

CHAPTER 1

INTRODUCTION

Google Trends confirms that “cloud and cloud computing” are the most searched keywords now a day’s throughout the world. It has won excitement not only among the researchers, but also among the senior executives, CIOs and Datacenter Managers across the world.

Common questions asked about a new technology while it is introduced are: “When was it invented?”, “Where it was first mentioned?” and “What are the projections for its future?”.

1.1 BACKGROUND

It is a general perception that products and ideas about cloud computing has started in 21st century. But, exactly speaking this is not the whole truth. Cloud concepts have existed for many years. A brief review of historical development is described in the following paragraphs.

Cloud computing concept started in 1950s with the evolution of mainframe computing.

Wherein, multiple users were allowed to access a central computer through dumb terminals, whose sole function was to provide access to the mainframe. Because of the high cost requirement for mainframe computers, it was not feasible for an organization to provide these to every employee. Nor did the need of such high capacity storage and high speed processing for a typical user, which is being provided by the mainframe computers. Providing shared access to a single resource was the economical solution for this sophisticated technology.

Concept of Virtual machines (VMs) came into existence around 1970s with the use of software like VMware for virtualization; which made it possible to execute one or more operating systems simultaneously in an isolated environment. A

virtual computer (similar to complete computer) could be executed inside one physical hardware which in turn can run a completely different operating system.

1950s concept of shared access mainframe have been took to the next level by VM operating system, by permitting multiple distinct computing environments to reside on one physical environment. Virtualization played an important role of catalyst in the evolution of communication and information technology.

Telecommunications companies started offering virtualized private network connections in the 1990s,

Earlier, only single dedicated Point-to-Point data connections were given by the telecommunications companies. The newly offered virtualized private network connections, which were available at reduced cost and had the same service quality as their dedicated services.

Instead of building out physical infrastructure to allow for more users to have their own connections, telecommunications companies were now able to provide users with shared access to the same physical infrastructure.

In these earliest stages, the term “cloud” was used to represent the computing space between the provider and the end user. During the second half of the 1990s, companies began to gain a better understanding of cloud computing and its usefulness in providing superior solutions and services to customers while drastically improving internal efficiencies. In 1999, Salesforce.com became one of the first major movers in the cloud arena, pioneering the concept of delivering enterprise-level applications to end users via the Internet. The application could be accessed by any customer with Internet access and companies were able to purchase the service on a cost-effective on-demand basis.

Early 2000s, shortly after Salesforce.com brought this new concept to the world’s attention, Amazon.com proved that it could outlast the dot-com bubble burst with the introduction of its web-based retail services in 2002. Amazon was the first major organization to modernize its data centers, which were utilizing only about 10% of their capacity at any given time (which was commonplace at the time, because companies were worried about sudden spikes in capacity needs). Amazon

realized that the new cloud computing infrastructure model could allow them to use their existing capacity with much greater efficiency.

Meanwhile in late 2000s, Google had become a key player in the Internet commerce marketplace. In 2006 the company launched its Google Docs services, which brought the power of cloud computing and document sharing directly to end users.

80% of Fortune 1000 companies are currently planning for the cloud computing services, and in future 30% of them will pay for cloud computing infrastructure as quoted in “Emerging Technologies Conference” year 2008 conducted by Gartner Inc. (Rhoton , 2010) [33].

Is future of cloud computing long lasting or is it one of the buzzwords of today and will be forgotten in a few years?

Answer to the above question is of course yes, it will last for long, since cloud computing is changing business models, cost models and data centers. KPMG survey 2010 also stated in the support of this. “Organizations can reduce IT spending and benefit from more flexibility and scalability by using cloud computing, the viability of many cloud computing services remains yet to be seen. Measures to tackle security, privacy and legal issues as well as the standardization of technology in the cloud are still in their early stages” (KPMG 2010)[20].

Gartner had also forecasted in 2010[15], that cloud computing is very popular throughout IT industry worldwide, and its importance and enthusiasm is also spreading in the IT needs of the educational institutions.

Although, Indian higher and technical educational institutions have their own priority, goals, mission and vision, these differences do not matter much. The institutions have started to move fully or partially in favor of the infrastructure in the cloud. Indian universities are also toeing the same line and moving towards cloud computing.

1.2 PROBLEM STATEMENT

However, this trend did not pace up in the Indian scenario yet, justifying the research and the following interrogations. This research endeavors to answers certain questions that follow:

Is cloud computing ready to meet the requirement and expectations of the universities?

Whether it is necessary to change to cloud infrastructure and what to consider before switching to it?

Is cloud computing ready and mature enough to accept the challenges of IT Industry?

1.3 DEFINITIONS OF TERMS

Cloud Computing: It is a term used for a computing model which provides universal on demand network access to a shared pool of configured resources.

Software as a Service: Applications and services, like webmail and remote backup, are hosted with the cloud provider and made available to the customer over the Internet; usually via a web browser.

Platform as a Service: In this delivery model developer tools are made available to PaaS clients, which allows for rapid application development in a homogeneous web environment.

Infrastructure as a Service: With this cloud delivery model a client is able to rent a virtual machine image as a service or even a collection of virtualized servers organized into a virtual private data centre. This delivery model affords the client the most control of all the delivery models.

Public Cloud: With Public Cloud Computing the services a user or organization accesses are hosted by a cloud provider that sells or rents out the same or similar cloud services to any person or organization in the general public.

Private Cloud: In Private Cloud Computing the entire cloud infrastructure is owned by the organization allowing them to exercise full control over its operation.

Hybrid Cloud: Hybrid Cloud Computing is simply a combination of both the public and private cloud deployment models.

Community Cloud Computing: In Community Cloud Computing resources are shared amongst a community or organizations that have the same or similar security and/or compliance requirements.

Autonomic Computing: It refers to the self-managing characteristics of distributed computing resources, adapting to unpredictable changes while hiding intrinsic complexity to operators and users.

Utility Computing, or The Computer Utility, is a service provisioning model in which a service provider makes computing resources and infrastructure management available to the customer as needed, and charges them for specific usage rather than a flat rate.

Grid Computing is the collection of computer resources from multiple locations to reach a common goal. The grid can be thought of as a distributed system with non-interactive workloads that involve a large number of files. Grid computing is distinguished from conventional high performance computing systems such as cluster computing in that grid computers have each node set to perform a different task/application.

A Service-Oriented Architecture (SOA) is an architectural pattern in computer software design in which application components provide services to other components via a communications protocol, typically over a network. The principles of service-orientation are independent of any vendor, product or technology.

A Service-Level Agreement: SLA is a part of a standardized service contract where a service is formally defined. Particular aspects of the service – scope, quality, responsibilities – are agreed between the service provider and the service user.

Enterprise Resource Planning: ERP is business process management software that allows an organization to use a system of integrated applications to manage the business and automate many back office functions related to technology, services and human resources.

1.4 PURPOSE OF STUDY

- To identify the current state of use of cloud computing in education institutions in India.
- Identify the critical issues which refrains the use of cloud models in educational institutions.
- Propose a cost effective model of cloud computing for educational institutions.

1.5 THEORETICAL BASIS

“Technical education is important because it plays key role in policy framing and leads to cultural, political, and social development. Some universities have been slow to regulate and develop mechanism for the use and encourage the portability of knowledge, while some institutions have been pushing the novelty in knowledge dissemination in technical education” (William E. Bertrand, 2010) [40]. The vast majority of technical education IT leaders to whom I’ve spoken say their role is (or should be) changing as they’re becoming more involved in strategic discussions around institutional effectiveness and student success. Quite simply, they don’t have time to manage disparate systems, and they’re starting to question the value of their technology investments.

To take it a step further, institutions of all types and sizes are starting to think about cloud technologies and shared services. Gartner projects software-as-a-service, or SaaS-based ERP revenues to grow from 12 percent worldwide in 2013 to 17 percent in 2017 (Gartner, Inc.(C). 12, September 2011 [16]. Cloud computing is the fastest growing part of technology and also cost effective for education system (Nilam, Baldev Singh, Gaurav Bagaria, 2014) [30]. True cloud applications have been proven in all markets to be a more efficient and less expensive delivery model for administrative systems; there’s no hardware, software, middleware or database to buy, install or maintain. By leveraging cloud computing, organizations can realign their IT resources from the administration, maintenance and operation of applications to more

strategic initiatives. Upgrades, patches, integrations, data security, backup, disaster recovery, performance tuning – all are managed by the vendor through a subscription model.

With significant limitations in mobility, configurability and accountability, the systems of yesterday – both ERP and best-of-breed – simply aren't meeting the needs of colleges and universities anymore. Technical education is calling out for a new solution, and most of the major ERP vendors have already started looking into how they can answer that call. In the best-case scenario, they will be able to start with a blank sheet of paper in order to address the unique contemporary needs of technical education. More likely, however, we'll see a shift of legacy ERP to some version of the cloud.

1.6 CONTRIBUTIONS OF STUDY

The cloud refocuses the primary mission and objective of technical education. The cloud technology simplifies and enables IT to get rid of non-essential processes and enhance IT agility. It allows the institutions to pay for only the IT services they use, provide better resource tracking, improved budget estimating, and get a faster return on investment.

Our proposed research will provide a suitable model of cloud computing which can be adopted by educational institutions in India to get the above cited benefits.

1.7 ORGANISATION OF REMAINDER OF STUDY

The Thesis is comprised of six chapters. The thesis also covers more or less the substances of the following four research papers published in different reputed journals.

Nilam, Baldev Singh, & Gaurav Bagaria(2014), “Vital Role of Cloud Computing technology in Indian education system: A study in special reference for technical education.” IJSRD, pgs344-347 (Vol-2,Issue 04). ISSN (Online)-2321-0613.

Nilam & Baldev Singh (2014, March 11), “Challenge and security issues of cloud computing in technical education”, INROADS, pgs 197-199 (Vol-3, Issue: 1s). ISSN (Online)-2277-4912.

Nilam & Baldev Singh (2015, December 2-4), “Scope of Cloud Computing in Indian Technical Education”, AIMS2015, 3rd IEEE International Conference on Artificial Intelligence Modelling and Simulation held at Kota Kinabalu, Malaysia.

Nilam, Baldev Singh & Ripu Ranjan Sinha(2016, June) “Critical Issues Refraining Implementation of Cloud Computing In Educational Institution”, IJIET, Pgs 267-274(Vol-7, Issue-1) ISSN(Online)2319-1058.

The thesis is divided into six chapters. The first chapter deals with the basic introduction of Cloud computing and ultimate goal of the research. It highlights the research questions and scope, limitations and assumptions made for the research.

The Second Chapter describes IT-diffusion and cloud computing in general and then defined some related terms like automatic computing, utility computing, grid computing and service oriented architecture. The specific usage of cloud computing in the higher educational environment was also explained in the same chapter where the main problems with the legacy systems in higher education were presented and furthermore the opportunities and issues using cloud computing in higher education were discussed. It also includes the literary review of development life cycle of cloud computing and current state of its use in higher and technical education.

The third chapter discusses concepts of research methods, and the methodology used in the desk research, online questionnaire and expert’s interviews and basic sample selection technique, and steps taken into consideration to carry out the research.

Chapter Four is dedicated to the study of current state of cloud computing in technical educational institutions based on answers to questionnaire and interviews with the experts in the field of Cloud Computing. First, the purpose and special requirements of the survey were explained and then its design and structure. Later in the same chapter, the results of the online questionnaire were showcased and analyzed.

Further, the preparation and planning of the experts’ interviews were explained. These interviews served with the desk research to elaborate the

recommendations to technical educational institutions regarding the adoption of cloud computing. Key outcomes of the research are also presented in chapter five.

Last but not the least a suitable cloud computing model for technical educational organizations is proposed for their specific needs of Software-as-a-Service products, to use Platform-as a- Service for teaching.

Conclusions of the research work are summarized in chapter six with a suggestion to carefully start experimenting with Infrastructure as-a-Service solutions if a compliant provider is found. Finally some areas are suggested to enhanced the work under the future scope.

In the end, a detailed list of references is included. A reprint of the published research papers, certificate of participation, and detailed online questionnaire are also appended with the thesis.