point Likert-type scale with values ranging from one to five is used. A pilot study was

Vol 6, No 2, 2014 ISSN: 1309-8047 (Online)

conducted to examine the questions and the structure, and to improve the quality of the questionnaire. Some feedback and suggestions helped the researcher to refine and improve the questionnaire. The researcher approached IT directors and senior management (decision makers) in Saudi government organisations such as the Ministry of Finance, the Ministry of Communication and Technology, the Ministry of the Interior, Saudi Universities, private consultants, and other independent experts. The questionnaire was distributed to respondents within the premises of their home organisations. Nine participants have responded so far. According to (Yin, 2003), "interview is the most vital source for generating case study information ". Information generation for qualitative research can be done most effectively through the methodology called interview (Oates, 2006). Therefore, next, phase two uses an in-depth semi-structured qualitative interview within a multi-case studies approach. Interviews will be conducted with twenty participants in total, five for each of four organisations. The conceptual model and literature helped to shape and frame the semi-structured questions.

3.3. Data Analysis Techniques

The data is analysed and tested by using descriptive statistics, Person-Coloration, multi-regression and AHP technique. SPSS is used to analyse the collected data and all statistics and figures are extracted from this software. The data is analysed by using descriptive statistic, Pearson Correlation, reliability test, reliability test and multiple regression to isolate the dependent and independent variables. The dependent variable in this study is Cloud Computing adoption, and the independent variables are Service Quality, Usefulness, Security, Complexity, Cost, Organisation Size, IT Infrastructure Readiness, Top Management Support, Feasibility, Trust, Organisation Culture, Organisation Structure, Privacy Risk, Direct Benefits, Indirect Benefits, Culture, External Pressure, Industry Type, Government Support, and Regulatory Concern. The study examines the relationship between the dependent and independent variables.

Vol 6, No 2, 2014 ISSN: 1309-8047 (Online)

4. INITIAL FINDINGS AND DISCUSSION

This study proposed a comprehensive framework as shown above, to help the organization to understand the factors and reasons that lead to the adoption of Cloud Computing technology. In addition to a critical review of Cloud Computing adoption models and theories, an empirical study has been carried out. As part of this, all possible factors related to this research have been studied and examined. In the data collection phase, the extracted factors are taken from the literature review. To test these factors and the research hypothesis, a survey was conducted and the initial results were collected. At this stage, nine respondents participated in this study, and answered the questions in the questionnaire. However, this study needs more data in order to provide the right answers. Consequently, this study is considered as one providing initial results. To summarise some of the results, in part one the factors associated with Cloud Computing adoption have been identified in terms of their relative importance: service quality (100%), usefulness (100%), security (100%), complexity (88.9%), cost (77.8%), organisation size (77.8%), IT infrastructure readiness (77.8%), top management support (88.9%), feasibility (88.9%), trust (100%), organisation culture (66.7%), organisation structure (88.9%), privacy risk (100%), direct benefits (77.8%), indirect benefits (100%), culture (44%), external pressure (55.6%), industry type (100%), government support (88.9%), and regulatory concern (55.6%). These results reflect the importance of these factors, and how these factors influence the decision to utilize the technology on the part of government organizations. Moreover, the results show that there are some factors that are more important than others. For example, a security concern is one of the most important factors that the organization should take seriously in its considerations. The next most important factor is IT infrastructure since this is important for any organization. It has been noticed that the private sector gives the cost extra consideration compared with government organizations because the latter are non-profit organizations. An important finding is the culture of the organization. This is another variable that might prevent the organization from adopting Cloud Computing technology. In contrast, feasibility is not so important as a key motivating factor in terms of government organizations since they do not rely on income in terms of the services they provide. The organizational culture in general

Vol 6, No 2, 2014 ISSN: 1309-8047 (Online)

seems to be less important compared to the other factors. A lot of descriptive techniques have been applied and many different results have been generated from the collected data. Here are some of the results in terms of the analysed data using SPSS:

Service Quality is an important factor to adopt Cloud Computing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	9	100.0	100.0	100.0

Usefulness is an important factor to adopt Cloud Computing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	9	100.0	100.0	100.0

Security is an important factor to adopt Cloud Computing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	8	88.9	88.9	88.9
	No	1	11.1	11.1	100.0
	Total	9	100.0	100.0	

Descriptive Statistics

	Mean	Std. Deviation	N
Security Concern Question No. 1	4.1111	1.26930	9
Security Concern Question No. 2	3.4444	.88192	9
Security Concern Question No. 3	2.5556	.88192	9

Correlations

Vol 6, No 2, 2014 ISSN: 1309-8047 (Online)

		Security Concern Question No. 1	Security Concern Question No. 2	Security Concern Question No. 3
Security Concern Question No. 1	Pearson Correlation	1	.397	-.397
	Sig. (2-tailed)		.290	.290
	N	9	9	9
Security Concern Question No. 2	Pearson Correlation	.397	1	-.839**
	Sig. (2-tailed)	.290		.005
	N	9	9	9
Security Concern Question No. 3	Pearson Correlation	-.397	-.839**	1
	Sig. (2-tailed)	.290	.005	
	N	9	9	9

5. CONCLUSION

This study will contribute to the practice, policy and theory of the adoption of Cloud Computing technology. The basic aim of this theoretical contribution is to provide an analysis of innovation adoption in the literature. It deals with the expansion of new adoption procedures and analyses the literature related to information systems (IS) in the field of Cloud Computing. This has been done in order to enhance our knowledge and understanding of the process of adoption of organizational technology. This research will also participate by providing new ideas, and by assessing the suitability of various theories related to organization innovation adoption which has evolved in western developed countries. In this way we will assess and understand the problems in developing Arab countries. The study attempts to identify the factors that affect Cloud Computing technology by focusing on the organization level. The main objective of this research is to help government organizations to adopt such technology. The study proposes a framework by combing the TOE framework based on the Iacovou model, to cover all aspects. In addition, the research uses a mixed-method approach to obtain rich data in order to answer the research questions. As of now, the initial data has been

Vol 6, No 2, 2014 ISSN: 1309-8047 (Online)

collected and analysed using different techniques and approaches. Further work will cover the second phase of this research, by analysing the qualitative data using the AHP technique.

BIBLIOGRAPHY

ABAA, K, 2012. Cloud Computing Adoption - Large Enterprises in India. *Journal of India***,** 175.

ALAVI, M. & CARLSON, P. 1992. A review of MIS research and disciplinary development. *Journal of Management Information Systems,* 8**,** 45.

ARMBRUST, M., PATTERSON, D., RABKIN, A., STOICA, I., ZAHARIA, M., FOX, A., GRIFFITH, R., JOSEPH, A. D., KATZ, R., KONWINSKI, A. & LEE, G. 2010. A view of cloud computing. New York: Association for Computing Machinery.

BRIAN, H. 2008. Cloud Computing. *Association for Computing Machinery. Communications of the ACM,* 51**,** 9.

BUYYA, R., YEO, C. S., VENUGOPAL, S., BROBERG, J. & BRANDIC, I. 2009. Cloud computing and emerging IT platforms: Vision, hype, and reality for delivering computing as the 5th utility. *Future Generation Computer Systems,* 25**,** 599-616.

CASTELLS, M. 2001. The Internet Galaxy: Reflections on the Internet, Business, and Society.

CEGIELSKI, C. G. 2012. Adoption of cloud computing technologies in supply chains: An organizational information processing theory approach. *International Journal of Logistics Management, The,* 23**,** 184-211.

GATIGNON, H. & ROBERTSON, T. S. 1989. Technology Diffusion: An Empirical Test of Competitive Effects. *The Journal of Marketing,* 53**,** 35-49.

HSU, P.-F., KRAEMER, K. L. & DUNKLE, D. 2006. Determinants of E-Business Use in U.S. Firms. *International Journal of Electronic Commerce,* 10**,** 9-45.

IACOVOU, C. L., BENBASAT, I. & DEXTER, A. S. 1995. Electronic Data Interchange and Small Organizations: Adoption and Impact of Technology. *MIS Quarterly,* 19**,** 465-485.

Vol 6, No 2, 2014 ISSN: 1309-8047 (Online)

LI, Y.-H. & LI, Y.-H. An empirical investigation on the determinants of e-procurement adoption in Chinese manufacturing enterprises. 2008. IEEE, 32-37.

LUFTMAN, J. & ZADEH, H. S. 2011. Key information technology and management issues 2010-11: an international study. *Journal of Information Technology,* 26**,** 193-204.

OATES, B. J. 2006. Researching Information Systems and Computing.

OLIVEIRA, T., MARTINS, M. F. & LISBOA, U. N. D. 2011. Literature Review of Information Technology Adoption Models at Firm Level. 14**,** 110-121.

ORLIKOWSKI, W. J. & BAROUDI, J. J. 1991. Studying Information Technology in Organizations: Research Approaches and Assumptions. *Information Systems Research,* 2**,** 1-28.

PETER, M. & TIM, G. 2010. The NIST Definition of Cloud Computing. *Association for Computing Machinery. Communications of the ACM.* New York: Association for Computing Machinery.

STUART, I., MCCUTCHEON, D., HANDFIELD, R., MCLACHLIN, R. & SAMSON, D. 2002. Effective case research in operations management: a process perspective. *Journal of Operations Management,* 20**,** 419-433.

VAQUERO, L. M., RODERO-MERINO, L., CACERES, J. & LINDNER, M. 2008. A break in the clouds: towards a cloud definition. *SIGCOMM Comput. Commun. Rev.,* 39**,** 50-55.

YIN, R. K. 2003. Case study research: design and methods.

ZHU, K., DONG, S., XU, S. X. & KRAEMER, K. L. 2006. Innovation diffusion in global contexts: determinants of post-adoption digital transformation of European companies. *European Journal of Information Systems,* 15**,** 601-616.