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European, Mediterranean & Middle Eastern Conference on Information Systems 2013(EMCIS2013)
October 17-18 2013, Windsor, United Kingdom

UNDERSTANDING THE DETERMINANTS OF CLOUD COMPUTING ADOPTION WITHIN THE UK

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Abstract

The evolution of cloud computing services over the past few years is potentially one of the major advances in the history of computing. There are many reported advantages to cloud computing with particular reference to the cost saving benefits, however, many disadvantages have also been reported, among them the dependency on the cloud service provider and security issues leaving organisations without clear understanding of the factors affecting their adoption decision. The growing adoption of cloud computing within the UK is predicted to be strong and it is estimated that by the end of 2013, over 75% of UK organisations of all sizes will be using at least one cloud computing service formally. This research presents an adoption model that confirms this trend from a sample of 257 participants that include mid-to-senior level business and IT professionals from a range of industries and organisation sizes. Additionally, a factor analysis was conducted to validate and analyse the eight components of the adoption model proposed. The results showed as the most important determinants for adoption of cloud computing within the UK the aspects related to compatibility, relative advantage, technology readiness and top management support.

Keywords: Cloud Computing, Adoption, Innovation, IT infrastructure, Technology-Organisation-Environment.

1 INTRODUCTION

Since 2008, when the first signs of the economic recession appeared on the horizon there has been significant consolidation, strengthening market pressures and ever changing business environments. Throughout all industries, many firms have adopted a significant range of new technologies over this time in order to either gain an edge over their competitors or to retain their competitive advantage.

During this time, the term "cloud computing" has grown from being a promising business concept to one of the fastest growing segments of the IT industry. Cloud computing is where software applications, processing power, data and potentially even artificial intelligence are accessed over the internet (Kumar, 2012). Many people already use cloud computing today through their personal email applications such as Gmail, Yahoo Mail or even Hotmail but just don't realise it. This is emphasised through a recent survey commissioned by Citrix that found "97% of those surveyed used cloud products and services, even if they were unaware that the services were classified as 'cloud'" (Citrix, 2012).

Cloud computing is proposed to become the next major technological disruption that transforms the 'standard' model of Information Technology (IT) services (Deloitte, 2012). 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, however, for others, the cloud is seen as immature, a major 'hype' and complex, whilst still inherently compelling (Romero, 2012). In order to remain competitive and in response to ever changing business environments, organisations of all size and industry sector are rapidly adopting many technological innovations, with the cloud being at the forefront.

There are many ways in which the adoption of cloud computing can revolutionise businesses. A number of studies within the field of cloud computing have addressed key areas such as new technologies, security requirements and the future expectations of these emerging environments. Misra and Mondal (2010) developed two types of business model for organisations wishing to adopt cloud computing services, from a financial point of view. These business models covered companies with existing IT infrastructure in addition to start-up companies. Surveys conducted by the pair revealed that firm size had an effect on the perceived strategic importance of cloud computing adoption with other studies also revealing that in addition to technology and organisational factors, the organisations environment was also important covering their industry sector and competitors.

This paper aims to investigate the key determinants for UK organisations of all size and industry type when considering their adoption decision of cloud computing using the technology-organisation-environment (TOE) framework. The paper introduces in section two, the cloud computing concepts including advantages and disadvantages. Section 3, presents the adoption model used for this research and Section 4 explains the research strategy approach and techniques selected. Section 5 presents the statistical analysis results and the initial insight of key determinants for cloud computing adoption within the UK. Finally, section 6 highlights the conclusions and further research proposed.

2 CLOUD COMPUTING

The evolution of cloud computing over the past few years is potentially one of the major advances in the history of computing. Cloud computing is defined by Mell (2011) as a “model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications and services)”. These computing resources can be rapidly provisioned and released with very minimal management effort or service provider interaction. The standard cloud computing model promotes availability and is composed of five essential characteristics, three service models and four deployment models (Mell, 2011) as illustrated 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

The major use of cloud computing is for the provision of access to online software applications, data storage and processing power which is why it is of significant interest to small, medium and large organisations across the globe. The fundamental structure of cloud computing is known as ‘software as a service’ (SaaS), ‘platform as a service’ (PaaS) and ‘infrastructure as a service’ (IaaS). In summary; when businesses opt for SaaS they generally want to run different software applications which are provided by the cloud service provider as a rental over the internet. For example; Salesforece.com customer resource management tool (CRM), Google Apps and Microsoft 2013 online etc. When the business opts for PaaS, then they wish to create their own web applications quickly and easily and without the complexity of buying and maintaining the software and infrastructure underneath it (Rackspace, 2011). And when businesses opt for IaaS, they can run many applications on cloud hardware of their own choice (Barnatt, 2011).

Cloud computing is most likely to be adopted by companies through a hybrid process which is a mixture of both public and private cloud services where appropriate. Private cloud computing involves the deployment of core technologies such as virtualisation, and multi-tenant applications in order for firms to create their own private cloud database, hosted and managed internally or externally by a third party. Each individual business unit then pays the IT department for using the standardised services as per an agreed chargeback mechanism. Many firms believe this route is less threatening than a complete move to a public cloud where the services are generally offered free or on a pay-per-use model.

2.1 Advantages of cloud computing

There are many reported advantages to cloud computing with particular reference to the cost saving benefits (Jackson, 2011) for example, 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 any type of device such as mobile phones, tablets, laptops or desktop computers. Cloud computing 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. 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. 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. 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. Cloud computing 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. Finally there is greater security and accessibility with customers having access to their resources from any geographical point in addition to the ability to test and evaluate these resources at no cost.

2.2 Disadvantages of cloud computing

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 & performance issues and internet service outage (Yang, 2012). Internet bandwidth is closely linked to the successful adoption of cloud computing services. This technological innovation uses internet as the primary channel for both data transfer and running applications and requires both secure and significant internet speed to provide an attractive service. However 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 level of fear of putting one’s information in the hands of third parties. Issues have arisen such as confidentiality, theft and 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. There is nothing of higher sensitivity than banking or personal data, yet this data is generally stored on servers over which customers have no domain or ownership. This helps explain why many organisations are inclined to take the decision of progressively moving towards cloud computing services by initially uploading applications of low sensitivity. Following this learning process, more valuable information is then 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. Additionally

Tsagklis (2013) believes 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 "implicit dependency on the cloud service provider" (Tsagklis, 2013). The industry often 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 can often be painful and cumbersome. This highlights the importance of prospective users carefully and thoroughly evaluating all options when selecting a vendor (Tsagklis, 2013).

2.3 The UK Cloud Computing environment

As of March 2012, there were 2.15 million UK enterprises (of all sizes) registered for VAT and/or PAYE (ONS, 2012). 61.9% of these were limited companies (Ltd) and public corporations (Plc.), 22.1% were sole proprietorships, 12% were partnerships and 4% were general Government and non-profit making bodies (ONS, 2012). According to the Office for National Statistics (ONS, 2012), the largest industry group of 'wholesale and retail' accounted for 16.8% of all registered businesses, followed by professional, scientific & technical enterprises accounting for 16.4% and construction with 12.3%.

As discussed earlier, cloud services evoke a greater understanding and expectation of agility, value-for-money, and scalability through a pay-as-you-go basis which can fit the needs of both small to medium organisations, larger enterprises and governments. Cloud computing is said to be less about the technology and more about challenging the fundamentals of how organisations manage their IT operations, and therefore businesses efficiently, within this online world (Cloud Industry Forum, 2011). Over the last 18 months, the UK has witnessed a 27% increase in first time users of cloud computing services and this rate of adoption has further accelerated within the last 9 months. There is no industry, sector, vertical or organisation size that has not yet engaged in the endless opportunities of cloud computing services. Neither is there an application area that is exempt from both the deployment and delivery models of cloud computing. In summary, cloud computing adoption within the UK is strong and continuously growing against a backdrop of end-user satisfaction and the exciting economics of cloud services (Cloud Industry Forum, 2013). Based on the latest research by the Cloud Industry Forum (CIF), they expect that by the end of 2013, over 75% of UK organisations of all sizes will be using at least one cloud computing service formally. Their latest research polled over 250 senior IT and business key decision makers from enterprises, small-to-medium businesses (SMBs) and public sector organisations, all which had UK based operations across a range of different industries. Over 60% of SMB's and over 60% of enterprises revealed that they already use some form of cloud-based or hosted service within their organisation (CIF, 2013). Cloud computing promises to deliver tangible business benefits to all organisations at a lower cost point since they are only required to pay for the required resources (Alshamaila, 2013). This has the potential to provide an excellent return on investment and allows organisations to deliver core value to their customers, resulting in competitive advantage.

A recent survey conducted by the Cloud Industry Forum clearly validates that cloud computing is becoming more common jargon in business language. Today, broad spectrums of organisations are using cloud based services and over 53% of the 300 UK organisations polled already use cloud computing in some shape or form within their organisation (Cloud Industry Forum, 2012). Another recent survey conducted by Aberdeen Group (2012) across 900 global companies revealed; "71% of the companies from the UK plan to invest in cloud, compared with 58% worldwide and 57% in the US". Even the UK government is intending to reduce its annual £15bn technology spend by creating a private cloud called, The G-Cloud which could reduce their IT costs significantly each year.

Initially the hype of cloud computing led people to believe that jobs would be lost due to the lower requirement of in-house IT staff. However this has been turned around and instead regular hiring sprees are pursued by leading cloud computing service providers who need highly trained and skilled staff to manage their systems and client relationships, thus creating a new era of skilled workers.

The global cloud computing market is expected to grow to $270bn in 2020 with America being first, just in front of EMEA (including the UK) on the list by geographic regions for cloud computing revenue growth (Market Research Media, 2012). IDC values the total UK IT market at approximately £20bn with cloud computing associated revenues growing to around £6bn of this by 2014 (M7, 2013).

3 ADOPTION OF CLOUD COMPUTING MODEL

As revealed earlier, there are many ways in which the adoption of cloud computing can revolutionise businesses. A number of studies within the field of cloud computing have addressed key areas such as new technologies, security requirements and the future expectations of these emerging environments using a number of different models. Most studies have explored the importance of technological factors that might affect cloud adoption (Low *et al*, 2011); however the influences of environmental and organisational factors vary significantly and open up new areas for research. Hence, a framework, which was first developed by Tornatzky and Fleischer (1990), called the 'technology-organisation-environment' (TOE) framework and later edited by various researchers has been extensively used to help analyse IT adoption by firms from many different sectors and geographic locations. Various literatures support the TOE framework for the examination of IT and IS (Information Systems) innovations and have focussed specifically on e-business, ICT, ERP, e-commerce and open systems to name a few. (Low *et al*, 2011) recently applied this technology-organisation-environment (TOE) framework to explore cloud computing adoption within the high-tech industry in Taiwan; hence it was a good adoption model for this research paper to use for comparison. The study stipulated that the following factors influence cloud computing adoption: 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).

3.1 Technology context

Within the original TOE framework, technological context was described as being both the internal and external technologies relevant to the organisation. This includes 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.

3.1.1 Relative Advantage

Relative advantage is a core indicator to the adoption of a new IS innovation 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. These studies (Thong, 1999; Lee, 2004) have revealed that when businesses perceive relative advantage of an innovation, then the probability of adoption will increase (Alshamaila, 2013). Cloud computing offers organisations 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 investments. 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. (Low *et al*, 2011) also highlight additional expected benefits from cloud computing adoption of such as speed of business communications, efficient coordination among firms, better customer communications, and access to market information mobilisation.
Hypothesis 1 (H_1): Relative advantage will be positively associated with the adoption of cloud computing.

3.1.2 Complexity

Rogers (2003) mention that adoption of new IS innovations will be less likely to take place if it is considered as being more challenging to use. Adoption of new technologies might cause problems for organisations of all sizes in terms of the need to possibly change their processes of how they currently interact with their business systems. Berman (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 yet have high enough confidence levels resulting in longer adoption periods, thus, complexity of the cloud computing innovation can act as a barrier to implementation. Based on the research above, it can be said that although complexity is a significant factor in the adoption decision, in contrast to other innovation characteristics, it is negatively linked with the probability of adoption.
Hypothesis 2 (H_2): Complexity will be negatively correlated with the adoption of cloud computing.

3.1.3 Compatibility

Rogers (2003) states that compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters. Previous literature has confirmed compatibility as an essential factor for the adoption of new IS innovations. Organisations are more likely to consider the adoption of cloud computing if the technology is recognised as being compatible with existing work application systems and the organisations values. In contrast, when technology is viewed as incompatible then major changes to processes are necessary which requires considerable new learning and high costs.
Hypothesis 3 (H_3): Compatibility will be positively correlated with the adoption of cloud computing.

3.2 Organisational Context

Organisational context is related to the resources and characteristics of the firm. This dimension includes factors such as the size of the organisation, quality of human resources, the organisational readiness (from a technological & personnel perspective), innovativeness and the level/complexity of top management support.

3.2.1 Top Management Support

Top management support is crucial for organisations looking to create a supportive environment and for providing the suitable resources (with technical expertise) required for the adoption of cloud computing services. Having this support aids organisations in overcoming any internal barriers and resistance to change. (Low *et al*, 2011) states 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, top management support is considered to have a significant impact on the adoption of new IT innovations.
Hypothesis 4 (H_4): Top management support will be positively correlated with the adoption of cloud computing.

3.2.2 Firm Size

Rogers (2003) highlights that organisational 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 IT innovations, largely due to their superior flexibility and aptitude to take risks. However experimental results on what the correlation is between organisational 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. Although, smaller organisations can potentially be more flexible & more innovative due to their size and lower levels of bureaucracy. Recent industry reports by Accenture (2010), suggest that larger organisations have a higher likelihood to adopt cloud-computing services than smaller organisations. This is supported by 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 a new technological innovation such as cloud computing.
Hypothesis 5 (H_5): Firm size will be positively correlated with the adoption of cloud computing.

3.2.3 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 computing service. Technological infrastructure refers more to the already installed and in-use enterprise systems and network technologies which provide the platform for new cloud computing applications to be built upon. The proposed cloud computing services will only become part of an organisations value chain of activities if they have the necessary infrastructure and technical competence. In conclusion, organisations who have the technological readiness are better primed for adoption of cloud computing.
Hypothesis 6 (H_6): Technological readiness will be positively correlated with the adoption of cloud computing.

3.3 Environmental Context

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

3.3.1 Competitive Pressure

The external environment has a direct impact on an organisation's decision. Competitive pressure refers to the level of pressure experienced by the organisation from its competitors within the same industry (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 and attempt to follow their competitor's adoption of similar new technologies. Through the adoption of cloud computing, 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 (H_7): Competitive pressure will be positively correlated with the adoption of cloud computing.

3.3.2 Trading Partner Pressure

Many organisations rely on trading partners (and cloud vendors) for their IT design and implementation of tasks (Low *et al*, 2011). Pan and Jang (2008), amongst other literature research reveal how trading partner pressure is a key determinant for IT adoption and use. Organisations of all sizes rely on the expertise and skills of trading partners when looking to adopt cloud computing services. The marketing activities and past projects completed by these trading partners can have a significant impact on an organisations decision as to whether or not to adopt new IT innovations.

Hypothesis 8 (H_8): Trading partner pressure will be positively correlated with the adoption of cloud computing.

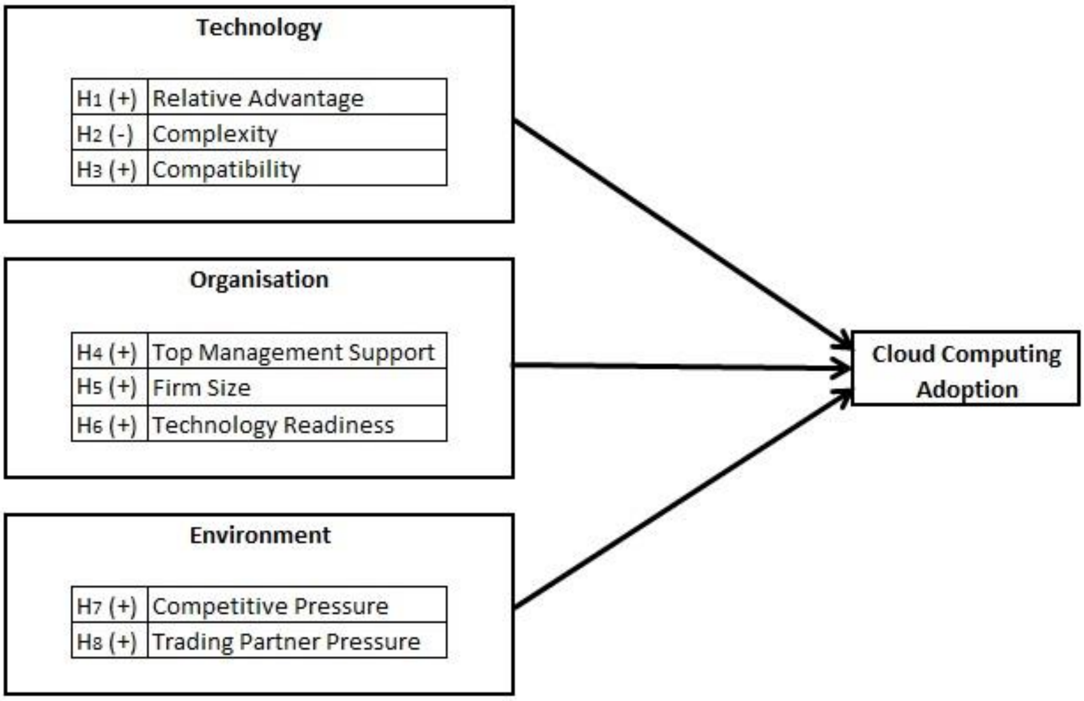

Figure 1. Conceptual model of TOE framework adapted for analysing cloud computing adoption

4 RESEARCH STRATEGY

This research paper takes a quantitative approach to identify the key determinants for the adoption of cloud computing within the UK. A self-created survey was used targeting mid to senior level Business and IT professionals from UK businesses with a vast range of industry sectors and organisation size being covered. A factor analysis is presented to validate the data collected fits within the TOE model and to provide the initial insight of key predictors for cloud computing adoption.

4.1 Questionnaire Design

The self-created questionnaire is constructed of 35 questions with two main parts. It is intended to analyse the 8 factors within the three contexts that have been modified to fit the TOE cloud computing framework based on the earlier literature review: Technology (relative advantage, complexity and compatibility), Organisation (top management support, firm size, technology readiness) and Environment (competitive and trading partner pressure).

The first part of the survey is comprised of nine questions relating to both the size and age of the sample organisations as well as general demographic questions used to validate each response.

- Questions 1 to 4 were used for general demographics and to validate that each respondent fit the necessary criteria
- Questions 5 to 7 contributed towards the 'Firm Size' construct with answers consisting of five choices in order to make analysis simpler
- Question 8 covered the specific industry sector that each sample organisation belonged to
- Question 9 covered the decision of whether the organisation had already adopted or not yet adopted some form of cloud computing services. This adoption decision was measured as a dichotomy, represented by 0 for organisations who had already adopted cloud computing services and 1 for those who have not yet.

The second part of the survey was constructed of 26 questions distributed across the three core 'TOE' dimensions, covering the remaining seven factors (note: Firm Size was covered within part 1 of the survey). Each question was answered using a five-point Likert scale where 1 corresponded to 'strongly disagree' and 5 to 'strongly agree'.

A pilot test was carried out with a sample population of five senior level Business and IT professionals to ensure the validity of each question and the overall clarity of the questionnaire. Some critical and reflective feedback was received which was used to help modify and revise the survey. The final questionnaire was uploaded to SurveyMonkey, an online survey tool and released to the sample population using SurveyMonkey's integrated email system which allows the analysis of respondents, opt-outs, bounces and non-respondents. SurveyMonkey was configured to not allow questionnaires to be partially completed in order to ensure minimal wastage. The sample population contained no cloud computing service providers (i.e. vendors) and comprised only end-users who had already adopted or not yet adopted some form of cloud computing. Follow up emails were also sent to all non-respondents on a weekly basis for a period of three weeks.

4.2 Data collection and demographics

The questionnaire targeted mid-to-senior level business and IT professionals from a range of industries and organisation sizes. A sample of the overall population received the survey which allowed the ability to infer things about the whole population as a whole. Respondents included individuals with job titles of CXO, Managing Director, Business Development Manager, Head of Strategy, Director, IT Manager, Head of IT and similar. Research revealed how small organisations are unlikely to have any dedicated IT department, so Business personnel were targeted in this instance with the ideal outcome of only one respondent per organisation. (Low *et al*, 2011) believe that a sample size of over 100 respondents is sufficient to deliver reliable results for analysis. Other literature (Weng and Lin, 2011 and Tan et al, 2008) state that response rates of approximately 25% are achieved through online survey questionnaires aiming to have a bigger sample that will be more likely to reflect the whole population (Field and Miles, 2010).

The final sample used was 1,003 in size with 51 individuals eliminated as the email addresses were incorrect, a further 17 individuals opted out of the opportunity to complete the survey leaving a total of 257 usable responses. This yielded an overall response rate of 25.62%. No responses were rejected as no entries contained errors or missing data and all respondents fell within the desired criteria. Over 90.27% of respondents had already adopted some form of cloud computing services into their organisation and table 2 shows the demographic characteristics of the 257 usable responses.

From table 2 it can be noticed that despite the disadvantages mentioned in Section 2.2 such as internet bandwidth, confidentiality and dependency on cloud service providers among others, the level of cloud computing adopters in the UK is very high.

Characteristics	Composition of Respondents (number)	Composition of Respondents (percentage of total)
Number of employees		
Less than 50	37	14.4%
51 – 100	16	6.23%
101 – 2,500	101	39.30%
2,501 – 5,000	34	13.23%
More than 5,001	69	26.85%
Company age (years)		
Less than 2 years	9	3.50%
2 - 5 years	8	3.11%
5 - 10 years	15	5.84%
10 – 20 years	43	16.73%
More than 20 years	182	70.82%
Annual sales (£million)		
Less than £2m	21	8.17%
£2m - £10m	24	9.34%
£10m - £50m	37	14.40%
£50m - £500m	79	30.74%
More than £500m	96	37.35%
Adoption status of each respondents organisation		
Adopters	232	90.27%
Non-Adopters	25	9.73%

Table 2. Demographics of the firms participating

5 Results and Discussion

The Kaiser-Meyer-Olkin (KMO) test was carried out to measure the sampling adequacy of the data through investigation of the correlations between individual variables. The final KMO score, i.e. overall MSA (measured sample adequacy) was 0.76071246, which sits between the scale of 0.7 and 0.8 indicating a 'good' level of sampling adequacy as illustrated in Table 3.

Kaiser's Measure of Sampling Adequacy: Overall MSA = 0.76071246					
Q05	0.680	**Q17**	0.705	**Q27**	0.849
Q06	0.745	**Q18**	0.627	**Q28**	0.813
Q07	0.643	**Q19**	0.708	**Q29**	0.752
Q10	0.774	**Q20**	0.705	**Q30**	0.821
Q11	0.753	**Q21**	0.789	**Q31**	0.786
Q12	0.835	**Q22**	0.822	**Q32**	0.757
Q13	0.803	**Q23**	0.839	**Q33**	0.694
Q14	0.671	**Q24**	0.874	**Q34**	0.692
Q15	0.670	**Q25**	0.792	**Q35**	0.676
Q16	0.637	**Q26**	0.803		

Table 3. Kaiser's Measure of Sampling Adequacy

Table 3 also reveals all the individual KMO scores for each individual variable (i.e. survey question). Ideally each of these data values should also be greater than 0.5, otherwise Field and Miles (2010) recommend excluding them from further analysis. The individual KMO scores fell within the range of 0.643 to 0.874 further indicating that factor analysis should yield distinct and reliable factors (Field, 2010, p. 560).

The initial step of the factor extraction process is to define all the linear components with the data set using SAS analytics. Table 4 shows the eigenvalues associated with each particular linear component (i.e. factor) prior to extraction. SAS identified 29 linear components within the data set and the eigenvalues are linked with each factor. The communalities in Table 5 also validate that all components can be retained.

Eigenvalues of the Correlation Matrix: Total = 29 Average = 1				
Factor	Eigenvalue	Difference	Proportion	Cumulative
1	5.7919	2.6789	0.1997	0.1997
2	3.1129	0.4912	0.1073	0.3071
3	2.6218	0.361	0.0904	0.3975
4	2.2607	0.3676	0.078	0.4754
5	1.8932	0.0886	0.0653	0.5407
6	1.8045	0.2194	0.0622	0.6029
7	1.5852	0.1717	0.0547	0.6576
8	1.4134	0.5331	0.0487	0.7063
9	0.8803	0.0988	0.0304	0.7367
10	0.7815	0.0603	0.0269	0.7636
11	0.7212	0.1208	0.0249	0.7885
12	0.6003	0.0233	0.0207	0.8092
13	0.5771	0.0142	0.0199	0.8291
14	0.5628	0.0396	0.0194	0.8485
15	0.5232	0.0894	0.018	0.8666
16	0.4338	0.0072	0.015	0.8815
17	0.4266	0.0398	0.0147	0.8962
18	0.3868	0.0251	0.0133	0.9096
19	0.3617	0.0161	0.0125	0.922
20	0.3456	0.0564	0.0119	0.9339
21	0.2892	0.0111	0.01	0.9439
22	0.2781	0.0282	0.0096	0.9535
23	0.2499	0.0138	0.0086	0.9621
24	0.2361	0.0309	0.0081	0.9703
25	0.2052	0.0145	0.0071	0.9773
26	0.1907	0.023	0.0066	0.9839
27	0.1677	0.0054	0.0058	0.9897
28	0.1623	0.026	0.0056	0.9953
29	0.1363		0.0047	1

Table 4. List of all the eigenvalues associated with each linear component (factor) before extraction

Final Communality Estimates; Total = 20.483619					
Q05	0.771	Q17	0.571	Q27	0.730
Q06	0.527	Q18	0.697	Q28	0.645
Q07	0.753	Q19	0.675	Q29	0.790
Q10	0.756	Q20	0.567	Q30	0.679
Q11	0.688	Q21	0.760	Q31	0.674
Q12	0.721	Q22	0.789	Q32	0.567
Q13	0.519	Q23	0.763	Q33	0.825
Q14	0.498	Q24	0.742	Q34	0.820
Q15	0.842	Q25	0.746	Q35	0.836
Q16	0.802	Q26	0.730		

Table 5. List of all the eigenvalues associated with each linear component (factor) before extraction

Rotated Factor Pattern

	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8
Q05	-0.020	-0.141	-0.005	-0.067	-0.021	-0.074	-0.151	**0.847**
Q06	-0.093	0.024	-0.034	-0.012	-0.073	0.094	0.019	**0.709**
Q07	-0.058	-0.022	0.033	0.025	-0.057	-0.060	-0.103	**0.855**
Q10	0.179	0.141	0.216	0.003	**0.792**	0.005	0.172	-0.022
Q11	0.151	0.160	0.080	0.073	**0.791**	0.035	-0.028	-0.011
Q12	0.096	0.046	0.151	-0.013	**0.814**	0.084	0.037	-0.129
Q13	0.089	0.291	0.040	0.051	0.296	0.013	**0.435**	-0.088
Q14	-0.090	-0.038	0.045	0.278	-0.085	0.007	**0.630**	0.068
Q15	0.138	0.090	0.028	0.009	0.145	0.008	**0.867**	-0.205
Q16	-0.027	0.022	-0.033	-0.028	0.084	-0.022	**0.883**	-0.104
Q17	0.174	0.109	0.055	0.004	-0.024	**0.698**	0.186	0.062
Q18	0.036	0.033	-0.064	0.054	0.133	**0.783**	-0.239	-0.012
Q19	-0.032	0.088	0.070	0.101	0.052	**0.801**	-0.064	-0.054
Q20	-0.035	0.012	0.182	0.082	-0.019	**0.719**	0.090	-0.014
Q21	**0.865**	0.032	0.038	-0.071	0.036	0.044	0.005	-0.020
Q22	**0.855**	0.168	0.068	-0.026	0.136	0.042	-0.032	-0.051
Q23	**0.833**	0.195	0.098	0.026	0.129	0.008	0.032	-0.062
Q24	**0.787**	0.234	0.148	-0.012	0.184	0.034	0.036	-0.101
Q25	0.156	**0.843**	0.048	-0.011	0.061	-0.015	0.069	-0.005
Q26	-0.003	**0.824**	0.082	0.024	0.187	0.044	0.053	-0.057
Q27	0.241	**0.795**	0.048	0.009	0.142	0.073	0.114	-0.008
Q28	0.219	**0.736**	-0.002	-0.004	-0.017	0.182	-0.137	-0.062
Q29	0.129	0.037	**0.840**	0.062	0.233	0.076	-0.011	-0.041
Q30	0.149	0.056	**0.752**	0.092	0.237	0.052	0.014	-0.145
Q31	0.130	0.072	**0.790**	0.053	0.125	0.063	-0.006	0.071
Q32	-0.050	0.016	**0.736**	0.080	-0.079	0.069	0.046	0.061
Q33	-0.046	-0.011	0.123	**0.884**	0.027	0.084	0.134	-0.028
Q34	-0.030	0.016	0.135	**0.884**	0.082	0.073	0.073	-0.043
Q35	0.002	0.021	0.018	**0.910**	-0.024	0.084	0.006	0.009

Table 6. Rotated Factor Pattern

Factor analysis is an exploratory tool (Field and Miles, 2010) that allowed investigation into the content of the questions that load onto the same factor in order to identify common themes (Table 6).

These common themes among the highly loaded questions allow the identification of that construct. The factor loadings highlighted corresponded with the original factors proposed in the theoretical model:

- Factor 1 represents top management support
- Factor 2 represents technology readiness
- Factor 3 represents competitive pressure
- Factor 4 represents trading partner pressure
- Factor 5 represents relative advantage
- Factor 6 represents compatibility
- Factor 7 represents complexity
- Factor 8 represents firm size

The next step was to evaluate how reliable the scale was before continuing with additional data analysis. The results of the basic internal reliability analysis of the dataset were completed for each of the constructs defined by the individual eight factors through calculation of Cronbach's α.

For the purposes of this research, the eight proposed components were (in alphabetical order) compatibility (CM), competitive pressure (CP), complexity (CX), firm size (FS), relative advantage (RA), technology readiness (TR), top management support (TS) and trading partner pressure (PA). The SAS output in Table 7 confirms that all eight subscales have a Cronbach's α score within the range of 0.754 to 0.893 indicating a high level of reliability.

Subscale	Components	Factor code	Item/Question no's	Cronbach's α score
1	Compatibility	CM	17, 18, 19, 20	0.754408
2	Competitive Pressure	CP	29, 30, 31, 32	0.820085
3	Complexity	CX	13, 14, 15, 16	0.756300
4	Firm Size	FS	5, 6, 7	0.757994
5	Relative Advantage	RA	10, 11, 12	0.811853
6	Technology Readiness	TR	25, 26, 27, 28	0.847779
7	Top Management Support	TS	21, 22, 23, 24	0.890727
8	Trading Partner Pressure	PA	33, 34, 35	0.893113

Table 7. Cronbach's α score for each component of the TOE model

In summary, the factor analysis was conducted using principal component methods on the 29 items using orthogonal varimax rotation. The Kaiser-Meyer-Olkin (KMO) test confirmed the sampling adequacy of the analysis as being 0.761 which is classed as a 'good' level according to Field and Miles (2010). This reveals that the matrix of correlation was sufficient in order to continue the factor analysis. Each of the individual KMO values was above 0.643 which is well above the acceptable 0.5 limit of Kaiser. Initial analysis was completed revealing the eigenvalues for each component within the data set. Eight components had eigenvalues greater than Kaiser's criteria of 1 and explained 70.63% of the variance confirming that eight factors should be extracted as SAS predicted.

Following the identification of the eight factors through factor analysis with principal component methods, the means and standard deviations were calculated for each component to provide an understanding of the data distribution in Table 5.

Component	Code	MEAN (SD)
Compatibility	CM	4.065 (0.612)
Relative Advantage	RA	3.956 (0.678)
Technology Readiness	TR	3.936 (0.732)
Top Management Support	TS	3.930 (0.777)
Firm Size	FS	3.868 (1.191)
Competitive Pressure	CP	3.817 (0.804)
Trading Partner Pressure	PA	3.575 (1.027)
Complexity	CX	3.506 (1.018)

Table 8. Means and standard deviations of all independent variables

The study stipulated that the following factors influence cloud computing adoption: 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).

For the technological context, the data confirms that compatibility and relative advantage are the most important components in this factor and surprisingly, complexity was found to have less impact. A possible explanation is that once organisations identify their feasibility to integrate cloud computing to their current IT infrastructure, the benefits for the organisation overweighs the technical complexity that is originally perceived from new technology. Despite the relevance of technological context factor, the three variables for the organisational context show consistent high values and in consistency with organisational literature, top management support is most critical for the adoption of cloud computing. Finally, the environmental context components are the less significant for UK organisations that may be explained by the extended use of vendors not only for cloud services but in overall for IT services.

6 CONCLUSIONS

Cloud computing has emerged as the fastest growing segment of the IT industry. This research has contributed to develop and validate a theoretical adoption model based on TOE framework. A sample of 257 participants that include mid-to-senior level business and IT professionals from a range of industries and organisation sizes was used to validate the theoretical adoption model. From the results, it can be confirmed the high level of adoption for the UK organisations. Additionally, the relevance of the organisational context highlighted specifically the importance of top management support and technology readiness. The second context affecting the adoption of cloud computing is the technological context, for this it was noted that despite complexity being perceived as an inhibitor for adoption its influence resulted in being less relevant through our results. However, the benefits that cloud computing offers and the feasibility to integrate this technology to current IT infrastructure seem to be high determinants for adoption. On the other hand, the environmental context resulted to be the minor determinant of cloud computing adoption.

Further research is suggested to overcome the limitation of this research. For example, a logistic regression analysis would allow one to validate the relevance of each variable. Also it is suggested to increase the sample to allow the analysis by industry, organisational size and other categories that may have influence in the adoption of cloud computing technology. Finally, future research could explore the determinants and factors influencing the adoption of each type of cloud computing (i.e. SaaS, IaaS, and PaaS).

References

Aberdeen Group, 2012. *UK leading cloud adoption rates*. Available at: http://www.aberdeen.com.

Alshamaila, Y., Papagiannidis, S., and Li, F. 2013. 'Cloud computing adoption by SMEs in the north east of England: A multi-perspective framework', *Journal of Enterprise Information Management*, 26(3): 250–275.

Barnatt, C., 2011. *Cloud Computing being Explained*. Available at: http://explainingcomputers.com/cloud.html.

Berman, S.J., et al. 2012. 'How cloud computing enables process and business model innovation', *Strategy & Leadership*. 40 (4).

Chan, Y. 2007. 'IT alignment: what have we learned?' *Journal of Information Technology*, 22(1): 297-315.

Citrix, 2012. *Confusion over Cloud Computing*. Available at: http://www.cloudprofiler.co.uk/confusion-over-cloud-computing-according-to-survey/.

Cloud Industry Forum, 2012. 'Cloud adoption and trends for 2012', *Cloud Industry Forum reports* [online]. Available at: http://www.cloudindustryforum.org/.

Deloitte, 2012. *Cloud Computing – Forecasting Change*. Available at: https://www.deloitte.com/assets/Dcom-Global/Local%20Assets/Documents/TMT/cloud_-_market_overview_and_perspective.pdf

Dhar, S., 2012. 'From outsourcing to Cloud computing: evolution of IT services', *Management Research Review*, 35(8): 664-675.

Duffy, J., 2012. *Ticketmaster books a private cloud with Cisco*. Available at: http://www.computerworlduk.com/news/cloud-computing/3367841/ticketmaster-books-a-private-cloud-with-cisco/.

Field, A. and Miles, J., 2010. *Discovering Statistics Using SAS: and sex and drugs and rock 'n' roll.* London: Sage Publications.

Goodwin, B., 2013. *Small companies slow to adopt disruptive technologies*. Available at: http://www.computerweekly.com/blogs/computer_weekly_data_bank/2013/02/small-and-medium-sized-companies.html.

GOV.UK 2013. *Stimulating private sector investment to achieve a transformation in broadband in the UK by 2015*. Available at: https://www.gov.uk/government/policies/transforming-uk-broadband.

Jackson, K., 2011. *The Economic Benefit of Cloud Computing*. Available at: http://www.njvc.com/resource-center/white-papers-and-case-studies/economic-benefit-cloud-computing.

Kumar, P. and Ravali, K., 2012. 'Going Green with Cloud Computing'. *Bookman International Journal of Software Engineering*, 1(1): 31-33. [online]/ Available at: http://bookmanjournals.com/se/Issue/2012_09_Sep/Web/6_P_Ashok_Kumar_27_Research_Communication_BMSE_September_2012.pdf.

Laforet, S., (2011). 'A framework of organisational innovation and outcomes in SMEs', *International Journal of Entrepreneurial Behaviour & Research*. 17(4).

Lee, J., 2004. 'Discriminant analysis of technology adoption behaviour: a case of internet technologies in small businesses', *Journal of Computer Information Systems*, 44(4): 57-66.

Low, C., Chen, Y. and Wu, M., 2011. 'Understanding the determinants of cloud computing adoption', *Industrial Management and Data Systems*, 111(7): 1006-1023.

Market Research Media, 2012. *Global Cloud Computing Market Forecast 2015-2020*. Available at: http://www.marketresearchmedia.com/?p=839.

Mell, P. and Grance, T., 2011. '*The NIST definition of cloud computing'*. Available at: http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf.

Misra, S. and Mondal, A., 2010. 'Identification of a company's suitability for the adoption of cloud computing and modelling its corresponding return on investment', *Mathematical and Computer Modelling*, 53(1): 504-521.

ONS – Office for National Statistics (2012). *UK Business: Activity, Size and Location, 2012*. Available at: http://www.ons.gov.uk/ons/dcp171778_280959.pdf.

Pan, M.J. and Jang, W.Y., 2008. 'Determinants of the adoption of enterprise resource planning within the technology-organisation-environment framework: Taiwan's communications industry', *Journal of Computer Information Systems*. 48: 94-102.

Rackspace, 2011. *Cloud U*. Rackspace. Available at: http://broadcast.rackspace.com/hosting_knowledge/whitepapers/Understanding-the-Cloud-Computing-Stack.pdf.

Rogers, E., 2003. *Diffusion of Innovations*. 5th edn. New York: Free Press.

Romero, N.L., 2012. 'Cloud computing in library automation: benefits and drawbacks' *The Bottom Line: Managing Library Finances*, 25(3): 110-114.

Thong, J.Y.L., 1999. 'An integrated model of information systems adoption in small businesses'. *Journal of Management Information Systems*. 15(4): 187-214.

To, M.L. and Ngai, E.W.T. 2006. 'Predicting the organisational adoption of B2C e-commerce: an empirical study', *Industrial Management & Data Systems*. 106(8): 1133 – 1147.

Tornatzky, L. and Fleischer, M., 1990. *The Process of Technological Innovation*, Lexington Books, Lexington, MA

Tsagklis, I., 2013. *Advantages and Disadvantages of Cloud Computing – Cloud computing pros and cons*. Available at: http://www.javacodegeeks.com/2013/04/advantages-and-disadvantages-of-cloud-computing-cloud-computing-pros-and-cons.html.

Yang, S. Q. 2012. 'Move into the Cloud, shall we?' *Library Hi Tech News*, 29(1): 4-7.