Journal of Enterprise Information Management

Technological, organisational and environmental factors influencing managers' decision to adopt cloud computing in the UK

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Received 4 January 2015
Revised 9 April 2015
Accepted 9 April 2015

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Abstract

Purpose – The purpose of this paper is to determine the factors influencing managers' decision to adopt cloud computing in the UK using the "Technology-Organisation-Environment" (TOE) framework.
Design/methodology/approach – Data were collected through a self-created questionnaire based survey that was completed by 257 mid-to-senior level decision-making business and information technology (IT) professionals from a range of UK end-user organisations. The derived hypotheses were tested using various data analysis techniques including principal component analysis and logistic regression.
Findings – 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 reflecting organisations' concerns on legal regulations, co-creation and customisation, service linkage and vendor locking which adds complexity to the process of selecting an appropriate vendor.
Research limitations/implications – This research found trading partners (cloud service providers) significantly influence managers' decisions to adopt cloud services, however, further research is required to fully understand all the aspects involved especially with the growing number of vendors available. 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 to conduct further analysis.
Practical implications – The findings reveal the important role of cloud computing service providers to enable end-users to better evaluate the use of cloud computing. It also reveals that top management support is no longer a driver as organisations are starting to adopt cloud computing services on the basis of cheaper and more agile IT resources in order to support business growth.
Originality/value – This research provides original insight for cloud computing adoption within the UK from a managerial perspective.

Keywords TOE, Cloud computing services, Technology adoption
Paper type Research paper

Introduction

Cloud computing is disrupting the "standard" model of information technology (IT) services in response to the increased digital solutions organisations require to remain competitive (Dhar, 2012; Romero, 2012; Linthicum, 2013; Choudhary and Vithayathil, 2013; Chang *et al.*, 2013). This disruption, influence managers' decision, who have to evaluate the number of advantages associated with cloud computing such as cost savings, agility, flexibility and improved collaboration and efficiency for mobile and digital environments (Noor *et al.*, 2013; Brender and Markov, 2013; Oliveira *et al.*, 2014). However, the service does come with a number of potential risks regarding security, reliability, data privacy, regulatory compliance and data protection laws among others (Yang, 2012; Brender and Markov, 2013) that have also to be taken in consideration before adopting cloud computing services. Furthermore, cloud computing represents the least transparent

Journal of Enterprise Information Management
Vol. 28 No. 6, 2015
pp. 788-807

1741-0398
DOI 10.1108/JEIM-01-2015-0001

outsourcing model (Dutta *et al.*, 2013) and yet there is a growing demand in organisations of all sizes in the industry sector for flexible and on-demand infrastructure, platforms and software as a service (Ambrust *et al.*, 2010; Subashini and Kavitha, 2011; Noor *et al.*, 2013). Consequently, decision makers have to address the advantages and risks associated with cloud services, as well as the implications of this growing technology for their specific organisation.

The current research is focused on UK end-users market where cloud services have witnessed a 27 per cent 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 and at the beginning of 2014 approximately 65 per cent 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 €600 Bn by 2020.

This research aims to determine the factors influencing managers' decision to adopt cloud computing in the UK. The remainder of the paper is organised as follows, second section defines cloud computing and explains how cloud computing is transforming IT service model. Third section analyses and compares previous cloud computing studies and presents the conceptual model to analyse the key management factors affecting the IT adoption of cloud computing. Fourth section describes the research method used to collect data from 257 professionals and discusses the main findings resulting from the analysis that includes factor analysis and logistic regression. Finally, in Fifth section conclusions are drawn together with limitation and further research.

Transformation of the IT services

Traditional in-house IT services model has been disrupted with the increased adoption of 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 (Dwivedi and Mustafee, 2010; Choudhary and Vithayathil, 2013; Oliveira *et al.*, 2014). The term "cloud computing" has only recently evolved as a major technological innovation from advances and integration in areas of virtualisation, grid computing and services delivered over the internet (Cusumano, 2010; Sultan, 2011; Oliveira *et al.*, 2014). Cloud computing is perceived as a computing paradigm where scalable IT-related capabilities are provided as-a-service over the Internet to multiple external customers, using interconnected and virtualised computers that allocate resources based on service-level agreements negotiated between service provider and end-user (Buyya *et al.*, 2008; Kumar and Ravali, 2012; Noor *et al.*, 2013). The National Institute of Standards and Technology (Mell and Grance, 2011) define cloud computing 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) that can be rapidly provisioned and released with minimal management effort or service provider interaction".

The standard cloud computing model promotes flexibility and is composed of five essential characteristics, four service models and four deployment models (Sultan, 2011; Mell and Grance, 2011; Lina and Chen, 2012; Brender and Markov, 2013) as summarised in Table I that will be further explained in terms of the benefits and risks that cloud computing presents.

Cloud computing benefits and risks

There are many reported advantages to cloud computing with particular reference to the cost saving benefits such as reduced: hardware investment, maintenance costs and lower electricity consumption (Dwivedi and Mustafee, 2010; Garrison *et al.*, 2012; Oliveira *et al.*, 2014). The service is dynamically scalable (on-demand self-service and rapid elasticity) because users only have to consume the amount of online computing resources they actually need without human interaction with the provider (Cegielski *et al.*, 2012; Brender and Markov, 2013). This is very useful for companies who experience high and low levels of demand for IT services and only want to pay for the server usage increase as and when it happens. The service is charged on a per usage basis (measured service) and has no fixed costs resulting in a lower investment and reduced risk with immediate access to cost saving improvements (Lin and Chen, 2012; Walterbusch *et al.*, 2013; Oliveira *et al.*, 2014). Other benefits of cloud computing include "agile updating" for applications (SaaS). The service provider hosting the application system perform updates that take place seamlessly without any scheduled downtime (Sultan, 2011; Yang, 2012) or the removal of legacy IT systems which allows organisations to extend their software applications into other global regions. This agility is also provided for the PaaS and IaaS models that allow organisations to remain at the cutting edge of technology in order to retain and attract clients with minimal up-front investment and eliminating ownership costs (Sultan, 2011; Gupta *et al.*, 2013; Ye *et al.*, 2013). 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, credit to the quick deployment opportunities and ease of integration (Yang, 2012; Gupta *et al.*, 2013). Additional benefits to enhance flexibility and collaboration for digital environments are that cloud computing is device-independent, the resource can be accessed not just from any computer via the internet (broad network access) but also from any type of device such as mobile phones, tablets, laptops or desktop computers, from any geographical location (Dhar, 2012; Chang *et al.*, 2013; Oliveira *et al.*, 2014). Despite cloud service providers offering the benefit of high levels of support, advanced security procedures, in-depth experience and knowledge in this area (Romero, 2012; Gupta *et al.*, 2013), security has remained as one of the main barriers for cloud computing adoption as discussed in the next section.

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 as well. 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 *et al.*, 2013; Noor *et al.*, 2013).

Table I.
Cloud computing characteristics and models

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		

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 and issues have arisen such as confidentiality, theft, loss of data and of course, questions over data ownership (Romero, 2012; Dutta *et al.*, 2013). However, organisations are accepting the existing security and privacy cloud computing offers and are increasingly more likely to use it along the with other technologies such Web 2.0 and social networks that have become so widespread (Romero, 2012; Gupta *et al.*, 2013). 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; Noor *et al.*, 2013; Oliveira *et al.*, 2014). 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 before more valuable information can be uploaded to the cloud (Romero, 2012; Choudhary and Vithayathil, 2013; Brender and Markov, 2013). The loss of governance is also a big concern since applications and services will be run remotely on third party environments leaving end-users with limited control over the functionality and execution of the hardware and software (Brender and Markov, 2013). Furthermore geographical location of the data centres is a critical consideration as privacy and data protection laws varies for each country (Dutta *et al.*, 2013; Brender and Markov, 2013).

A final, yet very important potential disadvantage of cloud computing is the unspoken dependency on the providers, i.e. cloud vendors (Sultan, 2011; Dutta *et al.*, 2013; 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 (Lin and Chen, 2012; Gupta *et al.*, 2013). 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 (Géczy *et al.*, 2012; Gupta *et al.*, 2013; Tsagklis, 2013; Brender and Markov, 2013).

Although previous research has revealed some potential risks from adopting cloud computing, this technology is still within the growth stage of its life cycle, especially so with the increasing pressure on IT teams to do more with less, budget and staff cuts, plus the existing economic climate, resulting in the need to cut costs whilst remaining competitive. The next section then analyses and compares previous cloud computing studies to identify the key factors that managers take in consideration for the adoption of cloud computing in light of the technology-organisation-environment (TOE) framework.

Research model

TOE framework

The TOE framework developed by Tornatzky and Fleischer (1990) has been extensively used to analyse firm-level adoption of technologies using three types of contexts that may influence technological innovation adoption and the implementation process. Despite this the TOE framework does not offer clear constructors (Gangwar *et al.*, 2014). It has been used to examine various technologies, including cloud computing from many different sectors and geographic locations, allowing the identification of the main factors influencing the adoption of cloud computing within different organisational contexts as illustrated in Table II that includes also constructs from other studies approaches.

Cloud computing antecedents	Technology context factors	Organisational context factors	Environmental context factors
Oliveira *et al.* (2014) Determinants influencing adoption (DOI and TOE) Portugal, Manufacturing and service sectors Data from 374 firms	Technology readiness Relative advantage (cost, security), innovation Complexity (innovation) Compatibility (innovation)	Firm size Top management support	Competitive pressure Regulatory support
Brender and Markov (2013) Risk management Switzerland Qualitative research with 19 participants	Firm technology expertise Data security and protection	Size Corporate culture	Service provider performance Legal regulations
Gupta *et al.* (2013) Factors influencing adoption, India, Singapore/Malaysia, USA Survey 211 participants	Cost reduction Ease of use and convenience Security and privacy	Sharing and collaboration	Service provider reliability
Alshamaila *et al.* (2013) Adoption (TOE) SMEs in the North-East of England	Relative advantage Uncertainty Compatibility Complexity Trialability	Size Top management support Innovativeness Prior technology experience	Competitive pressure Industry Market scope Supplier computing support
Lin and Chen (2012) Innovation adoption Taiwan, qualitative research 19 interviews with IT professional	Relative Advantage Compatibility Complexity Trialability Observability		
Sultan (2011) Economic viability and efficiency SMEs UK case study	Flexibility Availability Cost structure		
Low *et al.* (2011) Adoption (TOE) High-Tech industry in Taiwan	Relative advantage Complexity Compatibility	Top management support Firm size Technology readiness	Competitive pressure Trading partner pressure

Table II.
Comparison of focus and variables from previous cloud computing studies

Conceptual model and hypothesises

The TOE framework is based on an 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 or non-adopter 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.

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. (Lin and Chen, 2012; Gupta *et al.*, 2013; Oliveira *et al.*, 2014). For the purpose of this research, the technology in discussion is that of cloud computing.

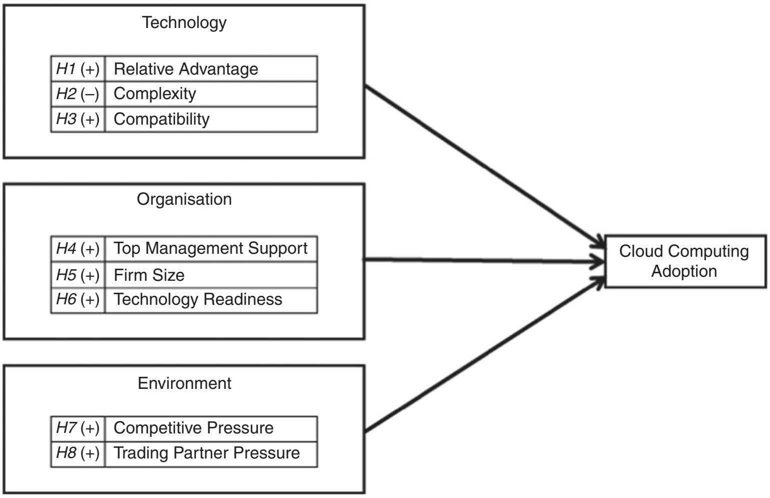

Figure 1. Conceptual model of TOE framework adapted for analysing cloud computing adoption

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 the 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 (Dwivedi and Mustafee, 2010). Organisations have almost instant access to on-demand hardware and software resources accessed over the internet with minimal upfront capital investment. Additional expected benefits from cloud computing adoption include speed of business communications within the organisation and with their customers including access to market information mobilisation (Low *et al.*, 2011). Additionally, To and Ngai (2006) argue that it is reasonable to assume organisations take into consideration the advantages and potential disadvantages, to ensure organisations will gain greater benefits from adopting cloud computing which outweigh the disadvantages and consequently would achieve competitive advantage over competitors:

H1. Relative advantage does influence the adoption of cloud computing.

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 cloud computing might cause problems for organisations of all sizes if it is perceived as more challenging to use than existing systems or if its integration with existing processes is complex. 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 or lack of other technology enablers for cloud computing such high-speed communication networks, parallel applications, etc. resulting in longer adoption periods (Dwivedi and Mustafee, 2010). 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:

H2. Complexity does influence the adoption of cloud computing.

Compatibility is the degree to which an innovation is perceived to be consistent with the organisation values and needs which is also influenced by past experiences (Rogers, 2003). Compatibility is consider 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. Cloud computing allows organisations to remain at the cutting edge of technology without affecting current legacy IT systems in-line with their organisational managerial and operational needs (Sultan, 2011; Gupta *et al.*, 2013; Ye *et al.*, 2013):

H3. Compatibility does influence the adoption of cloud computing.

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, organisational readiness (from a technological and personnel perspective), innovativeness and the level of top management support (Oliveira *et al.*, 2014; Brender and Markov, 2013; Chang *et al.*, 2013; Lin and Chen, 2012; Sila and Dobni, 2012).

Top management support is extremely important for organisations looking to create a competitive environment whilst also providing the suitable resources (technical expertise and infrastructure) required to adopt cloud services. Having this support aids organisations in overcoming any internal barriers and resistance to change. It has been recognised that top management awareness of the potential benefits of adopting cloud computing is essential to manage potential organisational change through an expressed vision and commitment, sending positive signals of confidence in the new technology to all employees of the firm (Low *et al.*, 2011). Senior managers 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 cloud computing:

H4. Top management support does influence the adoption of cloud computing.

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. Overall, 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. While cloud computing was initially reported to be more attractive to SMEs (Sultan, 2011), recent industry reports suggest that larger organisations have a higher likelihood to adopt cloud services than smaller organisations (Goodwin, 2013):

H5. Firm size does influence the adoption of cloud computing.

Parasuraman (2000) coined the term technology readiness as the propensity to embrace new technology for accomplishing goals that is determined by the overall state of mind resulting from a gestalt of mental contributors and inhibitors. Therefore, organisations can fall into five segments on the basis of their technology readiness from explorers who are the first to adopt technology to laggards who possess few motivations toward technology and typically would be the last group to adopt a new technological service or product (Parasuraman and Colby, 2001). Organisations with high technological readiness are aware of current IT infrastructure potential and limitations and are willing to provide adequate training to enable the cognitive capability required to adopt cloud computing. In summary, organisations who have the technological readiness are better primed for adoption of cloud computing:

H6. Technological readiness does influence the adoption of cloud computing.

Environmental context covers the macro area that an organisation conducts its business including industry market elements and the presence of technology service providers.

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. Through cloud adoption, organisations can benefit from greater operational efficiencies and reduced cost that will bring organisations higher profits. Additionally, many organisations would adopt cloud computing services that allow them more accurate data collection and better understanding of market visibility in order to create new products and services (Low *et al.*, 2011):

H7. Competitive pressure does influence the adoption of cloud computing.

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. More specifically, managers' will look into trading partners aspects such as regulatory support (Alshamaila *et al.*, 2013; Oliveira *et al.*, 2014), IT products co-creation and customisation (Gupta *et al.*, 2013) service linkage (Chang *et al.*, 2013) and vendor locking (Sultan, 2011):

H8. Trading partner pressure does influence the adoption of cloud computing.

Research method

This study aims to determine the factors influencing managers' decisions to adopt cloud computing in the UK, through the use of the TOE framework, in order to help organisations better consider their future IT adoptions. This section details the positivist approach and research methods used to test the hypothesis including measurement, data collection and sampling.

Data collection

The survey targeted mid-to-senior level business and IT professionals from a range of industries and organisation sizes. The targeted population was the cloud computing end-users from the adopting side. IT and service providers were not to be included in the targeted population. Initially the authors targeted non-IT companies using cloud computing via "The Manufacturer" magazine. As valid responses received via the magazine were not high, the authors also used could computing groups on LinkedIn. Those groups included: The Cloud Circle, a UK's first independent business and IT focused Cloud Computing Community with 630 members. The second group was IBM Cloud UK with 84 members based in UK and who are interested in cloud computing. The third LinkedIn group used was the Cloud Security Alliance, UK Chapter with 1,048 members. The fourth used group was the Google Cloud Platform, (global) discussion group with 358 members. The fifth group used was the "EMC Cloud Architect" global group with 2,875 members. The sixth and the final group used was the "Microsoft UK-Cloud Computing" group. The community group includes 10,551 members including senior IT managers and executives as well as business leaders who have an interest in cloud computing to have discussions, share ideas and seek advice and opinions. Those six groups provided the authors with a potential population of 15,546 members. However, only 1,003 satisfied the selection criteria of being a UK based end-users managers from non-IT service provider organisation. The final database comprised 1,003 suitable and relevant individuals, each with unique business e-mail addresses and no technology vendors were included. The survey recorded 325 "hits" from which, 51 individuals contained incorrect e-mail 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 per cent with no responses rejected as none contained errors or missing data and all respondents fell within the desired criteria.

Sample characteristics

The respondent sample was fairly evenly spread across organisation size, age, annual sales and industry sectors as illustrated in Table III.

Validity and reliability

The operational measures used in this research were taken from previous work (Appendix 1) and further validity was ensured by consulting experts in the field through a pilot testing of the questionnaire. The validity and reliability of the constructs were tested to ensure the measurements were accurate using SAS Base 9.4 software. Validity is concerned with the accuracy of a measurement, whether a particular survey question is actually measuring what it sets out to and reliability is concerned with whether the survey questions can be consistently interpreted across a variety of situations (Field and Miles, 2010). A principal component analysis (PCA) was conducted on the 27 items with orthogonal varimax rotation. 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 = 0.752, which sits between the scale of 0.7 and 0.8 indicating a "good" level of sampling adequacy. An initial analysis was run to obtain eigenvalues for each component in data. Eight components had eigenvalues over Kaiser's criterion of 1 and in combination explained 72.98 per cent of the variance. The results confirmed that each set of questions (see Table IV) load highly onto only one factor (Appendix 2) that corresponded with the original factors proposed in the theoretical model in Figure 1. Additionally, Cronbach's α scores results were used to assess the constructs reliability and it can be observed that all constructs have high reliabilities with values >0.7 as shown in Table IV.

Characteristics	Respondents (number)	Respondents (percentage of total)
Number of employees		
Micro	37	14.40
Small	16	6.23
Medium	101	39.30
Large	103	40.08
Company age (years)		
Less than 2 years	9	3.50
2-5 years	8	3.11
6-10 years	15	5.84
11-20 years	43	16.73
More than 20 years	182	70.82
Annual sales (£million)		
Less than £2 m	21	8.17
£2-10 m	24	9.34
£11-500 m	116	45.14
More than £500 m	96	37.35
Adoption status of each respondents organisation		
Adopters	232	90.27
Non-Adopters	25	9.73
Industry		
Charity/not for profit	27	10.51
Construction/Property	12	4.67
Consumer Packaged Goods	3	1.17
Education	19	7.39
Energy/Mining	5	1.95
Entertainment/media	12	4.67
Financial services	36	14.01
Hospitality/Catering	5	1.95
IT and technology	16	6.23
Legal	8	3.11
Manufacturing	11	4.28
Pharmaceutical	5	1.95
Private healthcare and services	4	1.56
Professional/Business services	20	7.78
Public sector (incl. local and central government, etc.)	39	15.18
Retail	12	4.67
Telecommunications	7	2.72
Transport, distribution and logistics	10	3.89
Utilities	6	2.33

Table III.
Sample characteristics

Results

Following identification and validation of the eight factors through PCA, a composite score was derived for each set of constructs using the standardised scoring coefficients as weightings. The obtained weighted scores were used for the logistic regression analysis with all eight independent predictor variables to test the research model (TOE), through its dichotomous (i.e. only two possible) outcome variable. The purpose of using this analysis technique is determining which factors contribute significantly to the manager's decision of adopt (or non-adopt) cloud computing services within the UK. Based on the TOE framework for adoption of cloud computing proposed the logit model specified as follows:

$$Dum(Adop) = \beta_0 + \beta_1.CM + \beta_2.PM + \beta_3.CX + \beta_4.FS + \beta_5.RA + \beta_6.TR + \beta_7.TS + \beta_8.PA$$

Table V shows the estimated coefficients and statistics for each of the predictors that were included within the model and of four predictors were identified as being significant by having *p*-values 0.05 and below. These were technology readiness, competitive pressure, complexity and trading partner pressure. Therefore it can be said that supporting evidence was found to accept the hypotheses of *H2*, *H6*, *H7* and *H8*.

Of the four significant predictors of cloud adoption; 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.

Discussion

The Environmental factors on whether or not to adopt cloud services were found to be the most significant as both competitive pressure and trading partner pressure were the most significant drivers. This is consistent with literature that highlights the pressure levels experienced by organisations from the same industry to follow those organisations using new technologies (Laforet, 2011) which seems to be reinforced with the emergence

Table IV. Cronbach's α score for each factor of the TOE model

Subscale	Factors	Factor code	Item/Question no's	Cronbach's α score
1	Compatibility	CM	17, 18, 19, 20	0.75
2	Competitive pressure	CP	29, 30, 31, 32	0.82
3	Complexity	CX	14, 15, 16	0.77
4	Firm Size	FS	5, 6	0.82
5	Relative advantage	RA	10, 11, 12	0.81
6	Technology readiness	TR	25, 26, 27, 28	0.84
7	Top management support	TS	21, 22, 23, 24	0.89
8	Trading partner pressure	PA	33, 34, 35	0.89

Table V. Logistic regression analysis

Predictor	β regression coefficient	SE	Wald χ^2 statistic	$Pr > \chi^2$
Top management support (TS)	0.72	0.55	1.70	0.1918
Technology readiness (TR)	1.24*	0.58	4.59	0.0321
Competitive pressure (CP)	1.19*	0.63	3.63	0.0568
Trading partner pressure (PA)	2.18**	0.51	18.45	< 0.0001
Relative advantage (RA)	0.58	0.51	1.30	0.2543
Compatibility (CM)	0.68	0.73	0.85	0.3573
Complexity (CX)	−1.38**	0.34	16.80	< 0.0001
Firm Size (FS)	0.22	0.31	0.50	0.4789
Intercept (constant)	−25.42	5.91	18.51	< 0.0001

Note: $*p < 0.05$; $**p < 0.001$

of cloud computing services by industry that cannot be easily replicated in-house. Trading partner pressure was the most important factor influencing organisations' decisions to adopt the cloud where managers are concern with the cloud computing vendors' credibility from previous projects. Additionally, managers are influenced by vendors' levels of support for legal regulations, co-creation and customisation, service linkage and very important the level of vendor locking (Alshamaila *et al.*, 2013; Oliveira *et al.*, 2014; Gupta *et al.*, 2013; Chang *et al.*, 2013; Sultan, 2011). 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.

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. 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. 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. Another aspect that organisations are concerned with is data privacy and protection as cloud service providers are regulated by the laws where the data centres are located which adds complexity to the process of selecting an appropriate vendor (Dutta *et al.*, 2013; Brender and Markov, 2013).

Technological readiness has also resulted as a significant driver for cloud computing adoption. Embracing new technology in organisational context relates to multiple different factors and it is important that any organisation wanting to adopt the cloud manage this gradually depending on whether the organisation falls in the classification of early adopters or in the laggard adopters (Parasuraman, 2000). 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.

Finally, relative advantage, compatibility and firm size were not supported by the results to be majors drivers of cloud computing adoption. Top management support was reported as main driver of adoption in previous research (Low *et al.*, 2011), however, this research found that top management support is no longer driving adoption of cloud computing and a possible explanation of this, is the growing awareness between business and IT managers about the potential benefits of adopting cloud computing that outweigh the risks (To and Ngai, 2006; Alshamaila *et al.*, 2013). Therefore, increased awareness permeates to all managerial levels recognising that cloud vendors offer high standard solutions that cannot be easily deployed internally, including sophisticated security and data protection technologies.

Research and practical implications

This research contributes to the growing literature around cloud computing from the business and IT managers' perspective by highlighting that trading partner pressure is the most significant adoption driver of cloud computing while the concern of cloud computing possibly being a complex service was determined to be one of the most important barriers to adoption. While technology and organisational factors have been found as key drivers for adoption, this research shows that environmental factors are the current drivers of cloud computing adoption. This might be explained by the fact that cloud computing has evolved to a level where organisations accept the relative advantage and compatibility that this technology offers to support business growth (technological context). Similarly, there is no evidence that organisational context factors represent drivers or barriers as organisations are facing not only the disruption of cloud computing to their business model but the convergence of multiple technologies of digital environments. Therefore, current conditions leverage the technological readiness and top management support from organisations of any size in order to adopt technologies that allow for flexibility and innovation with reduced investment such is the case of cloud computing.

The findings reveal the important role of cloud computing service providers to enable end-users to better evaluate the use of cloud computing. They also reveal that 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 revealed how previously, many organisations have "pushed back" on cloud adoption due to security concerns and data ownership issues, however this study has brought up evidence through the research findings to suggest that this barrier might be coming to an end and that organisations managers are starting to accept the cloud services or maybe those are becoming more secure.

Another practical implication for managers considering adopting cloud computing is the potential disruption that this may bring to the "standard" model of IT services. Organisations will have to evaluate how they manage and invest in technology itself, balancing proprietary systems to a shared and standardised infrastructure in order to remain agile and competitive. Managers have also to evaluate the development of legal and regulatory issues related to data centres location and data privacy. Moreover, managers should be conscious of the importance of selecting the right vendor who will be an integral part of the organisation's IT strategy.

Conclusions

This study aimed to determine the factors influencing managers' decisions to adopt cloud computing by UK organisations. The TOE adoption framework was broken down and investigated to determine what the most important factors were with regards to cloud adoption. These factors were drawn and selected from multiple past research studies: relative advantage, complexity, compatibility, top management support, firm size, technology readiness, competitive pressure and trading partner pressure. It was 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. Although further research is needed to achieve a more universal and comprehensive understanding of what the key determinants are regarding the adoption of cloud computing services in the UK, this research highlighted trading partner pressure as the most significant factor for the adoption decision of cloud services which brings to life the great debate raised in 2003 by Carr's Harvard Business Review article "IT Doesn't Matter" (Brown *et al.*, 2003). One of the arguments was that IT has increasingly become a commodity input that is necessary for competitiveness but insufficient for advantage. More than 15 years later, cloud service models (SaaS, PaaS and IaaS) offer IT as a commodity. However the challenge remains in how organisations and managers adopt it. Vendors play and important role and mangers should avoid the seductive proposition of "buy this technology and all your problems will be solved". As with any other technology, the value comes, not from the technology itself as a standalone but it rather comes from how to use it in introducing new practices that differentiate organisations from their competitors.

Limitations and further research

This study was focused on determining the most important factors influencing managers' decision to adopt cloud computing in the UK. However, there were a few limitations discovered that have opened up potential areas for further research. For example, 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.

Further research is suggested to better understand the environmental context that has resulted into the most significant driver for cloud computing adoption. This involves the development of new constructs to investigate the specific influence of legal regulations, data centres location, customisation, vendor locking while adding aspects such security, availability and sustainability that were not the focus for this research.

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Appendix 1

Constructs	Operational measure	References
Relative Advantage	RA1 – cloud provides competitive advantage RA2 – cloud provides more benefits than current infrastructure RA3 – cloud provides minimal upfront investment	Oliveira *et al.* (2014), Alshamaila *et al.* (2013), Lin and Chen (2012) and Low *et al.* (2011)
Complexity	CX1 – cloud services are easy to integrate with existing processes CX2 – confidence levels in cloud influence adoption decision CX3 – cloud is easy to use and manageable	Oliveira *et al.* (2014), Alshamaila *et al.* (2013), Lin and Chen (2012) and Low *et al.* (2011)
Compatibility	CM1 – cloud is consistent with current values and believes CM2 – cloud is compatible with managerial and operational needs CM3 – cloud is compatible with existing systems CM4 – cloud adoption is influence by previous adoption experience of other technologies	Oliveira *et al.* (2014), Alshamaila *et al.* (2013), Lin and Chen (2012) and Low *et al.* (2011)
Top management support	TS1 – management awareness of cloud benefits TS2 – management support to adopt cloud computing services TS3 – management employees' encouragement to use cloud computing services TS4 – management adequate resources to adopt cloud computing services	Oliveira *et al.* (2014), Alshamaila *et al.* (2013) and Low *et al.* (2011)
Firm Size	FS1 – number of employees (1 = Micro, 2 = Small, 3 = Medium, 4 = Large) FS2 – level of annual sales (1 = Micro, 2 = Small, 3 = Medium, 4 = Large)	Oliveira *et al.* (2014) and Low *et al.* (2011)
Technological readiness	TR1 – adequate training and education for employees to adopt cloud TR2 – existing technology supports cloud adoption TR3 – cognitive capabilities of IT human resources to support cloud adoption TR4 – cloud adoption is perceived as being both useful and easy to use	Oliveira *et al.* (2014), Low *et al.* (2011) and Aboelmaged (2014)
Competitive pressure	CP1 – cloud would allow stronger competitive advantage CP2 – cloud would increase ability to outperform competition CP3 – cloud would allow generation of higher profits	Oliveira *et al.* (2014), Alshamaila *et al.* (2013) and Low *et al.* (2011)
Trading partner pressure	PA1 – adoption of cloud would require support from trading partners PA2 – adoption of cloud would be influenced by the marketing activities of trading partners PA3 – adoption of cloud would be influenced by the trading partners level of support	Low *et al.* (2011), Oliveira and Martins (2011) and Hsu *et al.* (2014)
Cloud computing adoption	ADS – adopter (1) or non-adopter (0) of cloud computing services	Low *et al.* (2011) and Lin and Chen (2012)

Note: All items are based on five-point scale except those noted otherwise

Table AI. Measurement items

Appendix 2

Table AII.
Eigenvalues and factors loadings after extraction and rotation

	Top Management Support (TS)	Technological readiness (TR)	Competitive pressure (CP)	Trading Partner pressure (PA)	Compatibility (CM)	Relative Advantage (RA)	Complexity (CX)	Firm Size (FS)
TS1 (Q21)	*0.861*	0.041	0.034	−0.072	0.048	0.045	−0.019	0.020
TS2 (Q22)	*0.857*	0.162	0.070	−0.026	0.042	0.133	0.042	−0.041
TS3 (Q23)	*0.834*	0.193	0.101	0.028	0.007	0.125	−0.024	−0.066
TS4 (Q24)	*0.793*	0.225	0.154	−0.010	0.031	0.172	−0.015	−0.111
TR1 (Q25)	0.155	*0.850*	0.047	−0.009	−0.015	0.064	−0.072	−0.006
TR2 (Q26)	0.002	*0.820*	0.087	0.027	0.040	0.179	−0.035	−0.095
TR3 (Q27)	0.239	*0.804*	0.046	0.010	0.074	0.149	−0.122	−0.003
TR4 (Q28)	0.218	*0.742*	−0.008	−0.004	0.184	−0.005	0.124	−0.020
CP1 (Q29)	0.129	0.040	*0.838*	0.062	0.076	0.240	0.005	−0.020
CP3 (Q31)	0.135	0.058	*0.797*	0.056	0.060	0.108	0.032	0.048
CP2 (Q30)	0.151	0.056	*0.751*	0.091	0.054	0.239	−0.017	−0.113
CP4 (Q32)	−0.054	0.020	*0.733*	0.080	0.072	−0.077	−0.052	0.070
PA3 (Q35)	0.002	0.020	0.018	*0.909*	0.086	−0.028	−0.008	0.021
PA2 (Q34)	−0.028	0.012	0.137	*0.885*	0.072	0.076	−0.066	−0.048
PA1 (Q33)	−0.046	−0.010	0.122	*0.884*	0.083	0.030	−0.137	−0.031
CM3 (Q19)	−0.037	0.093	0.067	0.101	*0.799*	0.062	0.058	−0.071
CM2 (Q18)	0.040	0.027	−0.061	0.055	*0.785*	0.122	0.247	0.003
CM4 (Q20)	−0.044	0.024	0.175	0.081	*0.718*	0.001	−0.106	−0.023
CM1 (Q17)	0.180	0.098	0.064	0.006	*0.700*	−0.049	−0.160	0.036
RA3 (Q12)	0.097	0.057	0.146	−0.012	0.079	*0.831*	−0.047	−0.118
RA1 (Q10)	0.182	0.147	0.215	0.005	0.005	*0.796*	−0.172	−0.019
RA2 (Q11)	0.153	0.165	0.079	0.075	0.036	*0.792*	0.027	0.010
CX3 (Q16)	0.024	−0.035	0.035	0.029	0.020	−0.098	*0.897*	0.103
CX2 (Q15)	−0.148	−0.093	−0.031	−0.009	−0.012	−0.145	*0.866*	0.183
CX1 (Q14)	0.095	0.025	−0.039	−0.277	−0.006	0.066	*0.645*	−0.058
FS2 (Q5)	−0.074	0.009	0.026	0.016	−0.024	−0.064	0.044	*0.915*
FS1 (Q6)	−0.072	−0.117	−0.009	−0.067	−0.029	−0.045	0.154	*0.892*
Eigenvalues	5.502	3.109	2.448	2.246	1.797	1.760	1.479	1.363
% of variance	20.38	11.52	9.06	8.32	6.65	6.52	5.48	5.05

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