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# Adoption of Cloud Computing in Nepal

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**Abstract: This research aims to investigate the status of cloud computing among business and government organizations, to explore the major concerns of organizations regarding the adoption of cloud computing, to find out the major challenges and opportunities on adoption of cloud computing in Nepal. The study shows that Government and Business organizations are in similar position in adoption of cloud computing in Nepal. The literature was reviewed and much was discovered about the complexity of cloud computing. The status of cloud acceptance and their major issues were clarified by the participants who agreed to follow up interviews in a survey conducted. Security, connectivity, availability, vendor location and legal issues were found to be the major reason for delay in cloud adoption. Availability and security are the key aspects which can be increased through the appropriate adoption of cloud as per the literature review. Result of the data analysis shows that most of the Government and Business organizations are not using cloud computing.**

**Keywords: Cloud computing, Emerging technologies, Major concerns.**

## I. Introduction

Cloud computing has been in use before the term cloud computing was used. In fact institutions such as universities, government labs, research labs and the military are found to be using cloud. With the establishment of cloud computing in 2008, it has been able to grab the attention of people toward it from the information technology (IT). The blend of different technology and computing resources has created a rational ecosystem online through cloud computing. This has helped IT service providers to bring improvements in computing tasks through the accumulation of required resources. Cloud computing helps to maintain financial costs related to IT infrastructure for the businesses by providing better flexibility for computing resources that can be bought and consumed (end of 7).

The demand of cloud computing is not up to the same level as its supply due to its contemporary nature Cloud computing is a vague concept that takes various forms in practice, and there are multiple definitions that attempt to describe different characteristics and forms of cloud computing [1]. The theoretical benefits that cloud computing provide are yet to be fully realized by IT professionals, as many of the existing cloud products either do not fully utilize these benefits, or simply marketing hype [2]. Safety, privacy and reliability are major concerns and uncertainties in the concept of cloud computing.

Information Systems (IS) made organizations to enjoy efficient means of data management, collection, and mining at the cost of hardware, software, and Information Technology solutions. Hence, the struggle of finding more suitable and cost-efficient ways by using tools and technologies to run IT-sector by the organizations is being bolstered [3]. The extensive adoption of Service-Oriented Architecture, virtualization, utility and autonomic computing has made Cloud Computing grow significantly, and the major driver for this widespread adoption is the economic benefit that cuts expenses for existing applications [4].

The way IT Services develops, deploys, uses, maintains and pays for have been changed with the emergence of the Cloud Computing concept [1]. The term cloud computing can actually be defined as a service where resources, information, and software can be provided to computers over a network, which is mainly the Internet. Cloud Computing promises to be a cheap alternative to specialized clusters and super-computers. This platform is more reliable than grids and its scalability is also much more flexible and dynamic than resource pools [1].

### *A. Research Question*

The main research question is:

RQ1: What is the current status of cloud computing adoption in Nepal?

At first the research seemed simple to find the answer but after thorough research and analysis it is found that cloud ratification is not the same everywhere. Governments seem to be not far behind business organizations. Both Government and Business organizations have concerns regarding cloud adoption, but the organizations which have sensitive and critical data are more worried about security concerns regarding cloud adoption. Banking sector and Government organizations have more security concerns than other business organizations.

### *B. Objectives*

The main objective of this research is to explore the current status of cloud computing adoption in Nepal.

Specific objectives are:

- To compare the adoption of cloud computing in Government and Business organizations in Nepal.
- To investigate the major concerns on adoption of cloud computing.
- To identify the major challenges on the adoption of cloud computing.
- To explore the opportunities in adoption of cloud computing.

## II. Literature Review

### *A. History of Cloud Computing*

The post industrial society is dramatically changing after the introduction of computing along with the information society which has been revolutionized by Cloud Computing. Even if Cloud Computing has been viewed as a new technology, many have embrace as evolution of technologies such as client server architecture, World Wide Web, and networking [17].

In 1960s mainframes were used for computing and transaction processing with users accessing the computing resources through 'dumb terminals'. 1980s saw the advent of protocols for networking and client server architecture. "The ability to connect users to computing and data resources via standardized networks emerged as a key enabler of cloud computing" [17]. The World Wide Web and the Internet followed in the 1990s along with enablers such as web browsers. The emergence of application service providers who offer software packaged as service over the internet was widely seen during the decade. Refer Figure 1 for graphic on evolution of computing.

With the change in time the meaning of Cloud Computing is also changing. Therefore, it is quite important to go through the definition of Cloud Computing. Cloud computing is achieving more and more acceptability day by day. Programs such as Google-apps, MSN Messenger, Skype and Flickr have induced us to rely on cloud computing even some years back. The idea started in the 1960s when John McCarthy thought of computation as a public utility [5][6]. Distributed computing appeared with organizations and universities offering dialupinthelate1970s [8]. Grid computing in the early 1990s aimed at providing easy access to computer power like an electric power grid.

In various contexts the term "cloud" has been used to describe large ATM networks in the 1990s [7]. The emergence of Internet and its cheap cost for its increase speed in the 1990s is perceived as a paradigm shift. The need for a safe and secure data transfer among the communication between branches has created the concept of Virtual Private Networks (VPNs) [9]. These solutions required load balancing to optimize resource utilization. VPN is more secure than simple dial up, but connectivity to the outside world requires additional security measures. Enterprises were rapidly adopting Web 2.0, which is the second phase in the Web's evolution [10]. Various computing paradigms were presented in the 21st century. The popular ones between the mare cluster, grid, and cloud computing [11]. Among the popular names that are linked to cloud computing are Sales force with the idea of supplying enterprise applications through a website, Amazon with its Amazon Web Services (AWS) and Amazon's Elastic Computing Cloud (EC2), Microsoft and its famous Windows Azure, Google with its several services such as Google Docs which gave cloud computing a great push and public visibility. Eucalyptus, Open Nebula and Nimbus were introduced as the first open source platforms for deploying private, as well as hybrid clouds [12]. These were designed around different core uses of cloud computing parallel processing, distributed computing and creation of virtual frameworks in order to provide Virtual Machines (VMs) to users on demand. Other famous organizations such as IBM, Oracle, Dell, Fujitsu, Tera data, HP, Yahoo, and a number of other important names introduced cloud computing after that.

### *B. Cloud Computing Definition*

According to the US National Institute of Science and Technology (NIST), "Cloud computing is 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 client and service provider interaction. This cloud model promotes availability and is composed of five essential characteristics, three service models, and four deployment models" [7, p.8][13].

### *C. Cloud Service Providers and Data Centers in Nepal*

In Nepal, Most of Data Centers provide managed service, collocation, network support and cloud services. The cloud service providers in Nepal provide only limited type of cloud services with limited option. Almost neither of any companies provides a professional level full cloud services with SLA. The list given below depicts the data centers and cloud service providers in Nepal:

*a) GIDC (Government Integrated Data Center)*

GIDC (Government Integrated Data Center) is an international standard Government's Data Center running under NITC (National Information Technology center). GIDC started providing services to only Government organizations in 2009. Initially, GIDC was providing only webhosting, email hosting and server co-location services. Currently GIDC is proving cloud services to few Government organizations. The type of cloud services provided by GIDC is mostly infrastructure as a service (IaaS) and Platform as a service (PaaS). Since all the services provided by GIDC are free of cost, so there is no clear SLA between clients and GIDC. GIDC provides cloud services through single data center and they do not have DR center yet. They have targeted to build their own DR center in Hetauda within 2016.

*b) Data Hub Pvt. Ltd.*

Data Hub is an international standard internet data center in Nepal. It provides the services like co-location services, data and network security, disaster recovery. It is located on Thapathali, Kathmandu.

*c) Nepal Telecom (NTC) Data Center*

NTC is state owned telecommunication service provider in Nepal with 85% of the government share. NTC has 7 Data Centers across Nepal. Inside Kathmandu valley, NTC has 4 Data centers located in Jawalakhel, Sundhara, Tripureshwor and Babarmahal. Outside Kathmandu valley NTC has 3 datacenters located in Hetauda, pokhara and Butwal.

*d) Ncell Data Center*

Ncell, the largest private cellular operator of the country, has 4 Data Centers across Nepal. Ncell is not much open about these data centers, but the centers are meant for complete back up of the company. Data centers are in Kathmandu, Biratnagar, Hetauda and Pokhara.

*e) Cloud Himalaya*

Cloud Himalaya is an International Grade Data Management company in Nepal. Cloud Himalaya was established on early 2013 and providing server co-location and cloud services. They have a slogan, "YOU TAKE CARE OF YOUR BUSINESS, WE TAKE CARE OF YOUR DATA" Cloud Himalaya is focused on Server Co-location Services.

*f) Syntegrate (System Integrators)*

They are professional players in data and managed cloud services. They have multiple data centers in the country and also have operating services office in Singapore. Data centers are in Bansbari kathmandu, Baluwatar Kathmandu, Chitwan and Singapur.

*g) Umrao Datacenter (U cloud)*

They are U Cloud - aiming to look over cloud computing market in Nepal. They currently provide web hosting and cloud space directly from the SAN servers in Kathmandu. They also have maintained their data center in Butwal.

*h) CAS Infra*

CAS Infra, a group company of CAS Trading House, the leading IT System Integration company in Nepal and Appnomic Systems, a specialist Remote Infrastructure & Application Management Services company, announced launching of the first commercial data center (OHM data center) in Nepal. Ohm data center is located in Bhairahwa. This Data Center provides a world-class co-location, hosting facility and comprehensive Managed IT Services to businesses in Nepal.

*i) Access World (AWT) Clouds Services Nepal*

AWT is the First Complete Cloud Service Provider of Nepal having largest Data Centre in Nepal with single floor space, which is expandable to 15,000 sq feet and backed by its redundant data centers around the world. AWT Nepal is focused on website hosting for business, cloud hosting (VPS), enterprise secure email and platform hosting.

*j) Data Space Pvt Ltd*

It provides the services like co-location services, data and network security, disaster recovery. It is located in Putali sadak, Kathmandu.

Table 1. Types of Cloud Computing Services Provided by Providers in Nepal

| S. No. | Clod Providers | Cloud Services Provided | | |
|---|---|---|---|---|
| | | IaaS | PaaS | SaaS |
| 1 | GIDC (Government Integrated Data Center) | Yes | Yes | Yes |
| 2 | Data Hub Pvt. Ltd | Yes | No | No |
| 3 | Cloud Himalaya | Yes | Yes | Yes |
| 4 | Syntegrate | Yes | Yes | Yes |
| 5 | Umrao Data Center ( U Cloud) | Yes | Yes | No |
| 6 | CAS infra | Yes | Yes | Yes |
| 7 | Access World (AWT) Cloud Service | Yes | Yes | Yes |
| 8 | Data Space Pvt Ltd | Yes | No | No |

*D) Adoption*

This section commences by synthesizing the literature for salient determinants of adoption and technology adoption. Adoption is the acceptance and continued use of a product, service or idea. It means taking something new and making it your own. In terms of Cloud Computing and for this research adoption is describing when not having Cloud Computing to

making it part of a company's infrastructure. Adoption could be defined as a process where consumers go through a process of knowledge, persuasion and confirmation, before they are ready to adopt a product or service [15].

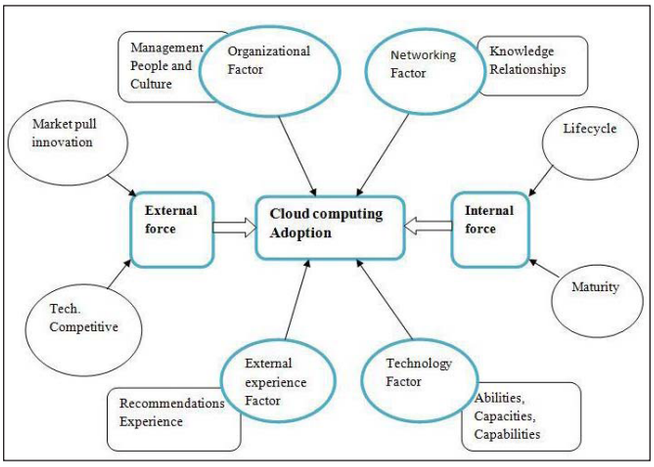


Fig. 1: Conceptual Model Framework on Cloud Adoption [74]

Various factors influence on the adoption of cloud computing. The major factors are external and internal forces. Internal force contains the life cycle and maturity of the system developed and external force contains market pull, innovation and technical competitive available in the market. Organizational factors like management people and culture of the organization also influence the adoption of cloud computing. Networking factors like knowledge and relationships also influence the adoption of cloud computing. External experience factors contain recommendations and experience of the cloud providers. Similarly, Technology factors like abilities, capacities and capabilities of the technical employees also influence the adoption of cloud computing.

### *E. Security*

The general definition of security is "the quality or state of being secure to be free from danger" [14, p.8]. This means to protect the target from the attackers who would deliberately or indeliberately tries to harm. In fact, a multilayered system that guards the organizations entity, its resources, assets, and people is needed to achieve the proper level of security by an organization. Whitman and Mattord (2009) have mentioned that the following security layers are needed by an organization:

*Physical Security:* is required to protect property and physical assets from unauthorized access and misuse of physical items, objects, or areas.

*Personnel Security:* is required to defend the individual or group of individuals authorized for access to the organization and its operations.

*Operations Security:* is required to guard the information of a certain operation or sequence of operations or activities, including the logistics methodology.

*Communications Security:* is required to safeguard the communications media, technology, and content from unauthorized access.

*Network Security:* is required to protect networking components, connections, and the content they manipulate.

*Information Security:* is required to guard the confidentiality, integrity and availability of information assets, whether in storage, processing, or transmission.

All of these overlap and are part of information security, and policy must include and cover them all [14].

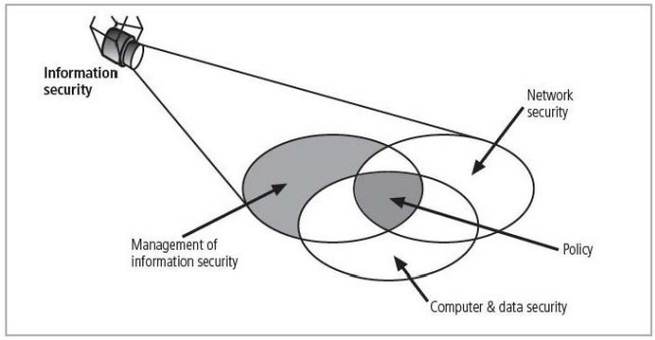


Fig. 2: Components of Information Security [14, p.9].

## III. Research Methodology

### *A. Study Area*

Since the main objective of this study is to explore the current status of cloud computing in Nepal. The researcher has focused his study on organizations in major cities of Nepal. Study was more focus on various Government and Business organizations that might be using cloud computing or may use cloud computing in near future. Survey questionnaires were distributed to only IT and management level staff of major Business organizations and Government organizations. Follow-up interview was conducted to IT and management level staff of organizations inside Kathmandu valley.

### *B. Data Collection*

A formal data collection process ensures that data are accurate and defined which aid the researcher to take decisions on the basis of that data gathered which ascertains the findings as valid. A baseline for the measurement and a target to improve is well defined by this process. The data collection and follow up interview was conducted for three months from November 2015 to January 2016. Since the main objective of this study is to explore the current status of cloud computing in Nepal and study was focus on Government and Business organizations in Nepal. So, the participants were chosen from various Government and Business organizations that are using cloud computing or may use cloud computing in near future. IT related and managerial level staffs were selected as participants for questionnaire and interview.

Local surveys, focus group discussion, or in-depth interviews for the detection of construct bias can largely help to establish which attitudes and behaviors are associated with a specific construct. The data are collected from different sources by interviewing the respondents from different Government and Business organizations and distributing the questionnaires to IT and managerial level employees of different organizations. The single common method factor approach is performed to minimize the common method bias.

*a) Primary and Secondary Data*

Since this research is concerned about adoption of cloud computing in Nepal, primary data is more crucial but in some part of the work secondary data is also taken into consideration. Primary data were collected through the structured web questionnaire and interview where as secondary data were collected from different source depending upon the condition and the limitations of the study. The main purpose of this task was to obtain answers to the research questions and to attain the objective of this research work.

*b) Interview Guide*

Interview guides summarize the content that researchers cover during interviews. On one hand, it guides the participants of the interviews to explore their own research topic through minimal directions, leading to "less structured" interviews. On the other hand, the research topics are thoroughly covered by elaborate specifications.

Since this research is simple exploratory one, I deal with three major or key questions which are "why", "what" and "how" to address different areas to be investigated. Normally, in most of the interview, "why" and "what" type of questions must be asked before "how". "Why" is used to define or describe the purpose of our study, "what" is used to obtain the knowledge about the different subjects to be studied, and "how" is used to analyze the subject or the situation.

*c) Data Analysis*

Data analysis is the process of evaluating data using analytical and logical reasoning to examine each component of the data provided. This form of analysis is just one of the many steps that must be completed when conducting a research experiment. Data from various sources is gathered, reviewed, and then analyzed to form some sort of finding or conclusion. There are a variety of specific data analysis method, some of which include data mining, text analytics, business intelligence, and data visualizations. Depending on the data collected from the work descriptive analysis and hypothesis is carried out. Transcribing of the data is the first step of data analysis.

*d) Sampling Techniques*

In this research work, since people from different government, semi government and Business organizations of major cities in Nepal are taken into consideration, so proportional stratified random sampling has been used. Stratified random sampling is a modification of random sampling in which population is divided into two or more relevant and significant strata based on one or a number of attributes. Here the overall sampling frame is divided into numerous strata and a random sample is then drawn so that the sample is more likely to be representative, as it can be ensured that each of the strata is represented proportionally. 120 users were chosen as the sample of this study and sent them the questionnaire for their response. Only105 questionnaires out of 120 were returned back to me and after analysis it was found that only 100 questionnaires were valid and could be used as the final sample of the study because of the incomplete responses provided. Hence, the valid return rate was 83.33%.

## *E. Instrumentation for Data Collection*

*a) Interview*

Since this research is simple exploratory one, deal with three major or key questions which are "why", "what" and "how" to address different areas to be investigated [82]. Normally, in most of the interview, "why" and "what" type of questions must be asked before "how". "Why" is used to define or describe the purpose of our study, "what" is used to obtain the knowledge about the different subjects to be studied, and "how" is used to analyze the subject or the situation.

Both face-to-face and one-to-one interviews were taken in order to achieve the goals of the research. The interview was carried out properly without any biasness. Similarly, data were obtained from the user through the paper based questionnaire. The questionnaire used in the study is shown in Appendix-A.

The questionnaire has been designed to be as easy and complete as possible and written in the English language and passed by the supervisor. Furthermore, the web based questionnaire was preferred over a classical one (printed and distributed) in the study. Before collecting the data few things were kept in mind. First, all respondents were given assurance about the validity of the questionnaire and were encouraged to participate. After the questionnaire submission, feeling of gratitude was expressed for participation in the study and the most important aspect that is the questionnaire was carefully designed to be simple and favorable to get the greatest possible number of responses from users. It was not too long allowing to be filled out within 15 to 25 minutes. The fonts and format used were also user-friendly.

## *F. Calculation Method*

*Sample Size Calculation:*

The confidence interval (also called margin of error) is the plus-or-minus figure usually reported in newspaper or television opinion poll results. For example, if use a confidence interval of 4 and 85% percent of our sample picks an answer it can be "sure" that if he had asked the question of the entire relevant population between 81% (85-4) and 89% (85+4) would have picked that answer.

The confidence level tells us how sure we can be. It is expressed as a percentage and represents how often the true percentage

of the population who would pick an answer lies within the confidence interval. The 95% confidence level means it can be 95% certain; the 99% confidence level means it can be 99% certain. Most researchers use the 95% confidence level. When we put the confidence level and the confidence interval together, it can say that it is 95% sure that the true percentage of the population is between +/- confidence interval. The wider the confidence interval is willing to accept, the more certain can be that the whole population answers would be within that range.

*Sample Size Formulas for our Sample Size Calculator*

Here are the formulas used in our Sample Size Calculator:

Sample Size

$$ss = \frac{Z^2 * (p) * (1-p)}{c^2}$$

Where:

Z = Z value (e.g. 1.96 for 95% confidence level and 1.645 for 90% confidence level)

p = percentage picking a choice, expressed as decimal (.86 used for sample size needed)

c = confidence interval, expressed as decimal

ss = Sample size

For Sample size ss=100, at 90% confidence level Z = 1.645 and p = .86 (average percentage picking a choice)

*Confidence Interval (Margin of Error)* $c = z^2 * p * (1 - p)/100$

$= 5.7\%$

At 90% confidence level, it can say that it is 90% sure that the result is valid with +/- 5.7% margin of error.

## IV. Data Analysis and Discussion

The creation of survey was a result of thorough examination of the literature that gives clear view of the current condition of cloud adoption and the differences between business organizations and government organizations. The questions were created in such a way that the elements of literature and factors involved in cloud computing synchronize with each other. This survey has considered those individuals who belong to these lected positions within organizations because most other professionals are not obliged to consider IT or cloud adoption decisions and they have no responsibility for security. The survey was conducted by sending out with a letter describing the study in brief and asking people through referrals with job titles on the list please respond after a failed attempt using social networking sites.

We received 100 responses that fit the description of our selected sample type; employed individuals in IT and management positions in both government and business organizations with a directs take in IT storage. Information gathered through direct contact for follow up interviews was actually given by Forty individuals. However, five out of them did not belong to IT sector so, we limit them with two concerning attitudes within their organizations. The other thirty five were asked five open ended questions on follow up interviews. Such techniques of conducting research have aided to talk with higher ranking individuals in prominent companies and in government organizations.

### *A. Analysis of the Survey*

*Question 1: What is your position within your organization?*

Most of the respondents were IT background, only 10% respondents were Manager/Director and 5% respondents were CEO. Similarly, 40% of the respondents are computer officer/IT officer, 10% IT director, 10% CTO and 10% system administrator. 15% respondents were chosen other option as their position in organization. There were not many responses from higher level position in large business organizations and government organizations.

*Question 2. Which type of organization is your organization?*

This question was aimed to spot similarities and differences of organizations. 55% of respondents are Government employee where as 45% respondents are from Business organizations. In some ways this is a higher ratio than in reality, but the aim was to get a half and half mix, which did not happen. It seems that management personnel at Business organizations are very busy and do not respondents questionnaire and provide time for short interview.

*Question 3. How would you rate your knowledge about cloud computing?*

The cloud computing is not new things; most of the IT personals have knowledge about cloud computing technology. 60% respondents were chosen cloud computing as knowledgeable and 22% respondents were chosen little knowledge about cloud computing. Similarly, 10% respondents were chosen not knowledgeable and only 8% were selected don't know option. The cloud computing technology is known to most of the IT people. But during interview, researcher found that there was little confusion and misunderstanding about cloud computing in some respondents even though they are from IT background.

*Question 4. Has your organization adopted or are there plans to adopt, cloud computing?*

The adoption rate of cloud computing by organizations in Nepal is low and only 16% Government organizations and 22% Business organizations are using cloud computing. 53% Government organizations do not use or plan to use cloud computing and 45% Business organizations do not use or plan to use cloud computing. Similarly, 33% Business organizations and 31% Government organizations are planning to use cloud computing. The cloud adoption trend in both Business and Government organizations are similar in Nepal. While the

international trend is that the government organizations are lagging behind Business organizations.

*Question 5. Which type of cloud deployment model your organization use or planning to use?*

The result of only Business organizations that use or planning to use cloud computing. 20% Business organizations use public cloud and private cloud each. None of Business organization use or planning to use Government cloud. Similarly, 40% Business organizations are planning to use public cloud and 20% are planning to use private cloud. The analysis shows that large number of Business organizations is planning to use public cloud as compare to private cloud.

The result of only Government organizations that uses or planning to use cloud computing. 16% Government organizations are using private cloud and 19% are using Government cloud. None of Government organization are using or planning to use public cloud. Similarly, 46% Government organizations are planning to use Government cloud and 19 % are planning to use private cloud. The analysis shows that majority of Government organizations are planning to use Government cloud service.

*Question 6. Which type of cloud service model your organization used or planning to use?*

The result of only organizations that uses or planning to use cloud computing. The figure shows that 51% organizations use or planning to use Infra structure as a service (IAAS) model and 39% organizations use or planning to use platform as a service (PAAS) model. Similarly, only 10% organizations use or planning to use software as a service (SAAS) model. The analysis shows that IAAS is most popular among cloud service models in Nepal.

*Question 7. What are the major concerns in terms of the influence on adoption of cloud computing? Mark all that apply.*

Most of the organizations have concerns regarding all the listed major concerns on adoption of cloud computing. 100% respondents from Government organizations have concern regarding data privacy and security while 95% respondents from business organizations have concern regarding data privacy and security. 100% and 90% respondents from Business and Government organizations respectively have concern regarding connectivity and bandwidth speed. Similarly, more than 80% respondents from both Government and Business organizations have concern regarding recovery of data, high availability, vendor location, legal action and cost. Less than 40% respondents have chosen other option as major concerns in terms of the influence on adoption of cloud computing.

*Question 8. In your opinion, what are the challenges in the adoption of cloud computing in Nepal? Mark all that apply.*

Most of the respondents from Government and Business organizations have chosen almost all options as major challenges on adoption of cloud computing. Only less than 40% respondents also chosen other option as challenges on adoption of cloud computing. Many respondents have mentioned challenges like: lack of trust, conflict management and maintain better security. Most of the respondents were worried about cloud vendor location and legal action. The study shows that there are many challenges in successful adoption of cloud computing in Nepal.

*Question 9. In Terabytes, how much data storage does your organization use, and what is the mix of primary data and backup?*

This question did not really solicit any reliable information. Probably the participants were unaware or unwilling to share the information which caused the occurrence of few responses. This led undefinitive responses. Nearly 40% of all respondents indicated that they did not know. Others probably guessed. All respondents indicated that their data is in excess of 1 terabytes (1 terabyte=1024 gigabytes) including primary and backup. Primary data accounts approximately 500 gigabytes to 10 terabytes while the backup size approximately 500 gigabytes to 5 terabytes. This is not surprising when one considers that many organizations have never audited their data. Moving to the cloud often promotes an audit of data.

*Question 10. How long does your organization keep or want to keep data backups?*

None of the participants chose under 4-5 years. Seventeen percent of the respondents from business organizations chose 4-5 years while none from government organizations had the same range. Nearly half of business respondents chose 6-10 years while only 7% are from government. The responses of "mixed" were 16% for business and 21% for government. Twenty percent of the business respondents selected "forever" compared to 72% to those from government. Government organizations whose employees chose "forever" were more than half, while only a fifth of businesses organizations selected "forever". It is assumed that these "forever" backups are on DVD or WORMs.

*Question 11. Do you think adopting cloud computing services will enhance your service delivery and thereby increase your market share?*

50% (strongly agree + agree) of received responses were of the view that cloud computing would go a long way to enhance their service delivery and expedite growth. Similarly, 25% respondents were neutral, 20% were disagreeing with statement and 5% were strongly disagree that adoption of cloud computing will enhance their service delivery and thereby increasing their market share.

*Question 12. What benefits do you expect to get from cloud computing? Mark all that apply.*

Most of the Business organizations expected to get benefits like: more flexibility, cost saving, better scalability, complexity reduction, focuses on core business and improved security. While most of the government organizations expected to get benefits like: more flexibility, better scalability and improved security. Even though the most of the organizations showed their

concerns on adoption of cloud computing, they want to enjoy the most of the opportunities offered by cloud computing.

*Question 13. On a scale of 1% to 100%, how much more secure do you believe in-house storage is versus storage in a cloud provided by a reputable provider?*

In response to this question the average among respondents from business organizations was 80%, but the average among respondents from government organizations was 90%. Most of the respondents chosen in-house storage as a more secure as private cloud. These shows their perception regarding cloud computing. This question was designed to explore the respondent's security perception regarding cloud storage against the in-house storage and found that most of the respondents believe that in-house storage is more secure than cloud storage.

*Question 14. On a scale of 1% to 100%, how much more secure do you believe private cloud is versus public cloud?*

The responses for this question were 75% among business participants and 95% among participants from government organizations. This question was designed to explore the respondent's security perception regarding private cloud against the public cloud and found that most of the respondents believe that private cloud is more secure than public cloud.

*Question 15. If you have or might adopt cloud computing, what security measures would you require from your provider? Mark all that apply.*

The data indicated that the respondents believed that their organizations require at least encryption, access authentication, antivirus protection, firewall protection, and 24/7 access monitoring using artificial intelligence with human backup. Businesses were not as interested in dual layer access authentication, triple layer access controls, IP address based restriction access plus password and varied access authentication by authorization of user. Similarly, Government organizations were not interested in triple layer access authentication, varied access authentication by authorization of user. Multiple analyses are possible using this chart, and the implications suggest that Government and Business organizations both are almost equal security conscious on adoption of cloud computing.

## *B. Follow-up Interviews*

Participants who agreed to a follow up interview were guaranteed anonymity. So with each of the 40 participants communicated a time range during which they would be available for a very short interview. Of the 40 participants, 35 were actually involved in IT. 25 participants were from government organizations, while the other 15 were from business organizations. Non-IT participants were managers, especially in marketing. These participants were asked only two questions, while the IT people were asked five questions, including the two asked of the non-IT participants. Most interviews with non IT personnel took less than five minutes, while it took about ten minutes with IT personnel. This research has aided to gain new perspective in understanding attitudes and the actual situations in some companies and organizations.

*a) Interviews with Non-IT Personnel*

Two questions only were asked of these participants:

1. What benefits can cloud computing offer for your organization?
2. What dangers do you see in adopting cloud computing?

*Question One:*

*What benefits can cloud computing offer for your organization?*

There were five participants not involved in IT, of which 2 were from government organizations. Even if a marketing department is not available to them, they were categorized as marketing managers since public relations do much the same jobs. Among the five Participants, the most popular answer was that cloud offers mobility and access on all kinds of devices from anywhere in the world. This was seen as a major plus with sales people and anyone who had to travel. The privilege of being able to run applications from their home office anywhere without installation made a couple of respondents who had to travel for a government agency really grateful.

In fact the idea of having access to data on the road and being able to modify files from a tablet and not have to carry a heavy laptop was liked by everyone in marketing. A couple of responders said that they believed that their storage problems would be solved. It was also mentioned that it might eliminate the constant upgrades. The separation of company data and customer access in different places was thought to be a good idea by some of the sales people. Almost all participants mentioned better communications options.

Marketing managers thought that the specialized email for mobile devices and collaborative documents online would offer their departments' better communication. They found the concept of instant updates to customer lists and the ability to track shipments on the road an attractive bargain. Those who mentioned it said that their company personnel were just not able to keep up with all reporting going through company servers.

*Question Two:*

*What dangers do you see in adopting cloud computing?*

There were much more responses to question two, especially among employees of government organizations. However, it was not all positive. Security concerns emerged from the idea that data would be public rather than private. An even bigger concern was moving to the cloud. Several respondents did not understand how this could be done securely. In addition they worried that people would have to learn all new protocol. The aforementioned real time updates of data bases are the real reason to worry about security. They felt that anything that is easy to access must also be easy to invade.

*b) Interviews with IT Personnel*

Out of 35 IT personnel, 23 were from Government organizations and 12 were from business organizations. All the IT personnel were asked the same two questions as non-IT participants plus three more.

1. What benefits can cloud computing offer for your organization?
2. What dangers do you see in adopting cloud computing?
3. Tell me about the situation concerning cloud adoption in your organization.
4. What is the prevalent attitude towards using the cloud in your organization, and how might this change?
5. What provisions will/did you seek in an SLA with a provider? Is there adequate legal backup in your country to enforce the terms?

*Question One:*

*What benefits can cloud computing offer for your organization?*

The IT personnel had clear understanding about the merits of the adoption of cloud computing so, they agreed that it is an important aspect for the organization. Nearly everyone brought up the flexibility offered by the cloud. This elasticity of storage and access is given great importance due to the inability to carry out this task by most organizations. System administrator particularly pointed out that if applications were run in the cloud and on a provider's servers with instant scalability, DoS attacks would be greatly diminished.

Most IT participants said they prefer the increased security of having the cloud provider's secure layers. The task to create custom security protocols to fit their organizations' unique needs is really like security specialists by working with cloud providers. One director of IT said "I learned a great deal from the specialists of our cloud provider and implemented some new protocols in our company." Mostly when asked about security, IT people thought of the security of data integrity as much as network access security, and the extra layer of backup provided by operating in the cloud was a benefit they all mentioned, even those from government institutions.

The idea of removing problems such as deciding how many servers were needed, what equipment had to be upgraded, and when to increase network capacity was gladly received by IT directors. Several mentioned that they could finally stabilize their networks for the first time, since they did not have to worry about public traffic or company data access by employees. One even mentioned that "I got more time with my family now since we were nearly completely migrated to the cloud." Participants said that they could now consider the company's core data, which stayed in house, and the internal applications as the governing force for network expansion and improvement.

*Question Two:*

*What dangers do you see in adopting cloud computing?*

This question showed the most differences between business and government organizations. Even if participants from business organizations had few criticisms of cloud computing they believed that all providers of cloud are equal which has to be considered by the company. More than half of the participants mentioned the necessity for a very detailed and clear SLA with the cloud provider. Penalties for out ages or other problems that result in loss of revenue or reputation because of cloud out ages or other problems need to be carefully documented in legal terms and signed. One danger was mentioned by only one respondent, that "the employees would become 'spoiled' with so much power instantly available." He mentioned that "coders used to write very tight code; until storage became so cheap they no longer needed to do that." The participant thought that "perhaps people would get lazy about backups and not keep control of multiple copies of their files."

Participants from government organizations thought that they had to be very careful when choosing a cloud provider, or they may have data leaked. Therefore, they had to vet providers carefully for their possible conflicts of interest. One participant from government organization voiced the opinion that "the government should create a new department to provide cloud access to government organizations." He said that "if that happened, a lot of organizations not planning to adopt the cloud would then change their minds."

*Question Three:*

*Tell me about the situation concerning cloud adoption in your organization.*

This question either took very little time to answer in the case of organizations currently not even considering adopting the cloud (all government among these respondents), or it took several minutes for the participant to completely outline the situation. Most were in process of moving to the cloud, though none had completed such an initiative. However, it seems that every organization has a different idea of what they need from a cloud provider and how they plan to use it. One participant mentioned that "the planning was the second most complex and difficult part of such an initiative, with convincing other departments that it had to be done, or proving the Return on investment (ROI) to finance."

Respondents from government organizations indicated that their organizations were, at best, very slow to adopt the cloud. Lots of research and vetting of possible providers was the state at one organization with absolutely no adoption of the cloud as yet. Other respondents indicated that some public access had been moved to the cloud, but that it was their own private cloud at are mote location. Financing cloud adoption was another problem mentioned, since whole new budgets had to be created to support it. The participants from business organizations all were more advanced in cloud adoption than any government organization represented, but most had not completed the migration. All of the business organization participants indicated that cloud was being adopted. Many indicated that they had adopted the cloud for their less sensitive data as a test case and that this was going very well.

Some companies were documenting their progress as a sort of test cases. They all expected success to varying acceptable degrees, but they were interested in acquiring as much information as possible before adopting the cloud enterprise-wide. Two participants were with very large global enterprises and were keenly interested in finding away to adopt the cloud for all their installations.

*Question Four:*

*What is the prevalent attitude towards using the cloud in your organization, and how might this change?*

This question took very little time. Most respondents from business organizations indicated that the attitude was fairly positive, since early experience was proving the value. A few respondents, including all but one of the participants from government organizations, indicated that the attitude was still a little stressed. They were not sure they were going about it right. The participants from government organizations said they knew it had to happen "eventually" but lots of people were happy to put it off. Two men said that there was a lot of research going on in order to prevent any actual action.

As for how things might change, most participants indicated that acceptance by other organizations or lack of bad news concerning the use of cloud would probably change attitudes. All participants indicated some version of "time". That is they expected time would prove the technology.

*Question Five:*

*What provisions will/did you seek in an SLA with a provider? Is there adequate legal back up in your country to enforce the terms?*

All respondents indicated that they would, or had, sought up time and security guarantees with some kind of enforce able civil penalties, since there was simply not enough legal backup in the national law. Nepal Government lag behind in updating laws to include cyber space and cyber crime, so even when they can track criminals or when negligence is proven on the part of a provider, there is not much that can be done, because the law lacks teeth. So organizations try to put teeth into the SLA whenever possible. Most of the respondents SLAs were as good as they could make them, and that they really had not had much trouble with them, as most providers of stature were as good as the negotiated SLA.

Many participants worried about adopting the cloud too quickly, even among those from organizations which already had. They worried that this would only add more confusion and create more ways for security to be breached if there was not more planning behind it. They cited stories of other organizations that had big problems when the providers could not deliver as promised. While most believed that moving to the cloud was inevitable, none were really sure what the best way was to do that. Two participants from very large organizations did believe they had the right mix of public and private, but were not sure it was being utilized as well as possible.

### *C. Contribution*

*a) Practical Contribution*

Practically this research will be helpful to cloud providers to know about the adoption rate of cloud computing and possible market for cloud computing in Nepal. Provides information to providers regarding major concerns of the organizations on adoption of cloud computing. It also helps the providers to know the popular cloud delivery model and cloud deployment model in Nepal. It also helps the providers to know the tentative average digital data available in organizations in Nepal.

*b) Theoretical Contribution*

Theoretically this research provides the adoption rate of cloud computing in Government and Business organizations. It also express the overall perception of organization's on adoption of cloud computing and major concerns while choosing cloud computing services. This research provides basic understanding of cloud computing, types of services and architecture of cloud computing. This research also lists the major concerns, challenges and opportunities on adoption of cloud computing in Nepal.

*c) Managerial Contribution*

This research is very helpful to the managerial personals of various organizations to understand the cloud computing service available in Local market and information regarding the cloud service providers in Nepal. This research will be very helpful to them to take further decision regarding adoption of cloud computing in their organization.

*d) Research Contribution*

This research will be helpful to the researchers who want to do research on cloud computing in Nepal. This research may be starter document to many researchers who will do further research on cloud computing in Nepal. The researchers can found much information regarding cloud computing and current status of cloud computing with further study role model.

## V. Limitations

The purpose of this research is to explore the current status of adoption of cloud computing and major concerns of clients regarding adoption of cloud computing in Nepal. The researcher has focused his study only in major cities of Nepal. The topic cloud computing adoption in Nepal cover huge area of study regarding cloud adoption but researchers only focus on current status of cloud adoption, major concerns regarding adoption of cloud computing, challenges and opportunities while adopting cloud computing in Nepal. Just three months period which was during high political instability was another limiting factor that affect on the amount of survey response. In the surveys, it depends upon self-reports and not direct observation of phenomenon of interest. Therefore respondents' honesty, seriousness, accurate memory, and interest in the research determine the accuracy of the findings.

## VI. Conclusion & Recommendations

The study has explored the current status of adoption of cloud computing in Nepal and found few organizations have adopted cloud computing services and majority of organization are not using cloud computing service even though most of the IT personal have knowledge regarding cloud computing technology. The cloud adoption rate is similar in government and business organization. But the international trend is that the government organizations are far behind the business organizations on cloud computing adoption. Private cloud deployment model and infrastructure as a service (IAAS) cloud computing service are popular than other types. The organizations have various concerns regarding adoption of cloud computing and most of the respondents showed the major concerns: data privacy and security, connectivity and bandwidth speed, recovery of data, high availability, cloud vender location, legal action and cost. Most of the IT personnel are aware of cloud computing and they believe that the cloud computing service will enhance their service delivery and increase their market share. The opportunities of adoption of cloud computing cover the various benefits of cloud computing that can be enjoyed by organizations are: more flexibility, cost saving, better scalability, complexity reduction and improved security.

Since this research work is carried out for academic purpose, organizations and service providers' perspective is taken into consideration for adoption of cloud computing in Nepal. This work may be useful to cloud service providers to expand their cloud computing business in Nepal with more degree of success. Future research needs to focus not upon who is adopting the cloud, or how many is adopting it, but how it is being adopted. Quantitative research of mature cloud initiatives by organizations in Nepal with framework development and validation can be done as future work. The ongoing research documenting cloud initiatives will be most valuable for planners to avoid costly mistake.

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