Chapter 4
Factors Affecting Cloud Technology Adoption: Potential User's Perspective

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Abstract The idea that drives Cloud technology shows great opportunities that can be exploited by an organization. However, with such opportunities come some challenges and factors that have to be put into consideration. Knowing and understanding these factors make an organization better prepared for adopting the technology. A number of factors have been suspected to affect organization's adoption of Cloud technology. The purpose of this chapter is to confirm which factors actually do affect adoption of the technology. Inspired by the Technology Acceptance Model (TAM) and an extensive literature review, a working hypothesis of the list of factors that have potentials to affect Cloud technology adoption was developed. These factors were then assessed by a randomly selected sample of 47 working professionals in the United Kingdom through an online questionnaire. Analysis of the result shows that Security, Cost, Service Availability, Compliance and Perceived Usefulness are factors of concern that organizations would have to deeply consider before moving to the Cloud. It also shows that majority of professionals are already aware and substantially educated about cloud technology and believe they will find the technology easy to learn and use. They also recommend it to organizations.

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4.1 Introduction

4.1.1 Motivation

The underpinning idea behind the Cloud technology in general and Cloud computing in particular have been considered by not a few to be the new IT paradigm. Yet others believe that the phrase is an over-stretched word. With the volume of recent research and white papers on the topic however, it can be considered a hot issue. There have been forecasts that the technology has not only taken the IT world by storm, but perhaps is here to stay. According to Armbrust et al. [1], Cloud technology has changed the face of commercial IT, ensuring that computing services can be treated like a utility—much like water and electricity. Indeed it has been said that many people are already using cloud technology in different forms without even realizing it. This for example include things like using the free Yahoo and Google email, using online file storage by storing files e.g., music over the internet, watching recorded training seminars that are stored online, the list goes on and on. If the technology advance as expected, it has good possibility of changing the IT and business landscape as we have come to know it today.

4.1.2 Background

Gartner in 2009 estimated the value of cloud services revenue to surpass $56.3 billion, a 21.3 % increase from 2008 revenue of $46.4 billion [2]. It is also forecasted that the market will reach $150.1 billion in 2013. This upward growth can of course only continue if many businesses and organizations are and remain comfortable with cloud computing as a solution that improves productivity. Cloud technology is a way to improve productivity, it has to be accepted and used by employees in organizations [3].

Several models have been posited to explain factors that affect the user acceptance of a technology [3–6]. One such model, the Technology Acceptance Model (TAM) posits that two beliefs, the perceived usefulness and the perceived ease of use are of essential importance to a user's adoption of technology [4]. It defines the perceived usefulness as the subjective probability of a user that a particular solution will enhance his productivity in an organization and the perceived ease of use as the degree to which the user thinks the solution will be without fault. The model has been used in many research works with great success [7, 8] and has been extended by a number of authors to include other factors. These works have greatly influenced this research work.

While there have been many papers and research work into Cloud computing and some on the benefit it offers, there has not really been much work done in actually analyzing the opportunities and the challenges the innovation offers from the customer and user point of view. This research work addresses this challenge.

It reviews cloud adoption and the factors that enhances or inhibits it, but carries out the research work from the perspective of the would-be customers and users of the solution. The result of the research should be able to assist decision makers in understanding what the average computer users and employees consider as pitfalls and benefits of using the Cloud as a solution.

4.2 Literature Overview

4.2.1 Introduction to Cloud Computing

Cloud computing has been regarded as a new technology trend that is expected to shape information technology process and the IT marketplace [9]. However, while not denying the obvious advantages that are possible with the implementation, several academic writers [10, 11] fail to see it as a new technology. To them, it is just a natural progression in the demand of information technology services and products and is based on already existing technological concept like grid computing, virtualization and service oriented architecture [10].

4.2.1.1 What is Cloud Computing?

Cloud computing is considered a phrase that has been quite difficult to define with. Qian et al. [12] described it as one of the vaguest technical terminology in history. According to them, this is because the phrase is applicable in so many application scenarios coupled with the fact that so many organizations have hyped up the phrase to mean more that it is supposed to Adamov and Erguvan [13] also described it as a word that is misused a lot. Indeed, not a few definitions exist for the phrase.

According to the U.S. government's National Institute of Standards and Technology (NIST), Cloud computing can be defined as everywhere, easy and on-demand access to a shared pool of resources (including networks, servers, storage, applications) over the network with zero or minimal interaction with or involvement of the service providers. On the other hand, Buyya et al. [14] described it as using infrastructure as a sort of "Cloud" where users and organizations are allowed to access applications and services on demand, no matter where they are located. Infrastructure here represents huge data centre that are monitored and managed by a service provider. He goes on to define Cloud as "a type of parallel and distributed system consisting of a collection of inter-connected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resource(s) based on service-level agreements established through negotiation between the service provider and consumers".

Cloud computing introduces three new concept to the term infrastructure [1]. These are:

- The impression that computing resource is infinite and so users do not need to plan much ahead for over utilization,
- The fact that organizations do not need to commit themselves to particular resource utilization. They can simply start small and upgrade as the need arises,
- The ability to pay for only the resources they have used, with the option to upgrade at any stage of utilization and downgrade after use of computing resources.

With Cloud technology organizations are able to host their applications or data with a Cloud service provider, access it from anywhere (using a browser) and pay for just the computing facilities they use much like a household will pay for the use of a utility.

4.2.1.2 Types of Clouds

In literature one distinguished typically three types of Clouds:

Private Cloud This is a Cloud environment that is built on a private network, with the organization having control over data, security and quality of service. Usually, this kind of cloud is built for the use of an organization and can be managed by the organization's IT.

Public Cloud This kind of cloud is usually managed and hosted by a third party cloud service provider with computing resources being dynamically provisioned over the internet using web applications or web browsers.

Hybrid Cloud This is made up of a combination of private and public Clouds. Here, part of the applications of an organization runs on a private cloud, while the other services are provisioned over the public Cloud [15].

4.2.1.3 Cloud Computing Architecture

According to Zhang et al. [16], Cloud architecture can be considered to be made up of the four layers that are closely knitted together to deliver the hosting service. These are listed below:

The Hardware/Data centre layer This consists of the physical resources of the cloud including things like servers, routers, switches etc. It is usually made of aggregated resources that are organized to function as a single fault tolerant resource.

The infrastructure layer This is also called the virtualization layer and is where the pool of necessary computing resources is deployed. The layer makes use of virtualization technologies such as that of VMware®. This layer is important and is used for dynamic service provisioning.

The platform layer This layer resides on the infrastructure layer and consists of the operating systems and the application frameworks. This layer operates to remove the burden of deploying applications to the VMware® containers.

The application layer These are the applications that actually provide the services offered by the cloud and are located at the top layer. These applications have the ability to automatically scale to performance.

4.2.1.4 Cloud Computing Service Types

Cloud computing services can be categorized into three types. They are explained below:

Infrastructure as a Service (IaaS) This refers to computing resources with guaranteed processing power and storage abilities being offered as a service usually in the form of virtual machines. An example of this service is the Amazon Elastic Compute Cloud (EC2).

Platform as a Service (PaaS) This refers to providing operating system and the accompanying resources that are necessary to use applications. In short one can consider this as an IaaS with a software installed already. An example is the Microsoft Azure and Google AppEngine.

Software as a Service (SaaS) This is providing a specific application as an on demand service. An example is the Google apps [15].

4.2.1.5 Major Cloud Services by Providers

Amazon Elastic Cloud Compute (EC2), one of the most common Cloud computing platforms adopted by organizations, allow an organization to use web services interface to provision different types of operating systems and load them with as much customized applications as desired [17]. Alternatively, the organization has the option of using one of the already built and customized Amazon virtual Images (AMI) with software based on needs. The solution allows capacity to be configured with minimal effort, provides adequate control of technology resources and offers the added advantage of only paying for capacity per hour with no long term commitment. Another Amazon cloud service is the Amazon Simple Storage Service (Amazon S3). It provides a web interface to store and retrieve large volume of data at any time and from anywhere with capacity up to 5 Terabytes [18]. Prices are charged per data transfer, based on location of you "Amazon bucket" which is the region you have chosen to domicile your data.

Google App Engine [19] offers opportunity to run applications on Google's computing infrastructure. Applications can be built using standard java technologies or any other language using a JVM based interpreter or converter. A dedicated native python runtime environment is also provided. Application can be published to be shared with the whole world or restricted to users of the

organization. A web page administration console is also provided to the users for managing the applications. Google offers free 500 mb of storage with enough CPU capacity to support about five million page hits per month for the engine which can be upgraded to raise the limit.

Windows Azure and SQL Azure provide an opportunity to host applications on Microsoft computing infrastructure while using a host of developer services to build applications. It supports an extensive selection of proprietary development tools and protocols including Live Services, Microsoft .NET services, Microsoft SQL services, Microsoft SharePoint services and Microsoft Dynamics CRM services. There is also opportunity to interface with non-Microsoft technologies using support for web API's such as SOAP and REST [11].

Other Cloud computing services providers includes Salesforce.com, IBM and EMC. However, these are not as prominent as the three already discussed above.

4.2.2 Cloud Technology Adoption

Adoption according to [20] can be defined as "the acceptance and continued use of a product, service or an idea". Despite the much talked about prospects of Cloud technology and the potential that the innovation offers for IT commercialization, several potential cloud users are in fact yet to opt for the solution [21].

According to Chow et al. [21], even most of the organizations that have implemented the solution have only just tested the waters in managing to put non business critical application on the cloud. This is largely due to the fact that they do not completely trust the solution as yet. This position was supported by Kim [22] that Cloud computing still has lots of issues that are preventing its adoption by majority of users. He mentioned compliance as a peculiar challenge for corporate organizations. However, a Cloud technology adoption survey carried out by Mimecast in 2009 to examine the perception and adoption of Cloud computing solutions among 565 respondents across US and Canada seems to confirm an interesting position [23]. According to this survey, 60 % of respondents seem to favor adoption of the solution, with 70 % of those already using the solution intending to further move additional applications to the cloud. This obviously indicates that those organizations feel they are realizing appropriate benefit from the implementation of this solution.

On the contrary, another research work by Behrend et al. [24] seem to confirm that adoption of the Cloud idea is still plagued with inherent issues that needs addressing before users can find the innovation comfortable to use. The research work investigated the adoption and usage of the Cloud by a community college in south eastern USA comprising of approximately 750 students. It further explained that Cloud computing is like any other IT initiative and its adoption is plagued by technical factors of the solution, characteristics of the organization that introduces the solution and the response of individuals within the establishment to the new tools introduced by the solution.

Yet, others like Greenwood et al. [25] believe that it is highly unlikely that any organization will totally host all its applications on the cloud. They believe that most environments of organizations that adopt Cloud computing will be heterogeneous—consisting of some applications hosted in the Cloud (possibly more than one cloud providers) and other hosted on dedicated servers within the organizations.

A number of factors have been reviewed by several authors and writers to affect the adoption of Cloud technology, some inhibiting the adoption rate and yet others serving as a motivation.

Cost

One such proposed factor that has been considered to affect Cloud adoption is the cost. According to Skilton [26], Cloud computing is able to help business and drive cost savings by helping an organization to "avoid the cost of over-provisioning and under-provisioning" of computing resources. Of course this is supposed to be in addition to the business advantages enabled by low entry cost since the organization will not have to invest in buying IT assets. Khajeh-Hosseini et al. [27] also stated that one of the reason consumers move to the cloud is for lower IT support costs.

This position is also supported by the research work of Khajeh-Hosseini [28] while looking at the migration of an Enterprise IT to IaaS. They discovered that moving to the cloud has clear financial benefits to the organization to the tune of almost 37 %.

However, Leavitt [29] thinks that while it is indeed possible that organizations save money on equipment and software, such money may be offset by investment on bandwidth, which is a critical cloud operation dependency, especially if large data is concerned. Kondo et al. [30] in his research work also seems to think that Cloud computing is effective only for small and medium sized applications, but that for large projects; the costs are simply too much. In fact, Misra and Mondal [31] confirmed that opinions on opportunities for cost savings in quite divergent on many blogs with one group confirming that the solution is economically profitable while others are saying is quite more expensive.

Security

Security is another major factor that has been said to affect Cloud adoption [21]. According to them, this is the major reason why potential cloud users have not joined the cloud, and those that have, are just testing the waters with non-sensitive business data. This position was also supported by the cloud services user survey carried out by IDC exchange [32], which listed security concerns as the number one major issue. The concerns here include the privacy of the hosted data and whether the cloud provider will be able to provide the relevant level of audit needed by the organization. With their data out of their control, it says most organizations worry if they are not more vulnerable to attackers.

On the contrary, Alecu [33] believed that implementing Cloud technology has obvious advantages to an organization. Cloud providers are better able to effectively manage and use available resources to better secure data in their premises

than a single organization would. They are for example able to provide centralized data storage, adequate monitoring of data access and adequate logging. Grossman [34] supported this claim by saying that the economy of scale with which most Cloud computing operates gives them the necessary resources to implement adequate security. Assuncao et al. [35] also said that Cloud computing being based on a virtualized technology offers increased security through creation sandboxes for running applications with unquestionable reliability. According to Youseff et al. [36] however, security is still a major issue that Cloud computing users would have to contend with before a decision to move to the cloud.

Availability

Another factor with potential to affect Cloud adoption is system availability [36] Availability as used here covers reliability issues, latency issues and performance issues. According to Youseff et al. [36], outage is one problem that users and cloud providers will have to battle with in the light of possible network outage and system failures. The effect of this is actually managed by putting an appropriate Service Level Agreement (SLA) in place between the users and the providers. Kim et al. [22] also pointed out that outages may be permanent or temporary, with a permanent outage implying that a company has gone out of business. This has happened before and is inevitable. Kim believes that a company should exercise discretion in the data they put on the cloud and should endeavor to make backups.

Harish and Dhanasehar [37] agreed with this stating that an organization that decides to move to the cloud will have no option but to totally trust on the availability offered by the cloud provider. The only way this trust can be earned is for a cloud provider to standardize their SLA. Clouds have also been said to suffer from a high level availability which Vaquero et al. [38] believes is as a result of the lower level of maturity of the paradigm.

However, Youseff et al. [36] did not fail to quickly point out that even though availability issue is not uncommon with cloud, most cloud infrastructures are built to provider high availability guarantees. A user can even drastically increase this by blending a mix of cloud offerings i.e., combining a Google app engine with an Amazon s3 service.

User awareness

User awareness and education is also another factor that has been noted to affect Technology usage, and indeed Cloud adoption. According to Rogers and Shoemaker [39], the acceptance or rejection of a technological innovation actually begins when users become aware of that product or innovation. In an independent research work carried out by Sathye [20] to discover factors affecting the adoption of Internet banking as a technology innovation, he discovered that user awareness of the product and the benefit it offers play a major role in users deciding whether or not to adopt the solution.

If users are not keen to adopting the Cloud as a solution, it may be perhaps because they are not aware of the solution or the benefit that adopting the solution has to offer. This position was also supported by the work of Beloglazov et al. [40]

that user awareness is one factor that cannot be ignored when it comes to usage of Information technology and innovations like the Cloud. The more aware users are of Cloud computing and its benefits, the more inclined they are to use the resources.

Perceived ease of use and perceived usefulness

Another well acclaimed factor that affects adoption of technological innovations and can well affect adoption of Cloud technology is the perceived ease of use and the perceived usefulness of the innovation. This theory was first pioneered by the research work of Davis [4] and has been confirmed by several other researches. He defined perceived ease of use as the extent to which the use of a particular product is believed to be free of effort and perceived usefulness as the degree of the belief that a particular tool or product will enhance the performance of a job. In a different research work by Grandon and Pearson [41], these factors were also established to have significant effect on the adoption of Electronic commerce.

A research work by Fenech [42] on the other hand did not seem to confirm that the two factors have a direct influence on the rate of adoption of the World Wide Web. He indicated that computer self-efficacy on the other hand seems to be a major determinant for the adoption. Self-efficacy, according to Marakas et al. [43] cited in Yi and Hwang [44] defined computer efficacy as an individual's judgement of his efficiency to adequately use the computer hardware and the applications that are installed on the device to achieve set objectives. Nonetheless, the research work of Behrend et al. [24] seems to unequivocally confirm that these two factors play a major role in Cloud adoption and usage in community colleges.

Compliance

Compliance is another major issue faced by organizations moving to the Cloud [45] and therefore has a great potential to affect adoption rate. According to Subashini and Kavitha [45], this is because most customers may not have control over where their data is actually located and hence fear falling short of regulatory and data privacy laws. As an example, certain data types are not allowed to leave the countries in many EU and American countries. Most enterprises in the US are bound by regulations concerning storage, disclosure and privacy of data. This for example includes Serbanes-Oxley Act and HIPAA [22]. According to Kim et al. [22], Consumers need to comply with these regulations even in their use of Cloud computing.

Supporting this argument, Chow et al. [21] reiterated that while the legal consequence of application and data hosting in the cloud is still far from being clearly understood, there is obvious "potential lack of control and transparency when a third party holds the data". This, according to them is affecting organizations' desire to move to public clouds. Most of them rather prefer to build private Clouds for themselves so that they can still partake of the benefits of the solution.

Vendor lock-in

Vendor/data lock-in has also been regarded as a factor that affects adoption of Cloud technology [46, 47]. Software stack has increased interoperability among

platforms, but the API used in Cloud computing is still essentially proprietary and so difficulty exists for an organization to extract out its data should a reason demand so. As more cloud providers emerge, portability (ability to extract data) is increasingly becoming a more important criterion [29]. As it is, if an organization is not happy with the services of a provider, they cannot easily and inexpensively transfer a service to another provider or copy data back to in-house. A rework or reformat of the data is usually necessary. While this position is welcome to cloud providers, it is a menace to consumers. Armbrust et al. [1] also criticized this situation proposing that the solution is to standardize the APIs that are used by Cloud computing providers.

4.3 Survey

The qualitative research work for this chapter was carried out using a survey. Surveys are quite widely used and can generate large quantity of standardized data and information for quantitative study and hypothesis testing. Surveys use methodical sampling questionnaires to measure the characteristics of the population with statistical precision [48].

The online version of questionnaire is the chosen form of survey used in this research work to collect the data used for analysis. It has the advantage of; being inexpensive, not requiring too much interviewing time, easy to analyze and also allowing respondents to maintain their secrecy to deeply consider their response. On the downside, response rate can be low and it may take quite a while to get reasonable number of responses.

4.3.1 Questionnaire Design

Based on the literature review focused on the factors affecting Cloud technology adoption, a questionnaire was designed. The questionnaire consisted of three parts; organization, Cloud computing questions and demographics. Before the final copy was agreed, draft copies were circulated to a couple of known experts in the field of Cloud technology as recommended by Rattray [49]. Their recommendations and input were taken into consideration to ensure that the questions asked were relevant. The questions were also sufficiently reviewed to ensure that it is clearly worded and not biased or leading in any shape or form. Best practices such as; asking easier questions first, grouping similar questions and avoiding use of abbreviations were also adhered to. While two questions were single item response, a number of the questions were multi-item scales to avoid bias, misinterpretation and reduce measurement error [50].

Likert-type questions account for majority of the questions and have been considered to be a relatively easy, efficient and appropriate method to use [49]. A

free text response was also provided in a section to encourage richer data gathering by allowing respondents to provide alternatives to options provided. A copy of the questionnaire is shown in the Appendix.

4.3.2 Questionnaire Hosting

After design, the questionnaire was hosted on the World Wide Web so that it can be easily accessible to respondents using internet access. As the popularity of internet increases and the cost of computer hardware and software decreases, internet is becoming a fruitful area for conducting survey research [51]. Apart from the obvious advantages of cost and time savings, online surveys provide access to group of unique individuals which otherwise would be difficult to reach.

The online vehicle used to deliver the survey is Google Docs application. Google Docs is robust, free and allows data to be extracted into excel formats for different kind of analysis. There is no restriction on the number of respondents that can fill the survey, as compared to some other free survey tools. It also rides on Google's time tested infrastructure to provide adequate reliability in speed of access.

4.3.3 Questionnaire Circulation

After been made available online, the questionnaire link was then forwarded randomly to some 200 professionals in various organizations across the United Kingdom. In order to also increase the sampling frame, the link to the surveys was also posted to some selected Cloud forums. Care was taken to ensure that organizations of varying sizes were represented in the list of respondents selected so that results are not skewed in a particular direction.

It should be noted however, that because only the opinions of professionals are required, the survey was restricted to these groups of people. Respondents were also encouraged to help forward to other professionals that are known to them. Support was provided in form of emails assistance to people who had any difficulty with filling the survey.

4.3.4 Results Collection

At the end of the survey (which lasted about 10 days), the resulting information and data were extracted from the hosting location to a Microsoft excel format to be imported and analyzed with the Statistical package for Social Sciences (SPSS) V17 software. The resulted data were also pruned and styled to make it more presentable and compatible with the SPSS software used for the analysis. Care was taken not to modify any statistical data in the process.

4.4 Analysis and Discussion

4.4.1 Analysis

Of the estimated 200 professionals contacted to fill the survey, only 47 actually filled the survey forms. This represents a response rate of about 23.5 %. Data from the responses were then collected, verified for consistency and analyzed with SPSS Version 17. All the questionnaires were correctly filled and were considered valid.

4.4.1.1 Organization

The first part of the questionnaire focused on the profile of organizations represented in the survey. Small sized organizations represented 19 % of the survey response (13 % micro, and 6 % small) while just 4 % represented medium sized organizations. Large enterprises were most represented in the sample with a value of 77 %. Also, of the total number of respondents, only 14.9 % have no input to the kind of solution their organization adopts. 19.1 % are decision makers while 36.2 % recommend solutions to decision makers. A further 29.8 % have at least an input into the solution that their organization adopts. We could conclude that all categories of professionals were adequately represented by the survey. These data are represented in Fig. 4.1 (Table 4.1).

4.4.1.2 Demographics

The last part of the survey covered the demographics of the respondent. Majority of the respondents have work experience falling in the ranges 6–12 and 13–20 years represented by 37 and 28.3 % respectively. 23.9 % have experience ranged 21–30 while only 4.3 % have over 30 years work experience. Majority of the respondents fell between the ages 26–35 and 36–45 with 41 and 43 % respectively (Table 4.2).

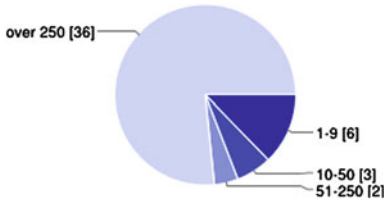

Fig. 4.1 Size of organizations represented

Table 4.1 Distribution of positions in the organization

Position	Frequency	Percentage
I am a decision maker	9	19.1
I recommend solutions to decision makers	17	36.2
I have input to choice of solution adopted	14	29.8
I have no input in choice of solution adopted	7	14.9
Total	47	100.0

Table 4.2 Work experience

Years	Frequency	Percentage
0–5	3	6.4
6–12	18	38.3
13–20	13	27.7
21–30	11	23.4
Over 30	2	4.3
Total	47	100.0

4.4.1.3 Cloud Technology Questions

According to the survey, a decisive 91 % said they will recommend Cloud technology to organizations. However, they differ on the type of Cloud option they would recommend. 52.8 % said they would recommend hybrid Cloud to organizations while a close 42.86 % decided to opt for private Clouds. Only 4.76 % decided in favor of public Cloud.

4.4.1.4 Factors Affecting Cloud Technology Adoption

User education and awareness

Analysis of the survey shows that all the respondents admitted to having heard about Cloud technology. This interesting result is also buttressed by the fact that 91 % of respondents regard themselves as at least somewhat familiar with the technology. As can be seen from the table, only 8.5 % consider themselves not to be familiar with the technology despite having heard about it. For the purpose of analysis, representing the various likert scales with continuous numbers (1 = not familiar, 2 = somewhat familiar, 3 = very familiar and 4 = expert), the mean of the distribution is 2.49 which can be considered close to the value 2 representing "somewhat familiar".

Service availability

At first glance, it was easily observed that a lot of respondents could not make out how service availability is affected by moving services to the cloud. This is easily inferred from the 46.8 % of respondents that neither agreed nor disagreed

Table 4.3 Familiarity with cloud technology

Familiarity	Frequency	Percentage
Not familiar	4	8.5
Somewhat familiar	18	38.3
Very familiar	23	48.9
Expert	2	4.3
Total	47	100.0

Table 4.4 Service availability

Service availability	Frequency	Percentage
Strongly disagree	1	2.1
Disagree	14	29.8
Neither agree nor disagree	22	46.8
Agree	8	17.0
Strongly agree	2	4.3
Total	47	100.0

Table 4.5 Vendor lock-in issues

Vendor lock-in issues	Frequency	Percentage
Strongly disagree	1	2.1
Disagree	5	10.6
Neither agree nor disagree	7	14.9
Agree	28	59.6
Strongly agree	6	12.8
Total	47	100.0

with the statement "organizations that move to the cloud are more likely to experience service availability issues". 29.8 % disagreed with the statement while 17 % agreed. Using continuous numbers to represent the various likert scales (i.e., 1 = strongly disagree and 5 = strongly agree), the mean value of 2.91 which is very close to the value 3 (neither agree nor disagree) confirmed the earlier statement (Tables 4.3 and 4.4).

Vendor lock-in

Analysis of the survey response confirmed that most respondents think that changing Cloud provider is an issue if an organization decides to go with Cloud technology. This is confirmed by the fact that a decisive 61 % of respondents agree with this statement. Only 11 % of respondent disagreed with the statement. Following the same representation as above, the mean value is 3.97 which is close to 4 (Agree) (Table 4.5).

Ease of use

The result of this survey confirmed that most respondents think that Cloud technology will be easy enough to learn and use. This was confirmed by 53.2 % of people disagreeing with the statement "Cloud technology will be difficult to learn and use". Interestingly, about 27.7 % neither agree nor disagree with the

Table 4.6 Ease of use

Ease of use	Frequency	Percentage
Strongly disagree	1	2.1
Disagree	25	53.2
Neither agree nor disagree	13	27.7
Agree	6	12.8
Strongly agree	2	4.3
Total	47	100.0

Table 4.7 Perceived usefulness

Perceived usefulness	Frequency	Percentage
Strongly disagree	3	6.4
Disagree	16	34.0
Neither agree nor disagree	12	25.5
Agree	13	27.7
Strongly agree	3	6.4
Total	47	100.0

statement. Representing the likert scales with numbers for analysis however, the mean is 2.61. This value is a little close to 3, which will suggest that even though the majority think Cloud technology will be easy to learn and use, the opinion can be considered quite close to neither agree or disagree (Table 4.6).

Perceived usefulness

While more people think that Cloud technology will enhance their productivity at their place of work (represented by the 34 % who disagree with the survey question), the statistics is not particularly skewed in any direction. In fact, a very close figure (27.7 %) agreed with the survey question. Representing the likert scales with numbers as usual and calculating the mean gives a value of 2.94 which is very close to 3 (representing Neither agree nor disagree) (Table 4.7).

Security

Analysis of responses show that majority of people agree that security exposure is an issue for an organization that moves to Cloud technology judging by the 68.1 % of people who at least agreed with the survey statement (42.6 % strongly agree and 25.5 % agree). This by far is the largest single value for strongly agree, showing that a number of people seems certain about this. Following the normal procedure of representing the likert scales with values from 1 to 5 to calculate the mean reveals a value of 3.87 which as expected is close to 4 (representing agree) (Table 4.8).

Compliance

Compliance is another area that seems respondents are sure is an area of issue with Cloud technology. 63.8 % of respondents seem to believe that there is danger of running afoul of compliance laws when moving services to the cloud. This contrasts with just 18 % who disagreed. As expected, the mean value is close to 4, an actual value of 3.72 suggesting that the average decision is that of agreement with the survey statement (Table 4.9).

Table 4.8 Security issues

Security issues	Frequency	Percentage
Strongly disagree	4	8.5
Disagree	3	6.4
Neither agree nor disagree	8	17.0
Agree	12	25.5
Strongly agree	20	42.6
Total	47	100.0

Table 4.9 Security issues

Security issues	Frequency	Percentage
Strongly disagree	1	2.1
Disagree	6	12.8
Neither agree nor disagree	10	21.3
Agree	18	38.3
Strongly agree	12	25.5
Total	47	100.0

Cost

It, however, seems a majority of the respondents are not exactly sure of the cost implications of Cloud technology and whether or not the solution will result in any cost savings. This is made evident by the fact that 46.8 % of the respondent neither agree nor disagree with the survey statement that "cost of Cloud computing can be prohibitive". 21.3 % disagree with the statement while 23.4 % agree. The mean value of 3.04 is rather close to 3 (Neither agree nor disagree) confirming the observation.

4.4.2 Further Analysis

An Analysis of Variance (ANOVA) test was carried out to see if there is any relationship between people's position in the organization and the various factors suggested to affect Cloud technology adoption. The resulting table is shown in the appendix. The analysis did show that position in organization do have statistical difference on familiarity with Cloud technology [$F(3,47)$, $p = 0.01$] although the same cannot be said for others. Those who recommend solution are more familiar with Cloud computing (Mean = 3.00) than those who make input (Mean = 2.21) and those who make no input (Mean = 2.00) (Table 4.10).

To further analyze the pattern displayed here, a test called post hoc analysis was carried out. The test helps in finding patterns between variables that would otherwise remain detected. The type of post hoc test carried out was called Scheffe test (Table 4.1). This test showed that people who recommend solutions to decision makers are statistically different from those who have input and those who have no input to choice of solutions adopted. The size of variability predicted is 31.11 % ($\eta 2 = 31.11$).

Table 4.10 Cost issues

Cost issues	Frequency	Percentage
Strongly disagree	2	4.3
Disagree	10	21.3
Neither agree nor disagree	22	46.8
Agree	11	23.4
Strongly agree	2	4.3
Total	47	100.0

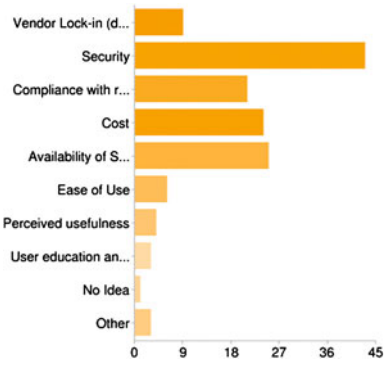

Fig. 4.2 The three *top* factors identified

The ANOVA test carried out to see if respondent's age range and years of work experience have a relationship with any of the factors did not yield any statistically significant result.

Also, the Spearman's correlation coefficient [52] was used to verify if there is any relationship between the factors affecting Cloud technology. The result is shown in the appendix. Most of the data at best only show very weak relationship, with the best being the relationship between ease of use and perceived productivity ($r = 0.393(47)$, p (two-tailed) < 0.05).

Figure 4.2 shows the bar chart for the three top factors that have been identified by respondents to consider when adopting Cloud technology. As can be seen from the chart, Security is the number one issue that respondents consider top priority. This is closely followed by availability of service and cost.

4.4.3 Discussion

This research work has established the factors considered by United Kingdom professionals to affect Cloud technology adoption. Generally speaking, the overall consensus of these professionals is that even though there are some challenges that still plague Cloud adoption, they will recommend it to organizations. This decision cuts across the various categories of professionals that exist in organizations (from decision makers to those who have no input to decisions) and could signify that challenges are not unexpected of a rather new innovation like Cloud computing.

Table 4.11 Post-hoc Scheffe test of familiarity with cloud technology and position

Position in organization	N	Subset for alpha = 0.05	
		1	2
I have no input in choice of solution adopted	7	2.00	
I have input to choice of solution adopted	14	2.21	2.21
I am a decision maker	9	2.33	2.33
I recommend solutions to decision makers	17		3.00
Sig.		0.680	0.050

Means for groups in homogeneous subsets are displayed
Uses Harmonic Mean Sample Size = 10.411

However, the type of Cloud technology preferred is the private Cloud or hybrid Cloud. This suggests that a number of people still feel more comfortable with having a big measure of control over their applications and services. This is even clearer as the overwhelming majority believed that security is a serious issue and is therefore a major factor that an organization would have to consider before moving its services to the cloud. This is in perfect agreement with the research work of Chow et al. [21]. Closely related to the issue of security is compliance with regulatory authorities. Clearly this is also another big worry for most professionals and is a big factor that needs to be addressed before an organization thinks of adopting Cloud technology. There can be dire consequences for organizations that find itself on the wrong side of the law (Table 4.11).

Perhaps one thing that has encouraged many people to look favorably on the adoption of Cloud technology is that an average professional is at least somewhat familiar with it and perhaps see it as the next phase of IT. As such, awareness and education is not really an issue with Cloud technology adoption. Interestingly, according to the research, people who recommend solutions are more familiar with the technology than all other categories. This is quite expected as such people often times are more knowledgeable about technologies as they often need to be able to defend their recommendations to managers. Conversely, people who make no input to decisions know the least about Cloud technology. In the same vein, learning and using Cloud technology will not be an issue according to the research. It may be that most people believe that its use would not be that different from the regular internet use they have become quite familiar with. To strongly support this, a lot of users now get the option to work flexibly from various locations and connect to applications located in their office. Perhaps Cloud use should not be any different from this.

It is a surprise though that even though Cloud technology is perceived to be easy to learn and to use, the average opinion on perceived usefulness is that of indifference. Clearly people do not have a clear understanding of how the use of Cloud technology can enhance their productivity at work and in fact whether it even will. This should be taken into consideration by an organization before deciding on compelling their employees to start using it. It is interesting to note though that a number of people think that Cloud technology will be easy to learn

also think it will be quite useful to them. However, this relationship is quite weak and should not in any way be taken as the general opinion.

Another clear factor that has been established to affect Cloud technology adoption according to the research is vendor lock-in. The average opinion expressed is that moving into Cloud technology will be quite difficult if an organization does decide to opt for it. This opinion conforms largely to that of most writers and experts of Cloud technology who believe that there is no standardization in the programming interface used by Cloud providers [1, 29]. Hence organizations moving to the Cloud should ensure that they are aware of and make provisions for this.

The opinion on cost and service availability is quite similar to that of perceived productivity. The average opinion is that of uncertainty. Indeed most people are not sure if implementing Cloud will bring about any cost savings or even end up being more expensive. The same goes for availability. There is no clarity of whether opting for Cloud will improve or lower service availability. This is not too strange considering that even among the experts the opinion is quite divergent. These are huge areas that an organization should look into before dabbling into Cloud.

One interesting feedback from the survey is that ensuring a valid business case for Cloud technology adoption could be a potential factor worth considering.

Security has been deemed the most important factor that affects Cloud adoption, according to this research work. This is by no means a surprise. As hackers and attackers get more skilled and proficient in getting unauthorized access to applications and services, there is increased awareness of security. To host applications in the Cloud is to give away the sense of being responsible for the security of one's applications and services and is clearly not where most people want to be. As stated earlier, it explains why the choice of Cloud is largely private Cloud or at the most retaining sensitive data in-house and hosting non sensitive ones with Cloud providers (hybrid). The second and third most important factor highlighted is availability of service and cost respectively. These perhaps are considered quite important because of their sensitivity to the success of a business and the fact that most people are still not sure how the Cloud affects them.

This research work makes a necessary contribution. Even though a number of factors have been suspected to affect Cloud technology adoption, this study actually goes ahead to confirm which of these factors do actually need to be well considered when planning on moving applications to the Cloud.

4.5 Conclusions and Future Research

Cloud technology can be beneficial to an organization [1]. However, the organization needs to be aware of the challenges and factors like security, compliance, vendor lock-in, cost and service availability that can impede enjoying its benefit. These factors have to be clearly prepared for so an organization can continue to

keep its cutting edge. Most professionals are already somewhat familiar with Cloud technology and believe that the technology will be easy to learn and use. They are also happy to recommend it to their organizations.

This research has some limitations that need to be highlighted. Firstly, the number of sample involved in this research is quite small compared to the working professionals in the United Kingdom. With more time and resources, the research work can be taken to a higher level. This is an area of further research.

Secondly, the research focuses only on the working professionals in the United Kingdom. It could be interesting, for example, to validate this result in another location, e.g., the United States. In addition, these factors need to be tested among a different category e.g., students who may be more technologically savvy than working professionals. This is also an area of future research.

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