Cloud Computing Adoption Issues and Applications in Developing Countries: A Qualitative Approach

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Abstract: *Cloud computing is an innovative computing reform that provides computing services without any physical boundaries. The purpose of this study is to present the theoretical understanding about cloud benefits, to explore the applications and issues related to cloud computing in IT and Telecom companies of developing countries. Technology-organisation-environment (TOE) framework is used to present the various technological, organisational and environmental factors to adopt the cloud computing. Qualitative research approach is used to analyse this exploratory phenomenon. Firstly, structured interviews were conducted and recorded with an audio device. Subsequently these interviews were transcribed and classified into nodes with the help of NVIVO software and quotations of the interviewees were used for developing relevant themes of study. Various technological, organisational and environmental factors are identified through qualitative data gathering and presented in the context of TOE framework. This study is helpful for the organizations to understand the critical factors essential for implementing a successful cloud environment.*

Keywords: *Computing Services, Cloud Computing, Data Centers, Cloud Issues, Cloud Applications*

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1. Introduction

Cloud providers provide different types of cloud services such as software's as a service, platform as a service, and infrastructure as a service to different organizations [16]. *Software as a Service (SAAS)* is defined as organizations use application software's such as word processor, databases and work related software etc. on rental fee for the specific period of time via internet and they do not need to install these application software on their local computers. One of the famous examples is use of Google Apps. *Platform as a Service (PAAS)* is defined as organizations using cloud services as a platform for data storage and maintaining huge databases on virtual servers from where data can be accessed in real time for example, Windows Azure by Microsoft. Windows Azure is an open and flexible cloud platform that enables you to quickly build, deploy and manage applications across a global network of Microsoft-managed datacenters. *Infrastructure as a Service(IAAS)*refers to the use of cloud computing as a whole infrastructure including utilization of hardware components, networking operations, and programming tasks, different companies are offering cloud infrastructure, for example Amazon offering, Amazon.com AWS [22].

Cloud computing has four type of deployment mechanism such as public, private, community, and hybrid clouds. *Public clouds* are those in which any person or organization can use cloud services irrespective of its physical. *Private cloud* refers to cloud services used within an organizations without public access to that specific cloud services [30].*Community clouds* refers to share the cloud services or infrastructure within a particular community of the society[12] for example a healthcare community cloud is used to share information between doctors and patients. *Hybrid* is combination of all previously defined types of clouds [06]. Private cloud packages are mostly used in the companies of Pakistan. Cloud usage with respect to company type in Pakistan is illustrated in figure 01.

Cloud computing is different and novel concept that enhances the scalability, virtualization, speed, and cost flexibility in the field of IT. Scalability is a key feature of the cloud computing that refers to expanding the service capability when required as well as contracting its features when not needed. Therefore it is a unique element of cloud computing that differentiates it from other traditional technologies such as desktop applications [35].

Cost reduction up to 85% can be achieved if using cloud computing for backup or recovery purposes [41].Virtualization is a technique for energy efficient computing as it reduces hardware requirements [03]. In Figure No. 02, cloud characteristic, types and deployment models are presented in the form of layered cloud

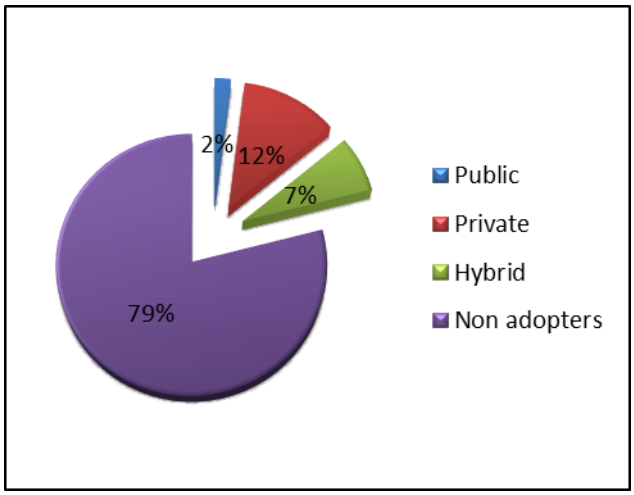

Figure 1. Cloud computing adoption ratio.

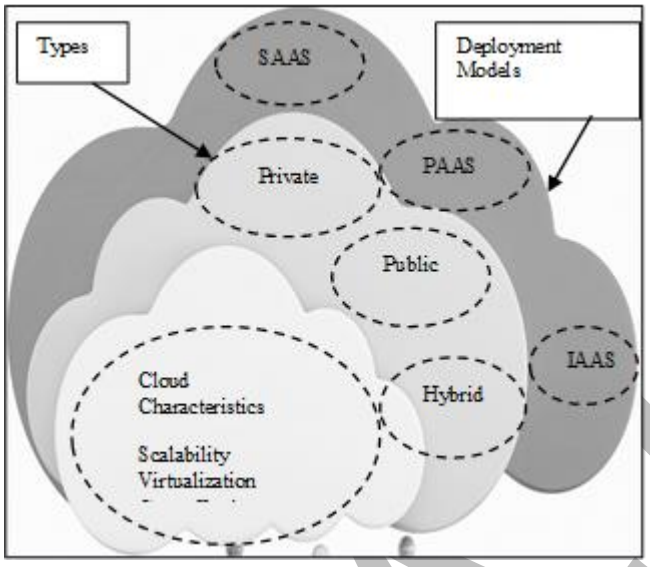

Figure 2.Cloud characteristic, Types and Deployment models

This research comprises comprehensive literature review of prior studies about cloud computing, TOE framework is used to explore the hidden factors influencing cloud computing in IT and Telecom industry. Technological context means IT infrastructure and applications which impacts on cloud computing adoption positively or negatively. Organizational context refers to the practices, type, size, culture of the organizations and environmental perspective means the government policies, society and market impact on adoption of cloud computing. This work provides guidelines for the students, teachers, researchers and managers for preparing network and business plans or IT based decisions. Our research objective is to investigate the extent to which cloud adoption is practiced in developing countries. Moreover, to highlight the technological, organizational and environmental factors involved in the adoption of cloud computing.

2. Factors Influencing cloud adoption

2.1. TOE framework and cloud computing studies

Cloud computing is an emerging technology spreading across the globe very rapidly. There is some major work produced by researchers such as "hindering factor in cloud adoption" studied by Wu and Lee [39] by using Technology Acceptance Model (TAM) model and proposed duo-theme DEMATEL (Decision Making Trial and Evaluation Laboratory). Another team of researchers from Taiwan named Low, Chen, and Wu [22] used technology-organization-environment (TOE) Framework to explore the factors impacting on cloud computing adoption. Moreover, the cloud applications in e-health and knowledge management also presented by the researchers of cloud domain. An absolute summary of previous work is provided in Table No. 1, more specifically model based studies are highlighted because of clear understanding of major work in cloud computing domain.

Table shows the level of research is being practiced in the field of cloud computing with the streamline of well renowned theories and models. Subsequently, we explored the TOE factors from literature.

2.2. Technological Factors

In Technological context, relative advantage is defined as the perceived benefits of technology adoption and companies extract additional advantages through taking technological risks [32]. Another factor is compatibility with technological features. It is extracted from prior theories that compatibility is a term that refers to how much the operating procedure and practices of the organization are relevant with the new technology that organization is willing to adopt [39]

Compatibility between existing system and cloud computing can be the key factors to bring innovation in any industry [10]. New adopters of technology innovations required gradual experience and knowledge. Comparison of existing system and proposed system as well as test the overall compatibility features are also required by the technology adopters [02]. Complexity is another technological factor that influence cloud computing. Complexity has negative impact on the adoption of cloud computing as extracted from previous literature complexity refers to difficulty of understanding and use of new technology in the existing system [39].

Table 1. Summary of Literature review.

Authors	Year of Publication	Domain of research	Sample	Methodology	Models/Theories used
Wu, Lan, & Lee	2013	Acceptance of using cloud services in University	University students	Qualitative/ A case study approach	TAM and duo-theme DEMATEL
Bogataj & Puclhar	2012	Business model factors influencing cloud adoption	300 micro 300 small 300 medium 300 large & 300 IT Enterprises	Quantitative	Business Model
Bollineni & Neupane	2011	Implications for adopting cloud computing in e-Health	They include IT-architects, business development manager, executive consultant, chief technical officer (CTO), program manager, business consultant, CEO	Qualitative and Quantitative both/ Interviews	Cloud computing overview model (NIST)
Low, Chen, & Wu	2011	Understanding the determinants of cloud computing adoption	111 firms belonging to the high-tech industry in Taiwan.	Quantitative / Questionnaire based	TOE framework
Ercana	2010	Effective use of cloud computing in educational institutions	Literature	Conceptual	Required infrastructure model and required application model
Vouk	2008	Cloud Computing – Issues, Research and Implementations	Previous studies	Conceptual	A Kepler-based workflow
Antonova, &Nikolov	2009	Conceptual KMS Architecture Within Enterprise 2.0 And Cloud Computing	Previous studies	Conceptual	SLATES Framework and KMS model

While studying cloud computing in India (neighboring country of Pakistan) Gupta and Chandelkar [17] says that cloud has many features such as load balancing, remote access and virtualization but more important is speed because without internet speed and proper machines cloud is meaningless. With reference of cloud usage, speed requirement is depend on internet traffic used by an organization. Overall, for using large-scale cloud services more speed is required. A crucial step is to develop a comprehensive network plan to access the applications provided by the cloud providers in real time [34]. Cloud accessibility is convenient, as many countries are connected via internet, and it is an internet dependent technology however, the access of cloud software as a service, infrastructure as a service, and platform as a service required high-speed internet.

Applications for desktop computers do not compatible with the mobile cloud environment. Smartphone's are capable to access the application download platforms like Android Market, Apple Store, and Blackberry App World, along with a plethora of third-party mobile applications cannot be matched [05]. Developers need to concentrate on market requirement while developing applications for clouds. For example in Pakistan cloud is used in CRM department therefore the applications similar to SugarCRM are required to be developed. SugarCRM is online cloud based software to manage cloud based customer relationship management.

Another issue in clouds is security which is genuine crisis because cloud is an internet based technology and Wi-Fi networks used by multiple MAC addresses at a time. In Pakistan Subscriber Identity Module (SIM) used in mobiles does not have capability of providing fast internet through GPRS or EDGE, because license of advanced technologies such as 3G, 4G and LTE has not been launched. Mostly people use Wi-Fi access point for using high speed internet in Pakistan, however there is no hotspots are installed on metropolitan level, as equipped in developed nations. Therefore, internet as well mobile security mechanisms and algorithms need to develop for secure communication. According to the above facts, relative advantage, compatibility, complexity, speed, accessibility, security, and application development are

the technological factors observed from the studied conducted around the globe. However in order to explore the hidden technological factors the response of following research question is explored.
RQ1: what are the technological factors predicting cloud computing adoption in developing country.

2.3. Organizational Factors

In Organizational context factors such as top management support, firm size, and technological readiness discussed. Top management support is involvement and interest of decision makers regarding technology implementation and adoption. Top management provides vision and paradigm for adoption of new technologies [20]. To create supporting environment and utilization of resources for the adoption of innovations top management support is very critical [21, 39]. Top management support in the sense of decisions regarding technology implementation and adoption. Hence, the top management plays an important role in the adoption of Cloud Computing

Firm size refers to the size of the business in term of production and market share. It is extracted from the previous studies that greater the size of the firm is greater ability of the firm to accept change and flexibility [29].In the various phases of adoption understanding firm size and behavior are important. Another factor, technological readiness defined as pro-activeness at the time of adoption how much organization is well prepared from technological point of view, in the context of experienced and technical expertise people [38, 39]. Therefore technological readiness, firm size and top management support plays significant role in the adoption of cloud computing. Firm type and organizational culture are also major factors in the adoption of cloud computing therefore for detail exploration the following research question is answered subsequently.

RQ2: what are the organizational factors predicting cloud computing adoption in developing country.
Cloud computing paradigm is not very much vivid however potential for economic development, as many business activities could be operated in cloud environment [24].

2.4. Environmental Factors

In environmental context, competitive pressure and trading partner's pressure are also influencing phenomena's that initiates the organizations to adopt the new trend of cloud computing. Competitive pressure is a pressure developed by the competitors within the same industry [38]. In this global era, market competition is increasing day by day, by the efficient use of technologies companies endeavor to acquire competitive advantage among others [39]. Trading partners refers to the partners in business dealing and sometime for keep on going with strategic partners, an intangible pressure is created because of them is known as trading partner pressure. Sometimes organizations depend on their trading partners for resolving implementation issues and maintenance of technical recourses [29]. Wang, Wang & Yang (2010) (p.808) says, "Not surprisingly, requests from powerful partners (ones that generate a large proportion of sales or a large proportion of the firm's profits) are a critical factor in adoption of specific innovation". Trading partners are concerned with the infrastructure and adoption trends so that this pressure forces companies to adopt cloud computing.

The other factors beside these includes customers behavior, IS infrastructure and government influence, also impacts directly or indirectly on adoption. While implementing and using cloud computing several environmental issues are being faced by the people around the world. This study is conducted to answer the following research question as well.
RQ3: what are the environmental factors predicting cloud computing adoption in developing country.
Organizational, Technological and Environmental factors identified in literature are illustrated below in Figure 3.

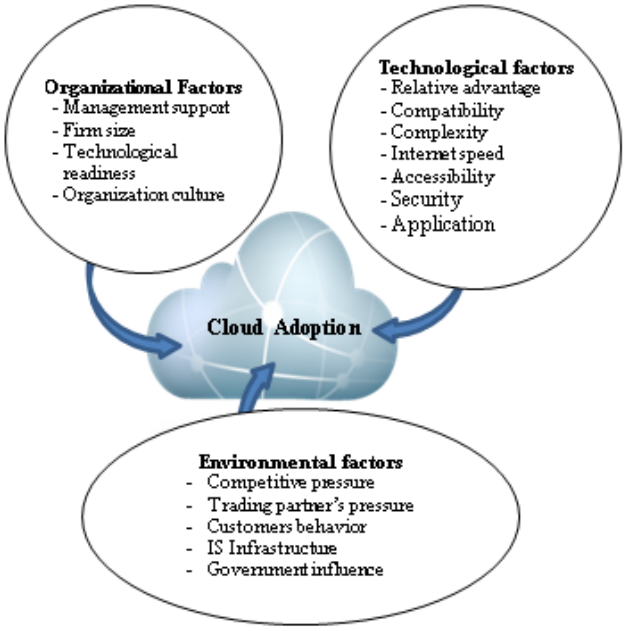

Figure 3. Proposed Factors influencing cloud computing adoption.

3. Methodology

3.1. Research Design

Case study approach was used because we have to investigate a contemporary phenomenon within its real-life context. Cloud acceptance and implementation are not clearly defined in the scenario of developing countries. Grounded theory pattern was used for development of theory by the consistent conceptualization and categorization of data [23]. In

this study, an inductive approach is used to develop the theoretical model and propositions because we have to explain the phenomena of cloud computing in various contexts with descriptions [23].After determining the sample size and target population interviews were conducted and recorded. Next step is transcription of data and analysis of data for development of theory in context of cloud computing. Previous literature was summarized and presented for understating the issues related with this emerging technology. This study is an exploratory study in which cloud computing benefits and applications are explored and discussed.

3.2. Sample

Our sample mainly consist of two types of organizations those who had adopted cloud and experienced its services and the other ones are those that are not using cloud computing but ready to use this innovative business style. Zong (Telecom Company) using cloud services for Customer Relationship Management (CRM) department. A software house in Islamabad also using cloud services for application development. In order to answer our research questions we selected major IT and Telecommunication (both local and multinational) companies of Pakistan for our interviews because their views are most authentic for clear picture of people's response for cloud salutation in Pakistan. Four managerial level employees were interviewed, two belongs to Telecom companies and others represent IT companies. We used extreme case sampling technique that is type of non-probability purposive sampling to access the detailed picture of the scenario and they are the ones who actually know much about the phenomenon [33]. Table No. 02 demonstrate the information of sample companies selected for interviewing.

Table 2. Selected Companies characteristics.

Company Name	Zong	Telenor	NetSol Technologies	Ovex Technologies
Company Type	Telecom Company	Telecom Company	Software House	Software House
Company Age	More than 05 years	08 years	18 years	10 years
No. of employees	3000	33,220	5000	670
Annual Sale	$111814306.02	$660587399.34	$23692500	$20000000
Interviewee designation	Manager Network planning and implementation	System Support Manager	Manager Web	Information Management System Specialist
Cloud Aspect	Cloud user	Cloud user	Cloud user	Cloud provider

3.3. Interviews

Data used in research was collected through interviews from IT personnel's working on management and executive positions because they actually deal with the decision about implementation and adoption of new technologies. Personal interviews stimulate trust and cooperation, which are prerequisites to observing and analyzing actual situation of cloud computing in Pakistan. Interviews provided the opportunity to aid the respondents in the explanation of their ideas.

3.4. Data Analysis

After collection of data, all the interviews were imported into NVivo software as one of our primary sources of research. Line by line coding of interviews was done by the help of NVivo software. Firstly, comparison of one unit of data with other units of data to look for common attributes across the data was made. Those attributes were given names (codes) for classification purposes. The second stage involved the process in which codes were refined [36]. Third stage involved establishing and explaining relationship between codes. After classification of constructs and concepts they are assembled and related for the formulation of new proposition. Arguments are presented in the form of quotations of company representations.

The detailed analysis includes following steps such as Transcription of data, Summarizing of data, Unitizing of data, Selective Coding, Categorization of codes, and Theory Formalizations. During this phase the following factors (see table 03) were explored while coding of interviews:

Table 3. Themes Emerged from qualitative analysis.

No.	Factors Explored (Themes)	Frequency
1.	Awareness of technology	02
2.	Electricity short fall	01
3.	Licensing	03
4.	User training	01
5.	Documents Collaboration	03
6.	Remote Access	04
7.	Storage	16
8.	Back up	02
9.	Ease of use	02
10.	Data Recovery Tool	03
11.	Online Games	02
12.	Social Media	02
13.	Customer Relationship Management	03
14.	Knowledge Management	01

4. Results and Discussion

Cloud computing adoption is a recent phenomenon that is capable of bringing transformation in investing decisions about information technology management. In Cloud computing resources are available 24/7 as one of our interviewee stated:

"*Cloud basically fly and go with us where we go, from there this concept developed" (04-10-2013).*

Most importantly online storage management saves our lot of time and resources

A Software House Quoted:

"*As long as we travel hard disk travels along with us, for example we work in the office and after that we go home open the same file at home"(4-10-2013).*

Cloud computing creates competitive advantage within IT & Telecom industry. Mobile cloud computing is an upcoming technology in Pakistan that sparks mobile phone industry. Cloud computing mechanism is an innovative style of computing services. Through deep analysis of literature and interviews following applications were explored.

4.1. Technological Factors

The interesting technological drivers such as online games, data backup, social media, remote access, storage, and ease of use were explored in our interviews. These themes play vital role in the adoption of cloud computing. Now-a-days people mostly play in-door games on computer and majority of them face installation problems at their personal computers because of less random access memory (RAM), however, it is an easy way to play games online with the help of already installed games in an online environment provided by the clouds without loading it into the RAM as one of our interviewee commented *"heavy games and not need to install no need to load even, everything is online"*. Huang, Chen, & Hsu [18] presented the cloud based gaming system with the name of "Gaming Anywhere" that were tested on multi-type operating systems such as windows/Android. Games are now available on tablets, mobiles, laptops and anywhere where we have Internet access we can avail this advantage from entertainment point of view. A software house commented about games usage: "*Cloud has lot of benefits in this new age of technology, now a day's games are also provided by the cloud*" (10-10-2013).

Cloud computing is also used as a data recovery tool in many organizations and accelerates the level of adoption of cloud. A software house commented, "By using cloud services we prepare online backup of all important documents/files" (10-10-2013).An intelligent storage hardware, software and network is designed by Citrix Cloud Solution which is capable of managing cloud servers for cloud users [08]. With the help of cloud computing all type of data backup can be stored on the Internet on virtual servers so that in case of any disaster or data loss all the required data can be again accessed from cloud storage.

Moreover, cloud computing is backbone of social media websites for example Facebook, where we can share, upload and download videos and pictures and at the same time a person using Internet in the Middle East or America can access that videos in his or her own country. Various architectures have been developed for merging of social media with clouds and social clouds are created where Facebook and Twitter users are able to exchange data storage [07]. After interesting discussion our respondents agrees and said "*yes, social media can be considered under the domain of cloud computing as on facebook we share videos and photos and also upload for the longer period of time*"(10-10-2013).

Remote access is a key influencer of cloud computing because world is global village now and organizations are spread all over the world such as multinationals, and global firms. These organization need to share information with employees worldwide. Similarly, when they travel for international meeting they need internet for data retrieval. As one of our interviewee commented "*More significantly it covers geographical distances it saves our traveling cost for our internal organizational purposes*" (04-10-2013).While studying cloud computing in India(neighboring country of Pakistan) Gupta and Chandelkar [17] mention that cloud has many features such as load balancing and remote access that distinguish it from traditional computing.

Major functions of clouds include online storage and backup provided by cloud user in virtual environment. To build and maintains large scale data centers with super computers and multiple hard disks is a challenge with increasing number of demand for storage capacity. Costly hardware is required to establish large data centers, and they emit heat and radiation that are unhealthy for global green environment. Thus, Cloud resolves this problem very efficiently by providing pay per use storage capacity online. A telecom companies quoted "*Cost saving, elasticity, scalability, load management, storage on demand are core benefits of cloud computing*" (04-10-2013).

New Technologies are generally difficult to use, due to hardware, software and interface complexity. As DOS (Disk Operating System) is difficult as compared to (Graphical User Interface) GUI based windows for nonprofessional. Cloud computing is a technology that resembles with existing technologies for example cloud based windows is similar to normal Microsoft Windows OS. Therefore, cloud computing is easy to use for computing users. A telecom company says, "*Cloud is new phenomena but simple to use as compared to other new era technologies* (04-19-2013). In addition, cloud computing is an internet oriented technology, it is uncomplicated thus easy to use [19].

4.2. Organizational Factors

Cloud computing is also used as knowledge management system for example a team of experts of a multinational firm is going to develop guidelines for middle and lower level managers of an organization, It is an easy way to access and share all of the material from the cloud with peers and sub-ordinates. Cloud computing assists and reduces work loads of universities IT staff who are responsible to upload course material [14]. This concepts also narrated by an IT company which says " *Cloud based environment provides us a knowledge sharing facilities as well as experts suggestions can be saved on cloud databases for instant usage(10-10-2013).*

"Organizations have to pay a lot of upfront costs to purchase hardware and acquire software licenses (operating systems, databases, etc.)"[31]. Therefore, regulations for licensing the more advanced IT and telecom technologies like; Advanced Long-term evolution (LTE), third generation (3G) and fourth generation (4G) are necessary for VOIP speed as well integration of new internet based technologies such as cloud computing. Currently computer users in Pakistan paying for various cloud services this problem was highlighted by an IT firm "*Purchased in the sense that we purchased services when we demands for more storage they(cloud providers) defiantly demand money*"(10-10-2013)

Cloud computing has many application in business units working in Pakistan among them most common application are in Customer Relationship Management (CRM) because usually in Pakistani environment IT and Telecom companies had outsourced their CRM department because they do not want to share other type of internal information with sales personnel's and telephone representatives. For this reason, the mannequin terminals usually provided working on cloud based architectures. Moreover, they just pay as they use the service of cloud providers. Customer Cloud computing is a new phenomenon for Pakistan therefore training is required for cloud to professionals of IT and Telecom even. Legal, operational, environmental and technical issues related to clouds required cloud computing training programs. *An organized training is required for understanding cloud features and how to use them efficiently"* (04-10-2013) quoted by a telecom company. Training brings positivity in acceptance attitude of user.

The developing countries such as Pakistan, is facing problems of electricity shortage. However, continues power supply is obviously required for using an internet based technology such as cloud computing. As an IT firm added "In *Pakistan from the last seven years electricity shortfall is a major issue*". Therefore power management within the office is requisite for cloud computing. Hence this negatively influence the adoption of cloud computing.

Relationship Management departments using cloud based architecture because of many reasons such as cost-effectiveness, authentication, confidentiality and efficient utilization of resources. Zong, a telecom company quoted *"Luckily' we are using cloud computing in our organization, in fact, cloud base customer relationship management is practiced (04-10-2013).*Similarly, Nemecek and Vankova [28] argued that cloud-computing success depends upon the user pattern such as CRM software as a service could be the best option for companies.

Cloud Computing is widely used for Documents Collaboration with peers and coordinators. Documents including formats MS Word, Excel, Access, PDF and other formats can be shared online with our colleagues and partners from anywhere at any time, without installation of typical hardware and software. Google Docs online utility is mostly used for Document sharing used in Pakistan. A software house commented: "*We mostly use cloud computing for document collaboration within the organization in different areas located such as from Islamabad to Lahore for sharing some important documents" (10-10-2013).*Custom Solutions Group (n.d) supported this argument and describes benefits of cloud revolution for fast communication and documents sharing. Similarly, another company says "*Of course it has benefits such as real time sharing, as told you earlier document collaboration and more significantly it covers geographical distances it saves our traveling cost for our internal organizational purposes" (10-10-2013).* Documents collaboration positively associated with the adoption of cloud computing.

Therefore, knowledge management, CRM, documents collaboration and licensing are the new-fangled features that impact on the adoption of cloud computing in organizations of developing countries.

4.3. Environmental Factors

In addition, cloud providers maintains their large datacenters and by using cutting edge technology and using different alternatives for power and cooling, reduce energy consumptions efficiently as organizations become aware of green computing, hence adoption trend of cloud computing increases [13]. Therefore, the green computing awareness positively impact the adoption of cloud computing. Firms focusing on cooperate social responsibility must keep this factor in consideration. Furthermore, the awareness about cloud benefits and implementation procedure is necessary. As a telecom firm arguments "*Awareness about use and benefits of cloud to industries is critical for implementation and outcomes*" (10-10-2013).

In our research verdicts, games, data backup, social media, remote access, storage and ease of use are classified under technological factors. On the other

hand, organizational factors such as CRM, knowledge management, licensing and documents collaboration are described. Awareness about benefits, and issues of cloud, electricity shortfall, and training cloud users are environmental pitfalls of cloud computing in developing countries. Thus our results in term of TOE framework are represented in the form of research model (see figure 4).

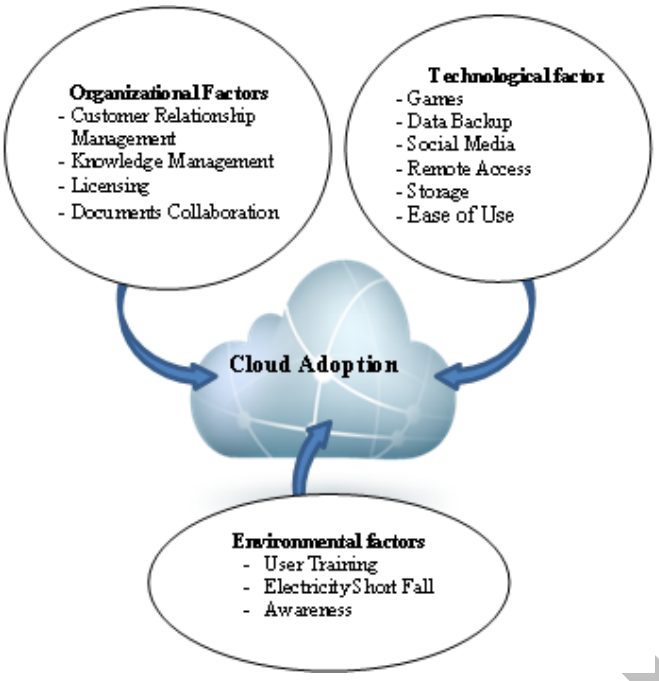

Figure 4. Factors influencing cloud computing adoption from qualitative findings.

5. Conclusion

We studied cloud computing usage level as well current adoption trend among IT and Telecom industry. Interviews were conducted and themes were emerged by transcribing those interviews. Subsequently, those interviews were quoted to support our arguments. In addition, we use TOE framework to summarize previous work as well as to demonstrate emerged influencing factors in adoption of cloud computing. Factors identified through this research were classified according to TOE framework. Emerging features such as online games, data backup, social media, remote access, storage, and ease of use are discussed under the domain of technology. However, knowledge management, CRM, documents collaboration and licensing are the new-fangled features in organizational context. Moreover, awareness, user training and electricity shortfall are major environmental issues faced by developing countries for using cloud services.

Cloud computing is an internet based technology that is widespread in urbanized countries though in developing countries it is at stage of accepting and adoption. Cloud computing services can be accessed from anywhere through internet, on payment depending upon the software, application, or infrastructure needed. In IT and Telecom industry cloud applications are observed in CRM department, for documents collaboration and for data recovery management. Cloud computing is an appropriate path for the companies because of its features however the awareness of cloud computing features among technology decisions makers is mandatory. User acceptance and training about usage of cloud technology in employees of IT and Telecom companies accelerates the adoption level of cloud computing. Cloud computing applications in knowledge management (KM) and education management are partially practiced and need to be utilized more in industries for economic growth and learning enhancement.

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