

# Cloud Computing usage in Higher Education Institutions in Vidarbha region and systematic Investigation of gain and barriers

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## ABSTRACT

The growing use of cloud computing is transforming how information and communication technologies are utilized. Its applications are expanding rapidly due to numerous benefits for students, enabling seamless information sharing and introducing innovative experiences within the educational system.

Despite extensive global research, there remains a gap in literature concerning the specific factors affecting cloud computing use in higher education institutions—particularly the Vidarbha region. This gap is evident in the limited number of region-specific studies. Therefore, this paper aims to deepen the knowing of the key elements affecting cloud technology implementation within higher education institutions in Vidarbha.

To gather relevant data, fieldwork was carried out across various higher education institutions located in different parts of the Vidarbha region. The study employed a qualitative research methodology grounded in an interpretive framework, focusing on identifying both the key benefits and the primary obstacles for adoption of cloud computing in the region's universities.

**Keywords** - Higher education, Cloud computing, Vidarbha region, gain factors, barriers factors, qualitative study, NVIVO.

## 1. INTRODUCTION

Cloud Computing is modern prototype which offers applications and services which are accessed using the internet with capabilities of sharing data, managing and storing data that is actually hosted on the remote server other than using in-house recourses or personal computers [1]. CC provides technological features like processing speed, distributed & grid computer availability and storage ability.

The cloud computing comes with the 4 deployment models: Public, Private, Hybrid and Community. Deployment models describe the type of availability to the cloud environment. [2]

1. **Private cloud:** This cloud infrastructure is operated, managed and owned solely by a single organization. This infrastructure is controlled by an academic institution or by the third party organization with related server and it may be existed in premises or out of the premises. The private

cloud offers the features like security, high availability also fault solving solutions which is not available in public cloud. Though, the cost of using private cloud is visibly more expensive than public cloud [3].

2. **Public cloud:** This cloud model is operated, managed, and owned by external providers, and openly used by the general public. Service providers such as Amazon, Google AppEngine, IBM, Amazon Elastic Compute Cloud (EC2) and Microsoft Azure offers free and inexpensive services to the people [4]. In spite of the lower cost and comprehensive availability, this model is surely not like private cloud. It is available for the internet users due to its directness. It is comparatively less customizable than then private cloud [5]. It has limitations of physical capacity also less working performance unless and until the customer pays more for the premium edition [6].

3. **Hybrid cloud:** The combination of public and private cloud models typically offers the advantages of these both different models also benefiting the users to evade the limitations of private and public clouds. Such integration is called a hybrid cloud [5]. Hybrid clouds are much complex than other two deployment models, because they involve a configuration of multiple cloud models (public, private, or community). Each model remains a unique object, but it is bound to other models through identical or proprietary technique which enables application and data transportability amongst them [7]. A hybrid cloud is an arrangement of minimum one private cloud and one public cloud infrastructure. A hybrid cloud is classically presented in one of the two ways: any vendor having a private cloud forms a partnership with a public cloud model provider, or public cloud model provider formulae a partnership with a vendor or person that provides private cloud infrastructure.

4. **Community cloud:** Community cloud service drops between the public and private cloud frameworks in accordance to target a set of costumers. It is fairly match to the private cloud, but the infrastructure as well as computational resources are more exclusive for two or more organizations that have a common privacy, security, and supervisory reflections, rather than a single organization [7].

In addition, cloud computing is also categorized as per the service models - software as a service (SaaS), platform as a service (PaaS), hardware as a service (HaaS), infrastructure as a service (IaaS).

However, universities and higher education institutions, which are becoming increasingly complex environments, must adopt specific strategies concerning cloud computing. These strategies include introducing web-based students service without corresponding increase in individual budgets, as well as deploying appropriate software and hardware solutions. Furthermore, their goals are to reduce overall costs while maintaining strong privacy protections, enhancing security measures, and ensuring sufficient capacity to support a rising number of connected devices.

## I. CLOUD COMPUTING ROLE AT UNIVERSITIES IN VIDARBHA REGION

Now a day Cloud computing is becoming common for Higher Education Institution [8]. The Universities in Vidarbha region and many colleges have accepted cloud based system which benefits these colleges to reduce the expenses by removing the necessity of software update & licensing [9]. Study states that using cloud computing service in any institution may decrease the cost upto 25% to 30%. It is observed that about 70% of IT professionals recommend the cloud computing stating the important of IT services are most crucial factors [10].

Educational institution has stated investing on platform, infrastructure, and software. Educational institution demands for computing needs to change from time by time. Cloud computing provides number of benefits to the educational institutions including improvement in efficiency, decrease spending on technology, stimulate innovation, and decrease agility [11]. Cloud computing also provides computational power at the low cost [12]. The cloud computing may be solved the resource problem and the short of innovative technology availability of educational institutions in Vidarbha region, [13]

In short time the use of cloud computing in higher education has increase and it is states that its use will be increased in future [10].

The cloud computing can improve quality of education & reduce the overall cost [4]. For example, several institutions in Vidarbaha have worked with Google to add substantial assistances from Google cloud applications for the students and teachers [5].

The teachers use these applications to upload as well as download curriculum and safely transfer the student's data into education system. The process prevent the institution in Vidarbha from heavily investing in Data centers, also hardware and software from doing lot of transitions.

The education institutions mostly focuses on the teaching and learning activities [13]. The universities in Vidarbha face many challenges as given below.

- Universities suffer from the inadequate resources equated with population rate. Therefore, students experience too much competition between each other for the safeguarding a seat in such universities.
- High-quality of resources are not accessible due to the cost factor. As a result, technology resources in Vidarbha region universities cannot work with complicated as well as advanced scientific projects.
- The Laboratories are not accessible out of class hours. Thus, the students are not allowed in when they can use university facilities.
- There is a gap of communication and knowledge distribution between students and the lecturers other than the classroom.

### **Barriers of adoption of Cloud Computing in Vidarbha region**

Many obstacles related to cloud computing adoption in educational institutions particularly in Vidarbha region can be explained, namely: inadequate bandwidth, lack of connectivity, and unbalanced power supplies. [15]

The most serious barriers in adopting of cloud computing are security, trust, local language and the portability. [16]

There are several other adoption barrier factors specifically to universities in Vidarbha region:

- Cost -The analysis of cost benefit from available clouds service indicates large financial costs for the research and education, as compared to income. The costs need to reduce in such contexts to allow access to cloud service. [15]
- Infrastructure and service readiness - Cloud computing setup is not installed by locally. Many

influences on technical issues like performance can be improved, while the data acquiescence concerns can be shortened. [15]

- Cloud computing skill – Many Research and educational institutions in Vidarbha region lacking computational infrastructure and the cloud computing skills. There is mostly deficiency of qualified staff in IT field, training sessions and well trained eLearning staffs.
- Information security concerns and compliance – Research and education experts in Vidarbha region share deals with security issues in executing cloud computing. Occurrences of collective, commonly articulated security measures are user lock-in, data protection, and control deficiency. [17]
- Reliability – Reliability is always prominent fear for the students and institutional systems which adopt a cloud computing. The service providers may be unwilling to dedicate enough resources as technical support to the small markets.
- Lack of awareness – As per Rogers [15], the first step towards adopting new technology is the awareness about the technology. A study determining the factors of adoption of cloud computing at universities in Vidarbha region found that the cloud computing benefits awareness is mostly and absolutely correlated with the cloud computing adoption. This study proposes that benefits awareness of the cloud computing is an important factor that moves the decision in adopting the cloud computing at the universities in Vidarbha. [16]

## 2. METHODOLOGICAL APPROACH

This study needs detail **analysis for understanding the current as well as predictable future situation**. This study attempt adopting a qualitative method, as it provides a good sympathetic of the situation in the real life, **also it investigates the major factors affecting in adoption of the cloud computing**. The data collection in research gather from the small-structured interviews with the professors in different universities in Vidarbha region as well as some experts in cloud computing service technology.

The analysis on collected data was conducted using Computer Assisted Qualitative Data Analysis (CAQDA). The Nvivo software was used for the research, which is the most useful software utility for the qualitative data analysis. Using Nvivo software the researcher can code the collected data also link and create relationships between codes [19]. In addition, it allows to reform, reorganize, and relate the coding nodes very easily. All the interviewees were specialists in the cloud computing technology. Table 1 below shows the interviewees' outlines. This study tries to consider both academic and technical viewpoints. Thus the participants has been categorized into the academic professors and technical experts. As per that there were total 9 participants for the semi-structured interviews, three professors from the computer science department, an engineering college, and an information system department. And five technical specialist (e.g. IT manager, system engineer, administrator, and programmers).

**Table 1 - Participants Interview Chart**

<b>Participant's Code and Profession</b>	<b>Title/Work</b>	<b>Experience</b>
Associate Professor (C1)	Head of the information technology department.	20 Years

Assistant Professor (C2)	Chairman of computer science department.	16 Years
Senior Lecturer (C3)	Assistant professor of computer science.	17 Years
Systems administrator (C4)	System designer / system architect. Supervise organizations' computer-related activities. Monitors software and hardware to meet overall information technology needs.	12 Years
Database administrator (C5)	Professional in installation, planning, configuration, database design, performance monitoring, troubleshooting, security, also backup and data recovery.	19 Years
Senior programmer (C6)	Developer writes, modify, and test code, also scripts that allow computer software and applications to run.	16 Years
Cloud system engineer (C7)	Design, deploy and manage cloud based infrastructure. Integrate cloud-based system with existing on-premises system.	11 Years
Information security analysts (C8)	Perform security measures to guard an organization's computer networks and machines.	05 Years
Network administrator (C9)	Perform installation, implement and preserve local, regional or extensive networks for an organization.	08 Years

### **The result of investigation of gain and barriers in adopting cloud computing in higher education**

Following section provides some findings of our study. The findings has categorized as per following points: the security and privacy, conflict of new technology, cost issues, compatibility, usage, centralization, management support, portability and knowledge sharing.

Figure 1 shows the result from the study about important factors affecting cloud computing adoption at the universities in Vidarbha, using—Nvivo (qualitative data analysis software package) map analysis.

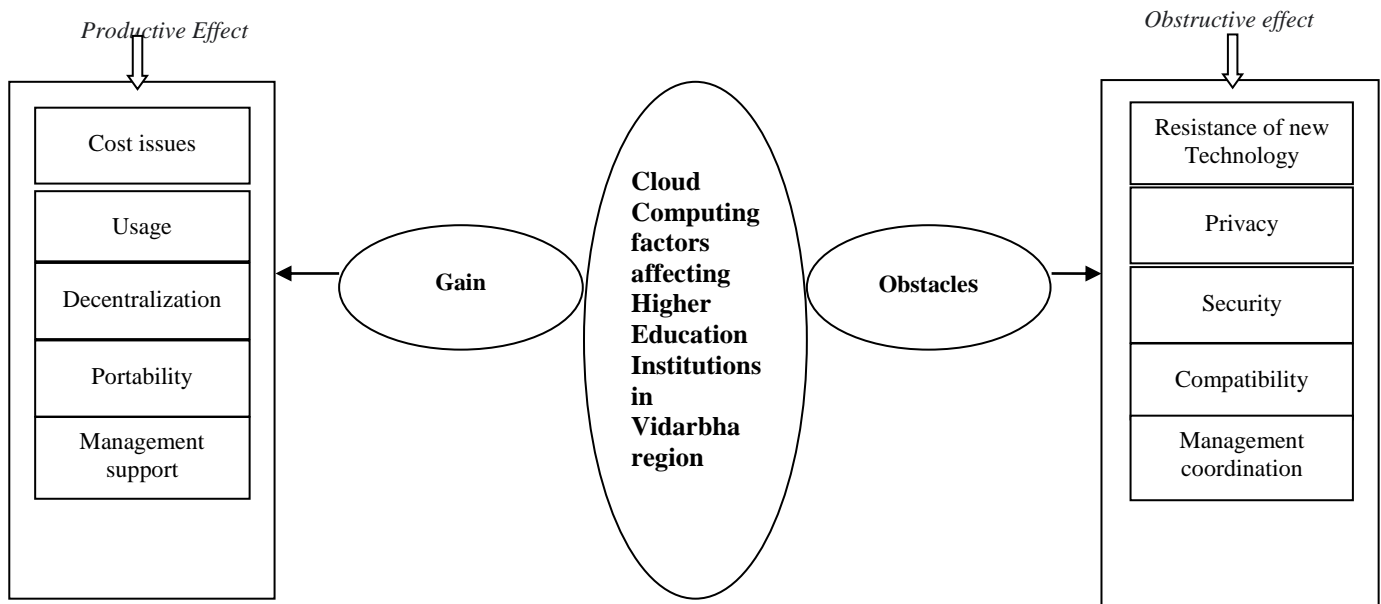


Figure 1: Finding from field - the gains and barriers that influences the adoption of cloud computing at higher education institutions in Vidarbha region.

### 1. Security and Privacy

Our study shows privacy and security are important issues which affect the adoption of cloud computing service in the higher education institutions. The Associate professor (C1) who is head of Information Technology department said -

“Because cloud computing represents a new computing model, so there is a great deal of uncertainty about security at all levels (e.g., network, host, application, and data levels) and we cannot ignore the fact.”

The Information security analysts (C8) added that “The uncertainty has consistently led executives to state that security is number one concern with cloud computing.” The capability of cloud computing to sufficiently address the privacy regulations has been termed into the question. [20]

Despite several barriers such as firewall, data encryption, service providers can always access data of the customer. The governments have policies and rules to access the service providers and company’s customer data whenever required for security purposes”.

Thus our finding says that security and privacy is the main barricades that negatively affect the cloud computing infrastructure adoption in the higher education institutions.

### 2. Unwillingness of New Technology

The cloud computing adoption at higher education is the alteration from the old traditional teaching and learning techniques to new innovation technologies. Assistant professor (C2) stated that:

“Now a days the adoption of cloud computing would not be a success as there is a strong resistance by students and lecturers to use any new. In other words, they prefer the traditional methods of teaching and learning.”

The Study results presented that conflict to cloud computing as new modernization technology negatively affects the adoption of cloud computing particularly in Vidarbha region' universities.

### 3. Cost effectiveness

The important factor in our finding is the cost benefits of using Cloud computing. Almost all participants settled to the point that the basic benefit of presenting cloud computing is the cost value.

The Key feature of cloud computing service, which makes more valuable because no need to spend extra more costs that are commonly assumed to be a lot of investment. The senior lecturer in Gondwana University (C3) stated that:

“The Gondwana university invested much more rupees for IT infrastructure in each branch/office in last 5 years. If the university had adopted Cloud Computing then it would have reduced lot more in its budget and avoid unnecessary wastage in Software, Network, Server, Applications, OS platforms etc”.

As a output, the cost-efficiency is the positive gain of cloud computing to apply technology in the higher educational institutions in Vidarbha region.

### 4. Compatibility

Compatibility is reflect as the vital factor for adopting new innovative technology where IT professionals are more probable to anticipate adopting the cloud service if technology is recognized as being compatible with an present work application structures and the Institution values and beliefs. [21]

The Systems administrator (C4) stated that:

In any institution the compatibility issue is always major concern for IT related technical team. Many software applications for example, Lock Web App, run on intranet but not on internet. Additionally, such system requires specific arrangement on user device.”

Accordingly, compatibility with any device and capability of integrating in-house technology is the more important gains of cloud computing service.

### 5. Easy to Use

Cloud computing easily adopts technology having simple and newest architecture. Each participates in an interview consider this factor as gain in higher education. Cloud computing typically applied in higher education institutions because of accessibility of learning management system and also student information system. [22]

The senior programmer (C6) said - “Cloud computing technology does not require more technical IT experiences. We don't need any coding skills to learn about or steps into cloud computing for the first time. Its simplicity forced us to step up for adoption”.

Moreover, Database administrator (C5) affirmed that:

“The cloud service is easy to use, compatible, reliable and adoptable to our need. Its goal of cloud computing is to provides easy, scalable access to resources and services”.

In above conclusions, the simplicity and user friendliness of using cloud computing leads the acceptance of cloud computing in Higher Educational Institutions particularly in Vidarbha region.

Conversely, adopting cloud computing in higher education involves some challenges and risk that need to be talked. We will learn about some main challenges and risk for cloud migration.

## 1. Centralization

One notable advantage of cloud computing is its distributed nature, which enables access from any location regardless of physical boundaries. Several interviewees noted that having various applications hosted centrally limited their ability to perform effectively. They believed such systems could only be accessed within the institution through the internal network.

“There are many difficulties with relying on locally hosted applications. Due to security concerns, we cannot permit users to access sensitive tools over the internet. However, we are gradually transitioning these systems to cloud platforms. This allows staff members to be more productive, as they can now work remotely whenever they choose,” (C2).

Echoing this point, a senior lecturer commented:

“Having applications centralized restricts our mobility. For instance, we need to be physically present on campus to use internal systems like grading software, which isn’t available remotely.”

In summary, the flexibility to access cloud-based services from different locations—thanks to their decentralized structure—can be seen as a significant benefit of adopting cloud computing in the higher education segment.

## 2. Management Support

Support from senior leadership is essential when making the final decision to implement cloud computing. This factor does not inherently act as either an advantage or a hindrance to adoption. If top management is well-informed about the potential benefits and limits of cloud computing, their support can serve as a key driver for embracing the technology. Conversely, a lack of understanding may lead them to perceive it as ineffective, turning their influence into an obstacle.

In a related statement, a cloud systems engineer (C7) explained: “Our senior leadership holds the ultimate authority over decisions regarding cloud computing adoption. However, they currently lack sufficient awareness of the advantages this modern technology offers. As a result, unless they become more informed about its pros and cons, it’s unlikely that we’ll adopt cloud computing in the near future.”

Therefore, this factor varies across organizations depending on the awareness and understanding levels of their management teams.

## 3. Portability

Portability factor in cloud computing refers to the ability to move academic resources such as course materials, research data, applications and services.[26] Our study finds portability in cloud computing in higher education can be both a gain and a barrier.

In this context, the Systems administrator (C4) stated that:

“Cloud computing enables students and faculty to access resources and tools from anywhere, at any time, using any device with internet connectivity. It allows for flexible learning and teaching environments, enabling students to work on projects and assignments remotely”.

Another professional, Network administrator (C9) said that

“Portability increases the risk of data breaches and security threats, particularly if the devices or connections are not properly secured. Also Institution may become reliant on on specific cloud provider, making it difficult switch to alternative services.

Therefore, portability factor is considered as gain and some extent also barrier of cloud computing technology implementation at higher education institutions in Vidarbha region.

#### 4. Knowledge Sharing

The research reveals that cloud computing enhances the speed and efficiency of knowledge exchange among students. A majority of professionals acknowledged that information technology plays a key role in facilitating knowledge sharing. One IT expert noted that cloud computing is fundamentally built around the concept of knowledge distribution, as it enables users to share content with customized access controls for each individual.

“I suppose that cloud computing would totally improve the level of sharing knowledge. It supports sharing of the same applications, content, and services amongst many users” (C9).

“Cloud computing applications support both for individual and group level services. For example, Google Docs is the simple cloud based technology serves as a tool for collaborative editing of documents in real time. Documents created in Google Docs can be shared, opened, and edited by multiple users simultaneously, and users can see character-by-character changes as other collaborators make edits” (C9).

Clearly, cloud computing has the potential to enhance the level of knowledge exchange between students and educators. Therefore, this aspect is regarded as a significant benefit of adopting cloud computing technology in higher education institutions across the Vidarbha region.

## **II. Applying Diffusion of Innovation Theory (DOI) to Cloud Computing adoption at higher education institution**

The Diffusion of Innovation (DOI) theory, established by Everett Rogers [15], [23], [24], is commonly applied in studies related to the adoption of new technologies. The primary purpose of this theory is to guide both individuals and organizations in making informed decisions about whether to adopt or reject innovations [25].

Figure 2 illustrates Rogers’ five-stage model for innovation adoption. This research proposes using the DOI framework to facilitate the operation of cloud computing in higher education institutions. The initial stage, referred to as “knowledge” or awareness, focuses on introducing the concept of cloud computing. The main objective at this stage is to enhance understanding of its general benefits and limitations.

The second stage involves identifying the advantages of cloud computing, with a particular focus on its compatibility with existing systems, relative benefits, cost-effectiveness, and its ability to enhance knowledge sharing between students and faculty beyond the classroom setting. This stage is followed by

an initial decision on whether to adopt cloud computing within the higher education institution. The outcome of this stage may result in either acceptance or rejection of the technology.

Rejections can be categorized into two types: those based on addressable concerns—such as technical issues that can be resolved by cloud service providers—and those based on institutional policies or regulations that lack a clear rationale. Despite being preliminary, this decision is influenced by the nature of the concerns raised and can evolve over time. The fourth stage involves the full-scale deployment of cloud computing, contingent on the initial approval. Finally, the fifth stage confirms the long-term commitment to continue using cloud technology within the institution.

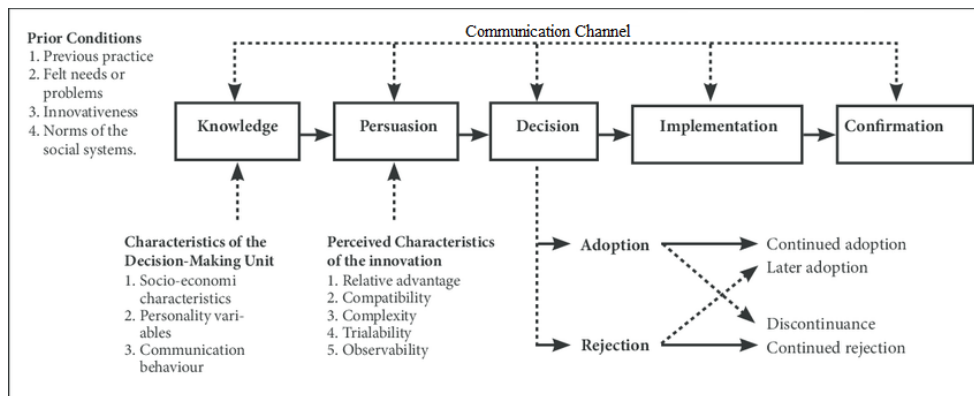


Fig. 2 : Innovation-decisions development model

### III. CONCLUSION

This study explores the key essentials inducing the adoption of clouds within universities in the Vidarbha region, considering both academic and technological perspectives. To gather insights, semi-structured interviews were administered with the key participants, including IT faculty members and technical specialists. Employing a qualitative methodology under an interpretive framework, all interviews were recorded following the receipt of ethical consent from participants. Additionally, the Nvivo software was utilized for transcribing the interviews, coding the data, and ultimately developing the conceptual framework for the study.

The findings specify that the adoption of cloud computing in educational institutions across the Vidarbha region is strongly endorsed by both academic scholars and technical professionals. Several advantages support this adoption, including cost efficiency, user-friendliness, enhanced knowledge sharing, compatibility with various devices and software, and the ability to access cloud applications from decentralized locations.

Nevertheless, certain challenges act as obstacles to implementation. These include concerns over data security and privacy, limited awareness among top management regarding the benefits and constraints of cloud technology, issues related to the compatibility of cloud services with existing internal systems during migration, and resistance to adopting new technologies.

Future research on cloud computing adoption could concentrate on creating a structured framework tailored to universities in the Vidarbha region. Although cloud computing remains a relatively recent innovation in this area, additional studies in this field would provide valuable insights

for academic institutions. Such research could help them better understand the advantages, limitations, and potential obstacles associated with implementing this technology.

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