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Key Management Determinants For Cloud Computing Adoption

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Abstract

Although there are a significant number of advantages associated with cloud computing, there is less clarity of what are the key management determinants for cloud computing adoption. This study aimed to investigate what the most significant determinants for cloud computing adoption are within the United Kingdom (UK). The 'Technology-Organisation-Environment' (TOE) adoption framework was used to develop eight hypotheses which allowed data collection through a self-created questionnaire based survey that was completed by 257 mid-to-senior level decision making business and IT professionals from a range of UK end-user organisations. The derived hypotheses were tested using various data analysis techniques including factor analysis and logistic regression. The results show that four out of the eight factors examined have a significant influence on the adoption decision of cloud computing services in the UK. Those key factors include competitive pressure, complexity, technology readiness and trading partner pressure. The latter predictor; trading partner pressure, was the most significant factor for the adoption decision of cloud services. The findings reveal the important role of cloud computing service providers to enable end-user organisations to better evaluate the use of cloud computing.

Keywords: Cloud Computing Services, Technology Adoption

1 Introduction

Organisations of all size and industry sector are rapidly adopting many technological innovations, with the cloud being at the forefront. The term 'cloud computing' has exploded from an interesting business concept for providing flexible and on-demand infrastructure , platforms and software as a service to one of the fastest growing segments of the IT industry" (Ambrust et al, 2010; Subashini and Kavitha, 2011; Noor, Sheng and Jian, 2013). Cloud computing is proposed to become the next major technological disruption that transforms the 'standard' model of Information Technology (IT) services in order to remain competitive and in response to ever changing business environments.

Adoption of cloud computing is a logical evolutionary step, made possible due to the recent mass adoption of the internet (Dhar, 2012). For many organisations who have embraced the cloud, it is seen as a powerful tool that will change the IT landscape forever (Linthicum, 2013). However, for others, the cloud is seen as immature, a major 'hype' and complex, whilst still inherently compelling (Romero, 2012).

This technological innovation is at the forefront of the computing world, especially so with the increasing pressure on IT teams to do more with less, budget and staff cuts, plus the existing poor economic climate, resulting in the need to cut costs whilst remaining competitive. Although there are a significant number of advantages associated with cloud computing, the service does come with a number of potential risks regarding security, reliability and data privacy and data protection laws among others (Yang, 2012; Dutta, Peng and Choudhary, 2013).

This research is focused on the entire UK end-user market where cloud services have witnessed a 27% increase in first-time users over the last 18 months (Cloud Industry Forum, 2013). According to The Cloud Circle (2012), every different vertical, industry sector and organisation size has engaged in cloud services to some degree. In 2013, approximately 65% of UK organisations were using some form of cloud services (Cloud Industry Forum, 2014), whilst the European Commission has estimated that cloud computing will boost EU GDP by €600Bn by 2020.

The future of modern computing lies in this service, cloud computing, whose major objective is to reduce costs and to minimise processing time associated with IT services, while improving and enhancing reliability, processing throughput, flexibility and availability (Hayes, 2008). This study aimed to investigate what the most significant determinants for cloud computing adoption are within the UK, in order to help organisations better consider their future IT adoptions. The remainder of the article is organised as follows. In Section 2 cloud computing is briefly defined. Section 3 explains the TOE framework and a comparison of previous cloud computing studies that have also use this framework. In Section 4 the conceptual model is presented together with the hypothesis developed to analyse the key management factors affecting the IT adoption of cloud computing. Section 5 describes the survey process conducted to collect data from 257 professionals. This section also includes the data validation and analysis conducted through several techniques including factor analysis and logistic regression. In Section 6 the main finding are discussed and conclusions are drawn to finally present limitation and further research in Section 7.

2 Defining Cloud Computing

The term 'cloud computing' has only recently evolved as a major technological innovation with significant advancements over the last 10 years (Cusumano, 2010). Whilst there is no official definition for cloud computing, a review of technology and computing literature reveals how multiple authors have defined it differently, typically focusing on the service and technical characteristics. Cloud computing is seen as a "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). However, other authors have emphasised it is an evolution of grid computing and define computing as "a type of parallel and distributed system consisting of a collection of interconnected and virtualised computers that are dynamically provisioned and present as one or more unified computing resources based on service-level agreements established through negotiation between service provider and customer" (Buyya et al, 2008). Kumar and Ravali (2012) define the cloud as where software applications, processing power, data and potentially even artificial intelligence are accessed over the internet. Another source states that cloud computing is the use of any server or software application, outside of one's local server (Wolf, 2010), with the simplest and shortest definition being "a new technology model for IT services" (Yang, 2012).

The standard cloud computing model promotes availability and is composed of five essential characteristics, four service models and four deployment models (Mell and Grance, 2011) as summarise in Table 1.

Essential Characteristics	**Service Models**	**Deployment models**
On-demand self service	Cloud Software as a Service (SaaS)	Private Cloud
Broad network access	Cloud Platform as a Service (PaaS)	Community Cloud
Resource pooling	Cloud Infrastructure as a Service (IaaS)	Public Cloud
Rapid elasticity		Hybrid Cloud
Measured service		

Table 1. Cloud Computing Characteristics and Models

2.1 ADVANTAGES AND DISADVANTAGES OF CLOUD COMPUTING

There are many reported advantages to cloud computing with particular reference to the cost saving benefits (Jackson, 2011; Garrison, Kim and Wakefield 2012) such as the removal of legacy IT systems which makes it difficult to extend IT infrastructure into other global regions. The service is dynamically scalable because users only have to consume the amount of online computing resources they actually want. Cloud computing is device-independent because the resource can be accessed not just from any computer via the internet but also from any type of device such as mobile phones, tablets, laptops or desktop computers, from any geographical location (Dhar, 2012). The service is charged on a per usage basis and has no fixed costs resulting in a lower investment and reduced risk with immediate access to cost saving improvements (Walterbusch et al, 2013). This is very useful for companies who experience high and low levels of demand for their website for example and only want to pay for the server usage increase as and when it happens; e.g. Ticketmaster (Duffy, 2012). High levels of support are provided and customers have the enjoyment of the most advanced security procedures available through the performance of the cloud service providers with in-depth experience and knowledge in this area (Romero, 2012). Other benefits of cloud computing include ‘agile updating’ where a service provider hosts an application and system updates take place seamlessly without any scheduled downtime (Yang, 2012). Additional attractions include zero initial investment into hardware and as mentioned earlier, a significant reduction in system administration costs. The cloud has often been seen as ideal for short term projects, since users can concentrate on the project, rather than the hassles of setting up the technical infrastructure for the support (Yang, 2012), thanks to the quick deployment opportunities and ease of integration.

Although there is plentiful publicity revealing the benefits of cloud computing and how every organisation in the world should adopt certain elements of these services where appropriate; there are some concerns and drawbacks also. It must be noted that cloud service providers will potentially encounter similar technical issues as an organisation might, who have their information and data stored in-house, such as server downtime, maturity and performance issues as well as internet service outage (Yang, 2012; Dutta, Peng and Choudhary, 2013). Internet bandwidth is closely linked to the successful adoption of cloud computing services and since this technological innovation uses internet as the primary channel for both data transfer and running applications, it requires both secure and significant internet speed to provide an attractive service. The 'Growth and Infrastructure Bill', currently before the UK Parliament will see the deployment of superfast broadband networks to over 90% of the UK by 2015 (GOV.UK, 2013).

With regards to the storage of 'digital data', there is still a high fear level of putting one's information in the hands of third parties (Romero, 2012; Dutta, Peng and Choudhary, 2013). Issues have arisen such as confidentiality, theft, loss of data and of course, questions over data ownership. However, organisations are increasingly more likely to use cloud computing, since the use of Web 2.0 and social networks have become so widespread (Romero, 2012). Both banking and personal data are of extremely high sensitivity, yet this data is commonly stored on servers over which customers have no domain or ownership (Bannister, 2011). This helps explain why many organisations are inclined to take the decision of progressively moving towards cloud services by initially uploading applications of low sensitivity (Romero, 2012). Following this learning process, more valuable information can be uploaded to the cloud. However users must be aware that since their applications and services will be run remotely on third party environments, then they will have limited control over the functionality and execution of the hardware and software. Tsagklis (2013) agrees that since 'remote software' is being used, it will lack the specific features of an application being run locally, reducing control and flexibility.

A final, yet very important potential disadvantage of cloud computing is the unspoken dependency on the providers, i.e. cloud vendors (Tsagklis, 2013). The industry refers to this as 'vendor lock-in' since it is often extremely difficult, if not impossible to move to another provider, once you have already commenced a commercial relationship with one. If a cloud computing user wished to switch to another provider then the transfer of significant data volumes from the old to new provider could be a painful and cumbersome process, highlighting the importance of prospective users carefully and thoroughly evaluating all options when selecting a vendor (Tsagklis, 2013).

Although research has revealed some potential disadvantages to cloud computing, this technology is still within the growth stage of its life cycle. The service has been well tested, proven to be an excellent innovation and has infinite potential for the future. An increasing number of organisations are continuously attracted to the service as it is constantly tuned, updated and seen to become more secure and trustworthy.

3 Technology-Organisation-Environment (TOE) Adoption Framework

A framework, which was first developed by Rocco DePietro, Edith Wiarda, Louis Tornatzky and Mitchell Fleischer (Low et al, 2011; DePietro, 1990), called the 'Technology-Organisation-Environment' framework (TOE) and later edited by various researchers, has been extensively used to help analyse IT adoption by organisations from many different sectors and geographic locations (Appendix A). Through this framework, the technology innovation development is influenced by three aspects of an organisations context:

- Technological context refers to the internal and external technologies that are applicable to the organisation. This includes technologies that are available within the marketplace but also currently in use at the organisation (e.g. Mobile commerce, e-commerce, open systems, ICT, ERP etc.)
- Organisational context relates to multiple different factors concerning the organisation itself, including firm size, scope, trust, centralisation, technology readiness, formalisation, intricacy of management layout and the quality of human resources
- Environmental context covers the "macro area that an organisation conducts its business, with business partners, competitors and the government" (Duan et al, 2012). This includes elements such as industry, intentions and the presence of technology service providers (Alshamaila et al, 2013)

Various literature supports the use of the TOE framework to investigate IT and IS innovations and have focussed specifically on e-business, ICT, ERP, e-commerce and open source systems to name a few, summarised in Appendix A, along with the main variables considered for each of the three main contexts (Alshamaila et al, 2013; Upadhyay et al, 2011).

Low et al. (2011) applied this TOE framework to explore cloud adoption within the Taiwanese high-tech industry. The authors specified that there were eight factors which influence the adoption of cloud computing: "technological context (relative advantage, complexity and compatibility), organisational context (top management support, firm size and technology readiness) and environmental context (competitive and trading partner pressures)" (Low et al, 2011). A questionnaire based survey was used to collect data from a sample of 111 high-tech firms and through their stated hypothesis, logistic regression analysis was run on the data revealing 'relative advantage, top management support, firm size, competitive pressure and trading partner pressure' to have a significant effect on the adoption of cloud computing services.

Another study was recently completed by McKenna (2012) using the same TOE framework to evaluate the determinants of cloud adoption within British IT and technology small-to-medium enterprises (SME's). The author evaluated the same factors as Low et al (2011) apart from the environmental context 'trading partner pressure' factor as it was not deemed important during the hypothesis evaluation stage. McKenna surveyed 104 SME IT organisations and through factor and logistic regression analysis (using SPSS), discovered that the following five factors were significantly important for driving cloud adoption: "relative advantage, management support, complexity, compatibility and technology readiness" (McKenna, 2012).

Both Low et al (2011) and McKenna (2012) highlighted significant limitations of their studies through the narrow focus on specific industry sectors and/or specific organisation size.

4 RESEARCH MODEL AND HYPOTHESES

The TOE framework is based on meso-level (organisational-level) theory and as discussed earlier, incorporates technological, organisational and environmental contexts as the most important determinants of cloud adoption (Figure 1). Previous literature has revealed eight predictors across these three contexts whereupon the adopter (0) or non-adopter (1) firms can be considered as a binary variable. The eight factors were hypothesised (H1 – H8) below to confirm if they have a direct effect on an organisations decision to adopt cloud services.

The relationship between all of the eight factors is outside the scope of this research. As a result, the hypotheses were tested revealing the most significant driver(s) of cloud adoption.

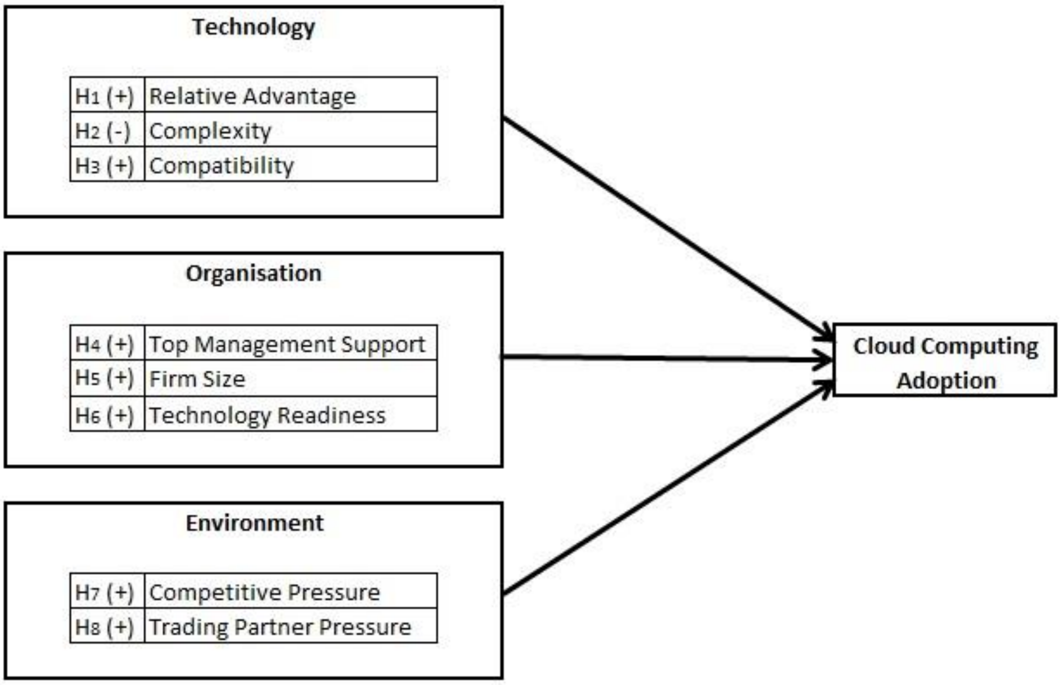

Figure 1: Conceptual model of TOE framework adapted for analysing cloud computing adoption

4.1 Technological Context

The technological context was described as being both the internal and external technologies relevant to an organisation, including technologies that are both already in use within the organisation as well as those that are not in use at this time but available in the marketplace. For the purpose of this research, the technology in discussion is that of cloud computing.

Relative Advantage

Relative advantage is a core indicator to the adoption of new IS innovations and Rogers (2003) defines it as being the degree to which a technological factor is perceived to provide a greater benefit for organisations. A number of previous studies have researched in detail the impact of relative advantage on an organisations technological adoption, including Thong (1999) and Lee (2004) who revealed that when businesses perceive relative advantage of an innovation, then the probability of adoption will increase (Alshamaila et al, 2013). Cloud computing offers many advantages to those adopting it including flexibility, scalability, on-demand, low entry cost and pay-per-use models. Organisations have almost instant access to on-demand hardware and software resources accessed over the internet with minimal upfront capital investment. To and Ngai (2006) state that it is reasonable to assume organisations take into consideration the advantages and potential disadvantages that might stem from adopting new innovations. Additional expected benefits from cloud computing adoption include “speed of business communications, efficient coordination among firms, better customer communications and access to market information mobilisation” (Low et al, 2011).

Hypothesis 1 (H1): Relative advantage will be positively associated with the adoption of cloud computing.

Complexity

Rogers (2003) mentions that adoption of new IS innovations is less likely to take place if it is considered to be more challenging to use. Adoption of new technologies might cause problems for organisations of all sizes in terms of the need to possibly change processes of how they currently interact with their business systems. Berman et al (2012) states that new technologies need to be easy to use and manageable in order to increase the adoption rate. In addition, due to the relative infancy of cloud computing, some organisations may not have sufficient confidence levels, resulting in longer adoption periods and signalling that complexity could be acting as a barrier to cloud implementation. Based on this research, although complexity is a significant factor in the adoption decision, in contrast to other innovation characteristics, it is seen to be negatively linked with the probability of adoption.

Hypothesis 2 (H2): Complexity will be negatively correlated with the adoption of cloud computing.

Compatibility

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). Researched literature confirms compatibility as an essential factor for adoption of new IS innovations where organisations are more likely to contemplate adopting the cloud if the technology is recognised as being compatible with existing work application systems and the organisations values and beliefs. In addition, the adoption of new technological innovations can be influenced by past experiences of any other successful technological adoption. In contrast, if the technological innovations in question (i.e. the cloud) is seen as incompatible, then significant changes to processes are necessary which requires considerable new learning and high costs.

Hypothesis 3 (H3): Compatibility will be positively correlated with the adoption of cloud computing.

4.2 Organisational Context

Organisational context is related to the resources and characteristics of the firm, including factors such as the size of organisation, quality of human resources, organisational readiness (from a technological and personnel perspective), innovativeness and the level of complexity with regards to top management support (Sila and Dobni, 2012).

Top Management Support

Top management support is crucial for organisations looking to create a supportive environment whilst also providing the suitable resources (with technical expertise) required to adopt cloud services. Having this support aids organisations in overcoming any internal barriers and resistance to change. Low et al (2011) state that "as the complexity of technologies increase, top management support" is essential to maintaining potential organisational change through an expressed vision and commitment, sending positive signals of confidence in the new technology to all employees of the firm. They play an important role as the implementation of cloud computing may involve integration of resources, activities and the reengineering of certain processes. Consequently, this factor is considered to have a significant impact on the adoption of new IT innovations.

Hypothesis 4 (H4): Top management support will be positively correlated with the adoption of cloud computing.

Firm Size

According to Rogers (2003) organisation size is one of the most fundamental determinants of the innovator profile. In addition, Pan and Jang (2008) state that large organisations have a higher tendency to adopt new IT innovations, particularly as a result of their superior flexibility, aptitude and ability to take risks. However, experimental results on what the correlation is between organisation size and IT innovation adoption are mixed. According to Annukka (2008), there are multiple studies revealing a positive correlation whilst other studies report a negative correlation. On balance, it can be argued that larger organisations have the skills, experience and resources to survive any potential failures better than smaller firms. However, smaller organisations can be more flexible and innovative due to their size and lower levels of bureaucracy. Recent industry reports suggest that larger organisations have a higher likelihood to adopt cloud services than smaller organisations (Goodwin, 2013) who completed a survey of over 268 senior UK business practitioners revealing how SMEs are less likely to adopt new technologies than larger organisations. In summary, organisation size is an important factor, affecting the strategic importance of adopting new technological adoptions such as cloud computing.

Hypothesis 5 (H5): Firm size will be positively correlated with the adoption of cloud computing.

Technology Readiness

The technological readiness of an organisation, which includes the technological infrastructure and IT human resources, has an effect on the adoption of new IT innovations (Low et al, 2011). The IT human resources provide the necessary skills, experience and knowledge base required to implement and integrate a new cloud service. Technological infrastructure refers more to the already installed and in-use enterprise systems and network technologies which provide the platform for new cloud applications to be built upon. The proposed cloud services will only become part of an organisations value chain of activities if they have the necessary infrastructure and technical competence. In summary, organisations who have the technological readiness are better primed for adoption of cloud computing.

Hypothesis 6 (H6): Technological readiness will be positively correlated with the adoption of cloud computing.

4.3 Environmental Context

Environmental context refers to the arena in which an organisation conducts its business, with researched literature relating it to surrounding elements including competitors, industry, governmental policies, market uncertainty and the presence of technology service providers (Alshamaila et al, 2013).

Competitive Pressure

The external environment has a direct impact on an organisation's adoption decision. Competitive pressure relates to the intensity and pressure levels experienced by organisations from their 'same industry' competitors (Laforet, 2011) highlighting its importance as a strong incentive and adoption driver. Many industries have characteristics of needing rapid change, where organisations face constant pressure and become increasingly aware of the need to follow their competitor's adoption of similar new technologies. Through cloud adoption, organisations can benefit from greater operational efficiencies, more accurate data collection and better understanding of market visibility (Low et al, 2011). This competitive pressure has resulted in many organisations outsourcing their IT infrastructure to not only improve effectiveness but also to enable lower prices to be offered, as an attempt to increase their market share.

Hypothesis 7 (H7): Competitive pressure will be positively correlated with the adoption of cloud computing.

Trading Partner Pressure

Many organisations rely on trading partners (i.e. cloud vendors) for their IT design and implementation of tasks (Low et al, 2011). Pan and Jang (2008), amongst other researchers reveal how trading partner pressure is a key determinant for IT adoption and use. Organisations of all size rely on the expertise and skills of trading partners when looking to adopt cloud services. The marketing activities, targeted communications and past projects completed by these trading partners can have a significant impact on a potential client's decision of whether or not to adopt new IT innovations.

Hypothesis 8 (H8): Trading partner pressure will be positively correlated with the adoption of cloud computing.

Null Hypothesis

The null hypothesis (N0) is the exact opposite of all alternative hypotheses (H1 - H8). It is required because one cannot prove the alternative hypotheses using only statistics; however it is possible to 'reject' the null hypothesis. Because the null hypothesis, even when rejected does not prove the alternative hypothesis, it merely supports them, it must be stated whether or not the chances of obtaining the necessary data is possible when the null hypothesis is true (Field, 2012, p. 27).

Hypothesis 0 (H0): The predictors proposed in H1 – H8 specify no connection with the adoption of cloud computing services.

5 Research Design and Results

This study aimed to investigate what the most significant determinants for cloud computing adoption are within the UK, through the use of the TOE framework, in order to help organisations better consider their future IT adoptions. The chosen research strategy was adopted, in order to accurately and definitively identify what the most significant drivers were and involved a deductive approach, allowing the creation of hypotheses through the reviewed literature and associated theories which were developed in conjunction with the eight core factors of the TOE adoption framework. This deductive approach involved the collection of numerical data, in order to determine whether these hypotheses could be either accepted or rejected. The numerical raw data, also known as quantitative data, was collected through a sampling technique, and processed and analysed through various statistical methods, revealing key information which could then be used to test the theory, i.e. the TOE model. The statistical analysis was completed using SAS analytics software to run the factor analysis and logistic regression. The self-created survey that was produced in order to obtain this quantitative data provided empirical evidence from a range of UK organisations of all industry types and sizes.

5.1 Respondent Characteristics

The final sample used was 1,003 in size with a recorded 325 'hits'. Of these 325 hits, 51 individuals contained incorrect email addresses and therefore did not receive the survey link and a further 17 individuals opted out of the opportunity to complete the survey, leaving a total of 257 usable responses (i.e. fully completed questionnaires). This yielded an overall response rate of 25.62% with no responses rejected as none contained errors or missing data and all respondents fell within the desired criteria.

The respondent sample was fairly evenly spread across organisation size, age, annual sales and industry sectors; however, there was a slight skew towards medium to large enterprises with high levels of annual sales that have been established for a long period of time. Significant efforts were made in attempt to limit this bias throughout the period the survey was live for, however as revealed by the literature review, SME's with a short established lifetime are less likely to have IT departments, resulting in a much smaller pool of relevant respondents who have a knowledge and/or interest in the cloud. This slight bias was not deemed detrimental enough to affect continuation of the reliability and data analysis.

A further limitation was that less than the 10% threshold of the sample accounted for non-adopters of cloud computing which was not ideal. However since this figure is actually 9.73% of the overall sample, it was also deemed to not have a negative effect on data analysis techniques. Bergtold *et al* (2011) discovered that sample size, whilst an important consideration, is not as large an issue as previously thought when conducting regression analysis in the presence of nonlinearity and possibly multicollinearity.

5.2 Data Analysis

Following identification of the eight factors through factor analysis, logistic regression was used with all eight independent predictor variables to test the research model (TOE), through its dichotomous (i.e. only two possible) outcome variables. The purpose of using this analysis technique is determining which factors contribute significantly to the adoption (or non-adoption) decision of cloud computing services within the UK.

However, prior to running regression analysis, multicollinearity must be tested for. Table 1 reveals the means and standard deviations across all adopter and non-adopter organisations in order to gain an initial impression on how well the data is distributed.

5.3 Testing for Multicollinearity

In order to check for multicollinearity, the two diagnostics of: variance inflation index (VIF) and associated tolerance were calculated (Table 5). The VIF values of each factor were (within the range of 1.085 to 1.340) well below the threshold of 10, with an average of 1.193 which is not substantially greater than 1; signalling no cause for concern or bias with regards to multicollinearity within the data set. The tolerance statistics were all greater than 0.2, again concluding that multicollinearity amongst the independent variables was not an issue.

Independent Variables	MEAN (SD)			VIF	Tolerance
	All	Adopter	Non-adopter		
TS	3.930 (0.777)	3.904 (0.780)	4.170 (0.692)	1.286	0.778
TR	3.936 (0.732)	3.903 (0.734)	4.240 (0.621)	1.257	0.796
CP	3.817 (0.804)	3.775 (0.810)	4.210 (0.617)	1.226	0.815
PA	3.575 (1.027)	3.500 (1.039)	4.267 (0.529)	1.101	0.908
RA	3.956 (0.678)	3.930 (0.667)	4.200 (0.642)	1.34	0.746
CM	4.065 (0.612)	4.042 (0.612)	4.280 (0.558)	1.085	0.922
CX	3.506 (1.018)	3.538 (1.007)	3.210 (0.643)	1.162	0.861
FS	3.868 (1.191)	3.846 (1.208)	4.067 (1.004)	1.085	0.922

Table 1: Means, standard deviations and diagnosing multicollinearity of all independent variables

5.4 Logistic Regression Output – The Wald Statistics

Having confirmed that none of the factors were affected by multicollinearity, regression analysis was run in order to test the research model. This produced a final SAS output table called 'Analysis of Maximum Likelihood Estimates' summarised below (Table 2), providing the estimate coefficients and statistics for each of the predictors that were included within the model (i.e. compatibility, complexity, firm size etc. and the constant).

Predictor	β regression coefficient	Standard Error	Wald Chi-Square statistic	Significance
Top Management Support (TS)	0.667	0.545	1.498	0.221
Technology Readiness (TR)	1.284 *	0.543	5.581	0.018
Competitive Pressure (CP)	1.192 *	0.621	3.68	0.05
Trading Partner Pressure (PA)	1.925 ***	0.462	17.403	<.0001
Relative Advantage (RA)	0.565	0.516	1.198	0.274
Compatibility (CM)	0.893	0.674	1.756	0.185
Complexity (CX)	-1.184 **	0.379	9.746	0.002
Firm Size (FS)	0.407	0.278	2.137	0.144
Intercept (constant)	-26.332	5.72	21.196	<.0001

NOTES: * p < 0.05, ** p <0.01, *** p < 0.001

Table 2: Logistic regression analysis

Table 2 shows that the coefficients of four predictors were identified as being significant in the model by having p-values below 0.05. These were technology readiness ($p < 0.05$), competitive pressure ($p < 0.05$), complexity ($p < 0.01$) and trading partner pressure ($p < 0.001$). Therefore it can be said that supporting evidence was found to accept the hypotheses of H2, H6, H7 and H8. With H8 (trading partner pressure) indicating the highest level of significance.

Of the four significant predictors of cloud adoption:

- The three predictors of technology readiness, competitive pressure and trading partner pressure were all positively related (+β) to the organisational likelihood of adopting cloud computing services, with trading partner pressure showing the most significant positive correlation
- The predictor of complexity was negatively related (-β) to the organisational likelihood of adopting cloud services

Table 2 also reveals that since no standard errors were greater than 2, the data was not sensitive to multicollinearity, therefore enhancing the validity of the regression analysis.

5.5 Validating the Model

The Hosmer-Lemeshow goodness-of-fit test in Table 3 revealed a non-significant $\chi 2$ score meaning "that there are no differences between the fitted values of the model and the actual values" (Low et al, 2011). The resulting p-value also indicated "that the research model was not significantly different from a perfect one that could correctly classify all respondents into their respective groups" (Low et al, 2011), concluding that the model was a good fit to the data. Therefore the null hypothesis can be rejected as there would be a very limited chance of obtaining the necessary data without the eight predictors influencing cloud adoption.

Hosmer and Lemeshow Goodness-of-Fit Test		
Chi-Square	DF	Pr > ChiSq
4.8787	8	0.7705

Table 3: The Hosmer-Lemeshow goodness-of-fit test

6 Discussion and Conclusions

A number of additional outputs were produced by SAS Analytics when the regression analysis was run. All these outputs further emphasise the process taken by SAS to determine which factor within the TOE model is the most significant driver of cloud computing adoption within the UK.

From the perspective of IT personnel, organisations are starting to adopt cloud computing services on the basis of cheaper and more agile IT resources in order to support business growth. The literature review revealed how in the past, many organisations have 'pushed back' on cloud adoption due to the hyped security concerns and data ownership issues, however this study has revealed evidence through the research findings to suggest that this barrier might be coming to an end and that organisations are starting to accept and trust the service.

In order to understand the adoption of cloud computing services, it was necessary to classify the factors that might have an influence and/or impact on the adoption decision, revealed through the literature review. It was also important to discuss both the benefits and possible pitfalls that come about with adopting, or not adopting the cloud. These ranged from cost savings, scalability, device independence, pay per use model and low upfront costs to risks such as downtime, bandwidth speed issues, reliability and data ownership disputes. The concern of cloud computing possibly being a complex service was determined to be one of the most important barriers to adoption.

However, as per the literature review, it is important that any organisation wanting to adopt the cloud should implement it gradually. An example of this might be to progressively increase the number of processes by enhancing the internet infrastructure, mobile technology that can access the cloud and ensuring the compatibility of IT legacy systems. Both ERP and CRM processes are popular initial phases of cloud adoption and there are significant benefits available to organisations who can adopt these high value SaaS services along with their trading partners, allowing them to remain highly competitive with their rivals. In order to prepare for a smooth and successful adoption of cloud services, end-user organisations must ensure their hardware and software remains up-to-date and cutting edge, as well as the skills and training of their (IT) staff.

This research aimed to discover the key determinants that most influence the decision by UK organisations as to whether or not to adopt cloud computing services through an innovative diffusion model. The Technology-Organisation-Environment (TOE) adoption framework was broken down and investigated in detail to determine what the most important factors were with regards to cloud adoption. These factors were drawn and selected from multiple past research studies: compatibility, competitive pressure, complexity, firm size, relative advantage, technology readiness, top management support and trading partner pressure (Figure 3).

The analysis of the data collected from the 257 respondents revealed several key findings and implications about cloud computing adoption in the UK across multiple industry sectors and organisation sizes, listed below:

- For an organisation to adopt cloud computing services in the UK, it will depend upon their technological, organisational and environmental contexts. Organisations with a stronger TOE conceptual model of cloud adoption will be in a far better position to facilitate a simpler implementation and integration of cloud computing services

- Four variables (competitive pressure, complexity, technology readiness and trading partner pressure) were discovered to be significant drivers of cloud adoption, and four variables were found to have less influence on the adoption decision (compatibility, firm size, relative advantage, top management support)

- The Environmental context of UK organisations decision on whether or not to adopt cloud services was found to be the most significant context as both competitive pressure and trading partner pressure were the most significant drivers, where trading partner pressure was the most important factor influencing organisations' decisions to adopt the cloud

- Complexity was found to be a barrier to cloud adoption in this research study, which is consistent with previous research where many organisations have a level of fear and concern regarding the adoption of new IT innovations, particularly that of cloud computing services

The finding of trading partner pressure being the most significant adoption driver of cloud computing in terms of a compulsory and convincing perspective is an important one witnessed throughout the industry. Researchers have drawn distinct connections between suppliers marketing efforts and their client's decision on whether or not to adopt a new technological innovation. In addition, it is important to highlight how vital targeted communications are, in order to reduce any perceived risk that potential clients might have of the cloud. This pressure from trading partners and the competitive pressure from the external environment of the organisation is a very strong incentive to encourage the adoption of new technologies such as cloud computing. These findings are also in-line with feedback received through the questionnaire pilot test that a demand side view (i.e. customer view) is no longer necessarily the key to understanding why cloud computing is rapidly becoming the only game in town. The economics and competitive advantage of the providers is driving the supply side to get to the cloud as fast as they can in order to retain their customers and offer a wide range of technological solutions. This implies that as more service providers jump on the cloud 'bandwagon', consumers (i.e. end-user organisations) will have little choice on whether or not to adopt cloud services and should proactively be planning in advance as to how to adopt the service before they are left with unsupported legacy systems.

Finally, one possible reason for complexity to emerge as a clear barrier for cloud computing adoption is that many cloud vendors do not fully appreciate the complexity of an organisations legacy IT systems and the significant fear that exists of an unsuccessful migration/cloud adoption. CIO's (Chief Information Officer's) need a cloud service that is suitable for the ‘real world’, i.e. they require a solution that can handle the complexity of their IT systems and hide it behind a dashboard. Trading partners need to break down the complexity surrounding cloud services by promoting more customer case studies on successful adoption stories. This includes being more aware of their customers’ needs, concerns and fears around cloud adoption and better marketing/promotional materials.

7 LIMITATIONS AND AREAS FOR FURTHER RESEARCH

Throughout this research study there were a few limitations discovered which are listed below. Each of these limitations have opened up potential areas for further research to be completed in order to achieve an even more universal and comprehensive understanding of what the key determinants are regarding the adoption of cloud computing services in the UK.

This study was focused on determining the most important factors driving UK cloud adoption, which was important as no other academic research had completed this work to-date. Although over 250 usable responses to the questionnaire were received and analysed, there was not a sufficient quantity of responses from each industry sector or organisation size. Further investigation could be completed on specific industry sectors or specific organisation sizes, i.e. large enterprises within the manufacturing industry.

Determination of the most significant drivers of cloud adoption was discovered through a logistic regression technique. Whilst this technique is more superior to factor analysis, it only focuses on the singular relationship between dependent and independent variables. As a consequence the interrelationship between the independent variables (i.e. factors) was not analysed. This is an area open for further research.

Further research could incorporate the following factors security, availability and sustainability (within the TOE framework) that were not the focus for this research. These factors are also relevant issues for management that links closely to the limitation of the environmental context that only had two factors within it.

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Appendix A

Past research papers which have used the same TOE adoption framework with a variety of variables

IS Adoption and Context	Authors	Technological analysed variables	Organisational analysed variables	Environmental analysed variables
Cloud Computing SMEs in the north east of England	(Alshamaila *et al*, 2013)	• Relative advantage • Uncertainty • Compatibility • Complexity • Trialability	• Size • Top management support • Innovativeness • Prior technology experience	• Competitive pressure • Industry • Market scope • Supplier computing support
Cloud Computing High-Tech Industry in Taiwan	(Low and Chen, 2011)	• Relative advantage • Complexity • Compatibility	• Top management support • Firm Size • Technology readiness	• Competitive pressure • Trading partner pressure
E-Commerce SME's within Spain	(Ghobakhloo *et al*, 2011)	• Perceived relative advantage • Perceived compatibility • Cost	• Information intensity • CEO's IS knowledge • CEO's innovativeness	• Competition • Buyer/supplier pressure • Support from technology vendors
E-Commerce Usage (B2B) North American SME's	(Sila and Dobni, 2012)	• Cost • Complexity • Network reliability • Data Security • Scalability	• Top Management Support • Trust • Pressure from Trading Partners • Pressure from Competitors	• Environmental Dynamism • Environmental Complexity • Environmental Hostility
E-Commerce SME's within Spain	(Ghobakhloo *et al*, 2011)	• Perceived relative advantage • Perceived compatibility • Cost	• Information intensity • CEO's IS knowledge • CEO's innovativeness	• Competition • Buyer/supplier pressure • Support from technology vendors
E-Commerce Usage (B2B) North American SME's	(Sila and Dobni, 2012)	• Cost • Complexity • Network reliability • Data Security • Scalability	• Top Management Support • Trust • Pressure from Trading Partners • Pressure from Competitors	• Environmental Dynamism • Environmental Complexity • Environmental Hostility
E-Market Australian small-and-medium sized enterprises	(Duan *et al*, 2012)	• Perceived direct benefit • Perceived indirect benefit	• Size • Organisation Readiness • Top Management Support	• External Pressure
Mobile Commerce Firms in Spain	(Martin *et al*, 2012)	• Technological competence	• Fit	• Competitive pressure
Open Systems Firms in Hong Kong	(Chau and Tam, 1997)	• Perceived benefits • Perceived barriers • Perceived importance of compliance with standards, interoperability, interconnectivity	• Complexity of IT infrastructure • Satisfaction with existing systems • Formalisation of system development and management	• Market uncertainty