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Cloud computing adoption in Greece

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Abstract

Cloud computing adoption is an increasingly important trend in information and communication technologies, offering the potential to improve the reliability and scalability of IT systems. Diffusion of cloud computing can potentially change the way business information systems are developed, scaled up, maintained and paid for. This not only applies to large organisations, but also increasingly to small and medium-sized businesses. In this developmental paper, we study cloud computer adoption by applying the Technological, Organisational and Environmental (TOE) model. Data was gathered from 104 organisations in Greece using an online survey. Based on our preliminary analysis, among the factors examined, only relative advantage was found to have significant influence on adoption decisions so far. We are currently continuing our data collection process, which will enable us to undertake more robust analysis. One of the areas of potential interest is the effect of the financial crisis among those who intend to adopt cloud computing.

Keywords: cloud computing, IT adoption, financial crisis, TOE framework, diffusion of innovation

1 INTRODUCTION

This paper's main research objective is to contribute to the ICT technology adoption literature, by studying cloud computing adoption during the Greek financial crisis. Cloud computing is *"a style of computing where massively scalable IT-related capabilities are provided as a service using Internet technologies to multiple external customers*" (Plummer *et al.*, 2008, p.3). For organisations cloud computing promises to deliver tangible business benefits, often at much lower cost as they only pay for the resources needed, offering them good return on investment of their limited resources. In turn they can focus on what truly delivers value to their customers and results in a competitive advantage. Given that the

absence of sufficient resources can limit an organisation's IT capabilities, in particular in the case of small businesses (Cragg and King, 1993; Wymer and Regan, 2005), the promised benefits of cloud computing render it an attractive proposition for small firms, which need to maximise the return on their investment and remain competitive in an ever demanding business environment. More specifically, our main research question is what the major factors are that influence cloud computing adoption and in particular whether organisational size is a significant factor. We are also interested in whether environmental factors, such as the financial crisis, have influenced adoption decisions.

2 LITERATURE REVIEW

Theories such as Roger's (Rogers, 2003) Diffusion of Innovation Theory (DOI) have been widely applied to studies looking at how organisations adopt innovations and how these are diffused over time. This paper will use the Technology, Organisation, and Environment (TOE) framework put forward by Tornatzky and Fleischer (Tornatzky and Fleischer, 1990), which is closely related to DOI, when it comes to the technological and organisational context. The former refers to the internal and external technologies related to the organisation and may include technology or practice, while the latter refers to the resources and the characteristics of the firm, e.g. its size and its managerial structure etc. TOE extends DOI most notably by adding the environmental context, which refers to the business environment in which a firm conducts its business, enabling it to explain intra-firm innovation adoption (Oliveira and Martins, 2011). Each of the three contexts comprises key factors that need to be considered.

2.1 Technological Context

Starting with **relative advantage**, this is defined as "*the degree to which an innovation is perceived as being better than the idea it supersedes*" (Rogers, 2003, p.229). The higher the perceived need of an innovation for an organisation the higher the probability that it will adopt the innovation (Rogers, 2003; Lee, 2004). The second factor is **uncertainty,** which refers to the extent to which the results of using an innovation can be guaranteed (Ostlund, 1974; Fuchs, 2005). The next factor, **compatibility**, is *"the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters"* (Rogers, 2003, p.240). From a business perspective there is a need for the technical and procedural requirements of the innovation to be compatible and consistent with the values and the technological requirements of the adopting organisation (Lertwongsatien and

Wongpinunwatana, 2003), while from a technical perspective the focus is on achieving a high level of integration between the existing and the adopted technologies (Kamal, 2006). A perceived high compatibility of the innovation with an organisation's already deployed technologies could positively affect the adoption process (Tornatzky and Fleischer, 1990) while poor integration of new systems with existing ones could result in the opposite (Akbulut, 2003). The fourth factor is **complexity,** which refers to *"the degree to which an innovation is perceived as relatively difficult to understand and use"* (Rogers, 2003, p257). Complexity has been found to be a significant negative factor in the adoption decision (Thong, 1999; Kendall, 2001; Ramdani and Kawalek, 2008). Finally, **trialability,** i.e. *"the degree to which an innovation may be experimented with on a limited basis"* (Rogers, 2003, p.258), has been reported as having a positive impact on the decision to adopt the innovation (Martins *et al.*, 2004; Ramdani and Kawaiek, 2007). This is more significant for early adopters than laggards as the latter can benefit from the experience of the former as an indication of how the innovation performs (Rogers, 1995). **Observability** is defined as "the degree to which the results of an innovation are visible to others" (Rogers, 2003, p. 258). The results of some ICT innovations have been seen to impact the industry and are easily observed and communicated to others, whereas some innovations are difficult to observe and to illustrate to others (Ramdani, 2008). Featherman defined **Privacy risk** as "Potential loss of control over personal information, such as when information about you is used without your knowledge or permission" (Featherman *et al.*, 2003, p. 455). Adoption of a new technology involves risk (Erumban and de Jong, 2006). Due to the open nature of the Internet, privacy risk has been recognised as a key factor hindering the use of some ICT technologies, e.g. e-service evaluation and adoption (Featherman *et al.*, 2003). As far as cloud computing is concerned, privacy risk is among the typical concerns businesses may have (Aziz, 2010). Recognition of some concerns in cloud computing can be a possible hindrance to SMEs adopting cloud computing until uncertainties are resolved. Much of the uncertainty around cloud computing is about how data is handled and where it is stored. Risk due to **geo-restriction** may be particularly important for cloud computing adopters. A new factor, geo-restriction, is identified as being crucial for businesses when considering adopting cloud computing services. Businesses tend to underline this point in any negotiation with service providers. Some SMEs might show no tolerance regarding this issue (Alshamaileh *et al.*, 2012).

H1: Increased perceived relative advantage of cloud computing increases propensity to adopt cloud computing services.

H2: Decreased perceived uncertainty of cloud computing increases propensity to adopt cloud computing services.

H3: Increased perceived compatibility of cloud computing increases propensity to adopt cloud computing services.

H4: Decreased perceived complexity of cloud computing increases propensity to adopt cloud computing services.

H5: Trialling cloud services before adopting them increases propensity to adopt cloud computing services.

H6: Increased perceived observability of cloud computing increases propensity to adopt cloud computing services.

H7: Decreased perceived Privacy risk of cloud computing increases propensity to adopt cloud computing services.

H8: Decreased perceived Risk due to geo-restriction of cloud computing increases propensity to adopt cloud computing services.

2. 2 Organisational Context

The first factor that needs to be considered in the organisational context is the **size of the firm,** which has been identified by several studies as one of the main predictors of ICT innovation adoption (DeLone, 1981) (Buonanno *et al.*, 2005; Levenburg *et al.*, 2006) On the one hand larger firms that have more resources at their disposal are able to pilot and experiment with new technologies, which can positively impact the adoption of innovations (Premkumar and Roberts, 1999). On the other, small businesses that, due to their size, can be more agile and flexible can be very innovative, adapting to the changes in their environment (Damanpour, 1992; Jambekar and Pelc, 2002). **Top management support** is also key to successful integration of new technological innovation in organisations (Lertwongsatien and Wongpinunwatana, 2003) (Ramdani and Kawaiek, 2007; Wilson *et al.*, 2008), as it can convey the importance of the innovation for the organisation to all stakeholders and at the same time ensure the availability of the necessary resources (Premkumar and Roberts, 1999; Daylami *et al.*, 2005). The last organisational context factor is **innovativeness,** which refers

to the degree to which an individual or a firm tends to adopt a specific innovation earlier compared to other member in the same social context (Rogers and Shoemaker, 1971). The receptiveness of an organisation toward new ideas plays a key role in the adoption decision (Marcati *et al.*, 2008), while longitudinally, a history of innovativeness promotes the likelihood for further positive adoption decisions when it comes to new technological innovations (Damanpour, 1991; Marcati *et al.*, 2008). Finally, adoption can be affected by the **prior technological experience**, accumulated while using new innovations, which has been found to be an important factor influencing technology adoption decisions (Igbaria *et al.*, 1995; Hunter, 1999; Kuan and Chau, 2001).

H9: The smaller the size of the firm, the more likely cloud computing will be adopted by firms.

H10: High top management support increases propensity to adopt cloud computing services.

H11: The more innovative a firm is, the more likely it is to adopt cloud computing.

H12: The more prior technology experience a firm has accumulated, the more likely it is to adopt cloud computing.

2.3 Environmental Context

The external environment in which a firm operates can have a direct effect on the adoption decision, with prior empirical studies noting the importance of **competitive pressure** as an adoption driver (e.g. see (Grover, 1993; Iacovou *et al.*, 1995; Crook and Kumar, 1998)). The **industry** within which the firm operates can influence its ability to adopt new ICT innovation (Jeyaraj *et al.*, 2006). In contrast, there is also evidence showing that the sector in which a firm operates has little influence on ICT innovation adoption (Levy *et al.*, 2001). As firms in different industry sectors have different needs, it appears that some businesses in certain sectors are more likely to adopt new ICT technologies than others in different sectors (Yap, 1990; Levenburg *et al.*, 2006). **Market scope** is the horizontal extent of a company's operations (Zhu *et al.*, 2003), referring to whether organisations operate locally, nationally or even internationally. **Lastly, supplier efforts and external computing support** is "*the availability of support for implementing and using an information system*" (Premkumar and Roberts, 1999). Organisations may be more willing to try a new technology if they feel there is sufficient support for it (Premkumar and Roberts, 1999). On the other

hand, there have also been reports of this factor not being significant for innovation adoption (Raymond, 1985; DeLone, 1988).

H13: Increased competitive pressure increases the propensity to adopt cloud computing services.

H14: The industry within which a firm operate affects the propensity to adopt cloud computing.

H15: Firms with wider market scope are more likely to adopt cloud computing.

H16: Increased external computing support increases the propensity to adopt cloud computing services.

This study takes place in Greece, which has been in political and financial turmoil for the past few years (for a review of the Greek crisis see (Choupis; Pagoulatos and Triantopoulos, 2009; Kouretas and Vlamis, 2010; Sakellaropoulos, 2010; Zahariadis, 2010)). During such times of economic contraction companies need to respond appropriately. Cloud computing promises a financially viable way of scaling up infrastructure, which leads us to hypothesise that:

H17: The more a company has felt the effects of the financial crisis the more it may be willing to adopt cloud computing services.

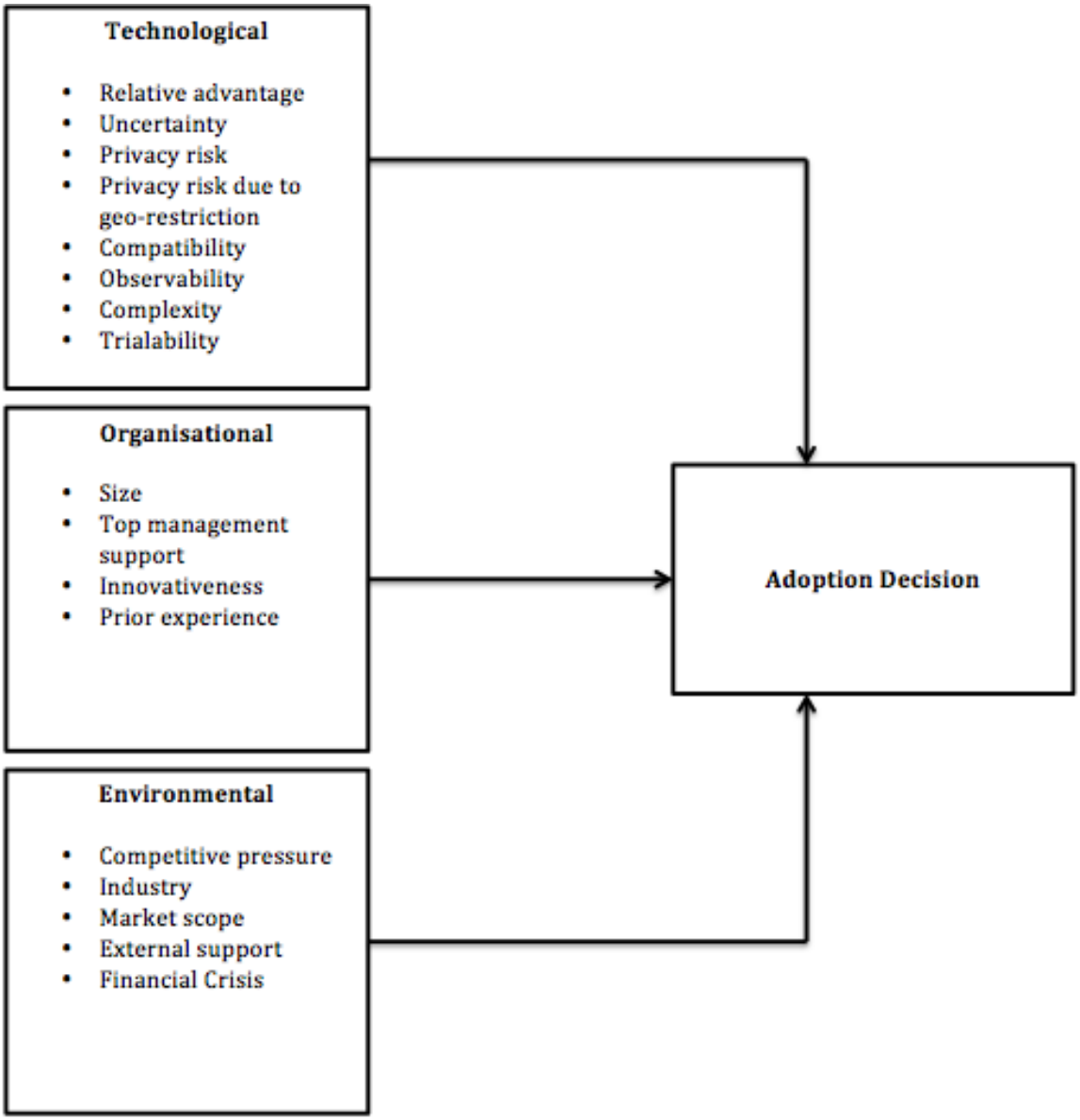

Figure 1. TOE model

3 METHODOLOGY

3.1 Research design and data collection

TOE constructs were operationalised by adopting and adapting items and scales found in the literature, as summarised in Table 1. The items used for measuring the constructs were derived from operationalisation used in prior empirical studies, and were adapted to suit this research context, followed by pilot testing. The results showed that the questionnaire covered important aspects identified within the literature review.

When it came to reliability, Cronbach's alpha coefficients for each of these constructs were calculated. It has been suggested that a minimum level of 0.6 for reliability coefficient is preferred (Hair *et al.*, 2006). External support was originally measured by 5 items but 1 was excluded due to low reliability.

Factors	Source	Items	Reliability (Cronbach's a)
Technological			
Relative advantage	(Moore and Benbasat, 1991)	8	.953
Uncertainty	(Featherman *et al.*, 2003)	5	.816
Privacy risk	(Featherman *et al.*, 2003)	3	.881
Privacy risk due to geo-restriction	(Featherman *et al.*, 2003)	3	.935
Compatibility	(Moore and Benbasat, 1991)	4	.871
Observability	(Moore and Benbasat, 1991)	3	.768
Complexity	(Moore and Benbasat, 1991)	7	.879
Trialability	(Moore and Benbasat, 1991)	5	.941
Organisational			
Top management support	(Yap *et al.*, 1994; Ramdani, 2008)	4	.756
Innovativeness	(Agarwal and Prasad, 1998)	4	.864
Prior similar technology experience	(Lippert and Forman, 2005)	3	.937
Environmental			
Competitive pressure	(Lippert and Forman, 2005)	2	.835
External support	(Yap *et al.*, 1994)	4	.716
Financial Crisis	(Prawitz *et al.*, 2006)	8	.633

Table 1. Measurement of research variables

Hypotheses testing: Multivariate analysis assesses the relationships among three or more variables simultaneously. There are several multivariate statistical techniques (e.g. logistic regression) (Everitt, 2003). The hypothesis-testing component of the present study used multivariate analysis techniques in order to test the hypothesised model.

Regression analysis is used as a common method of analysing and describing the relationship between a response variable and one or more explanatory variables. Logistic regression helps to predict the probabilities of decision making and measures how well the independent variables explain the dependent variable (Pallant, 2007). In view of the research objectives for this research project, it was considered that binary logistic regression would be an appropriate analysis method for analysing and predicting organisations' choice behaviour. This is mainly because it helps to analyse the dependency of a dichotomous variable from other independent variables. Usually, the dichotomous variable is an event that can occur or not. In this case this event refers to whether a company decides to adopt cloud computing (coded as 1) or not (coded as 0). It is worth mentioning the successful usage of these types of regression models in previous ICT innovation adoption studies, e.g., Enterprise systems adoption (Ramdani, 2008), and E-business adoption (Zhu et al., 2003). In this type of model one estimates the probability of an event occurring.

3.2 Sample

The data collection was initiated in the November 2012 and is still in progress. So far we have collected 156 responses out which 123 were completed in full. Within those we used a subset of 104 responses, based on whether the responder had a senior management position influencing the cloud adoption strategy or implementation. The majority of the firms participating were SMEs (fewer than 250 employees and 50M Euros turnover) (74% vs. 26%). About a third were offering technological services and products. 11.5% had a local or regional scope, while the remaining were equally split between the national and international scope when it came to their market orientation. As far as cloud computing adoption is concerned, 43.3% reported that they had adopted cloud computing, 51% that they were thinking of adopting it in the next 3 years, while the remaining answered that they were not considering adopting cloud computing.

4 PRELIMINARY RESULTS

This section presents our preliminary results. Given the sample size and the number of variables we have decided to keep only the core TOE framework options and not include privacy risk, geo-restriction and the effect of the financial crisis into our analysis. Our dependent variable in our logistic regression was whether participants had already adopted or not cloud computing. Cox & Snell R^2 was .389 while Nagelkerke R^2 was .522.

			Predicted		
			Adoption		**Percentage**
	Observed		**No**	**Yes**	**Correct**
Step 1	Adoption	No	53	6	89.8
		Yes	11	34	75.6
	Overall Percentage				83.7

	B	S.E.	Wald	df	Sig.	Exp(B)
Relative Advantage	1.156	.499	5.358	1	.021	3.177
Uncertainty	-.397	.511	.604	1	.437	.672
Compatibility	-.374	.589	.404	1	.525	.688
Complex	.694	.661	1.101	1	.294	2.001
Trialability	.655	.480	1.864	1	.172	1.925
Observability	.122	.417	.085	1	.770	1.129
SME (Yes?)	-.707	.667	1.121	1	.290	.493
Top Management Support	-.716	.500	2.052	1	.152	.489
Innovativeness	-.372	.492	.570	1	.450	.690
Prior Experience	.348	.419	.690	1	.406	1.416
Competive Pressure	.055	.388	.020	1	.887	1.057
Sector (Technological?)	.175	.610	.082	1	.774	1.191
Scope (International?)	-.774	.599	1.668	1	.197	.461
External Support	-.903	.614	2.162	1	.141	.405
Constant	.126	3.305	.001	1	.970	1.134

Table 2. Logistic regression predictions and factors.

Only relative advantage factors have been found to be significant at this stage. We will continue our data collection process in order to increase our sample and valid cases.

5 DISCUSSION

While cloud computing is considered an important ICT innovation that can provide strategic and operational advantages, it has yet to see significant rates of adoption among organisations. Therefore, there is a requirement to understand what factors influence cloud-computing adoption in the small businesses. Based on the TOE theoretical framework, this study attempt to develop a research framework to study the influential contextual factors on cloud computing adoption in organisations.

Based on our preliminary analysis, this study provides evidence that perceived relative advantage was positively associated with the adoption decision on cloud computing and was significant (p=0.05 in the research model). This outcome corroborates the results of a great deal of the previous work in this field, such as (Premkumar and Roberts, 1999; Nelson, 2003; Dedrick and West, 2004; Gibbs and Kraemer, 2004; Wu and Lee, 2005; Anand and Kulshreshtha, 2007). In fact, it corresponds to the dominant argument regarding the significance of relative advantage in understanding organisations' adoption of new ICT innovations.

When firms perceive that an innovation offers a relative advantage, then it is more likely that they will adopt that innovation (Lee, 2004). However, these relative advantages need to be clear for organisations. It can therefore be assumed that small firms need to perceive cloud services as new a computing model that could increase their profitability before they will take a positive adoption decision. The client's innovativeness and self-motivation are not always enough. Therefore, awareness and understanding of these advantages is important for the adoption decision. This draws attention to the central importance of the role of supplier marketing efforts.

Based on our preliminary analysis, the rest of factors examined were found to have insignificant influence on adoption decisions so far. We are currently continuing our data collection process, which will enable us to undertake more robust analysis.

6 CONCLUSION AND LIMITATIONS

This study has been an attempt to explore and develop an organisations cloud computing adoption model that is theoretically grounded in the TOE framework. A validated conceptual model to be developed in order to examine the influence of key contextual factors on cloud computing adoption in organisations in Greece. New technologies are expected to bring significant benefits and value to a company, well beyond those that already-adopted technologies deliver. Adoption of new technology is sometimes postponed for the reason that the firm is not fully aware of the potential benefits of adopting these innovations. As discussed earlier, the client's innovativeness and self-motivation are not always enough. Therefore, awareness and understanding of these advantages is important for the adoption

decision. Relative advantage was observed to have a significant influence on cloud computing adoption in the organisations. This implies that managers should evaluate the potential benefits of cloud computing, and increases their awareness about these services in order to decrease the level of uncertainty.

This study expands our knowledge about the ICT innovation adoption among organisations. However, it is thought that there are many areas for additional studies and empirical research, given the limitations of the research. We must say that this piece of research represents only a tiny fraction of the vast knowledge about ICT innovation adoption but it may be considered as an important contribution in the pursuit of fulfilling the knowledge about ICT technology adoption in organisations, cloud computing services in particular. However, there has not been much research done on cloud computing in organisations and much more can be discovered, especially the process in which different size enterprises adopt new technologies such as cloud computing. Notwithstanding the fact the this piece of work has focused mainly on the factors that affect cloud computing adoption among organisations, certain areas that need further research have emerged. Future research could build on this study by examining cloud computing adoption in different sectors and industries and in different countries in both a qualitative and quantitative way.

For instance, though our online survey investigation of the model of cloud computing adoption provided findings on the cloud computing adoption among organisations, further research is needed to complete our understanding of this subject. Large-scale, longitudinal research would be preferable for addressing this issue. In fact, the diffusion of innovation is a socialisation process that occurs over time, in which member attitudes toward the desirability of various behaviours are developed as time passes (Zmud, 1982). Therefore, there is no way to avoid including time when diffusion is studied. However, such a research project requires much financial investment and human effort. Factors influencing the adoption of a particular technology at a particular phase may change over time through other phases. It would also be interesting to look at a firm's performance pre/post adoption of new ICT innovations.

The focus of the research model has been on the relationships among constructs identified in this study. The variables included are not intended to be comprehensive. They were selected as representing the key factors potentially affecting organisations ' adoption of cloud computing. The findings should be viewed with caution as other potentially important factors (e. g. individual characteristics) have been excluded.

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