INDIAN COUNCIL OF AGRICULTURAL RESEARCH

FINAL RESEARCH PROJECT REPORT (RPP- III)

PROJECT REPORT (RPP- III)

1. Institute Project Code : 88

2. Project Title : Development of a web based learning ecosystem based on cloud computing framework.

3. Key Words : Cloud computing, Cloud enabled education and training, Virtual Desktop Infrastructure (VDI)

4. (a) Name of the Lead Institute : NAARM, Hyderabad

(b) Name of Division/ Regional Center/ Section : ICM and ESM Divisions

5. (a) Name of the Collaborating Institute(s) : NA

(b) Name of Division/ Regional Center/ Section of Collaborating Institute(s)

6. Project Team(Name(s) and designation of PI, CC-PI and all project Co-PIs, with time spent)

S. No.	Name, designation and institute	Status in the project (PI/CC-PI/ Co-PI)	Time spent (%)	Work components assigned to individual scientist
1.	P D Sreekanth Senior Scientist, NAARM	PI	20	1. To develop content for selected (GIS) courses 2. To design a web based learning system for selected training programmes and courses of NAARM and providing the required computing infrastructure 3. To build desktop based virtual class room facility and study its effectiveness 4. To investigate the effectiveness and efficiency of cloud computing applications in agricultural education

2.	GRK Murthy	Co-PI	15	1. To design a web based learning system for selected training programmes and courses of NAARM and providing the required computing infrastructure 2. To build desktop based virtual class room facility and study its effectiveness 3. To investigate the effectiveness and efficiency of cloud computing applications in agricultural education
3.	M Balakrishnan	Co-PI	15	1. To design a web based learning system for selected training programmes and courses of NAARM and providing the required computing infrastructure 2. To build desktop based virtual class room facility and study its effectiveness 3. To investigate the effectiveness and efficiency of cloud computing applications in agricultural education

7. Priority Area : Research Approach

8. Project Duration: Date of Start : January 2013

Date of Completion : March 2014

9. a. Objectives

I. To design a web based learning system for selected training programmes & courses of NAARM and providing the required computing infrastructure.

II. To build a Desktop based Virtual Classroom [VCR] facility & study the effectiveness of VCR.

III. To investigate the effectiveness and efficiency of cloud computing applications in agricultural education.

b. Practical utility

The cloud-based services provides improved collaboration and research capabilities, opportunities to lower IT costs and at the same time to provide better levels of computing services. With the help of the proposed web based learning ecosystem, students, trainees and faculty can take advantage of the ability to work and communicate from anywhere and on any device using cloud-based applications & virtual classrooms. The integration of e-learning services to cloud computing infrastructure and virtual classroom takes the education methodology to a newer level.

10. Final Report on the Project (materials and methods used, results and discussion, objective wise achievements and conclusions)

Enclosed ANNEXURE-I

11. Financial Implications (` in Lakhs)

11.1 Expenditure on

(a) Manpower

(b) Research/Recurring Contingencies : 2.5

(c) Non-Recurring Cost (Including cost of equipment) : 26.5

(d) Any Other Expenditure Incurred

11.2 Total Expenditure : **29** lakhs

12. Cumulative Output

a. Special attainments/innovations

Cloud computing is the delivery of computing as a service rather than a product, whereby shared resources, software and information are provided to computers and other devices as a utility (like the electricity grid) over a network (typically the Internet). 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 service provider interaction.

b. List of Publications (one copy each to be submitted if not already submitted) - Nil
   i. Research papers
   ii. Reports/Manuals
   iii. Working and Concept Papers
   iv. Popular articles
   v. Books/Book Chapters
   vi. Extension Bulletins

c. Intellectual Property Generation - Nil
(Patents - filed/obtained; Copyrights- filed/obtained; Designs- filed/obtained; Registration details of variety/germplasm/accession if any)

d. Presentation in Workshop/Seminars/Symposia/Conferences - Nil
(relevant to the project in which scientists have participated)

e. Details of technology developed
(Crop-based; Animal-based, including vaccines; Biological – biofertilizer, biopesticide, etc; IT based – database, software; Any other – please specify)

Enclosed ANNEXURE-II

f. Trainings/demonstrations organized

A full fledge training cum demonstration was given for FOCARS and PGDMA students at NAARM during conducting online exam for FOCARS and practical session of GIS agribusiness course for PGDMA students.

g. Training received – Nil

h. Any other relevant information - Nil

13. (a) Extent of achievement of objectives and outputs earmarked as per RPP-I

Objective wise	**Activity**	**Envisaged output of monitorable target(s)**	**Output achieved**	**Extent of Achievement (%)**
1. To develop content for selected (GIS) courses	Preparing a resource material for complete GIS course	Brought out a manual for GIS course	A total of 208 pages learning resource material for Geospatial Information System (GIS) was published	100
2. To design a web based	Preparing a templates for	Creating virtual machines for class	These virtual machines are	100

learning system for selected training programmes and courses of NAARM and providing the required computing infrastructure	identified training programmes and PGDMA cources	rooms.	accessed using RDP (Remote Desktop Protocol) from standalone Windows computers as well as Hardware thin clients for PGDMA GIS in Agribusiness course. The course content was ArcView Exercise	
3. To build desktop based virtual class room facility and study its effectiveness	Establishment of virtualization server and virtual machines	Creating Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS), Infrastructure-as-a-Service (IaaS)	Desktop based virtual classroom machines were configured for PGDMA course at NAARM, Hyderabad. Total 24 virtual desktop machines were created on VMWareESxi 5.1 platform on Fujitsu hardware server.	100
4. To investigate the effectiveness and efficiency of cloud computing applications in agricultural education	Testing and evaluation of VM class rooms	Conducting courses/ training programmes on cloud based environment	Online evaluation using cloud environment is feasible	100

(b) Reasons of shortfall, if any

Nil

14. Efforts made for commercialization/technology transfer

Nil

15. (a) How the output is proposed to be utilized?

Resource utilization is within feasible range and hence more machines can be added with less memory and processing power allocation

(b) How it will help in knowledge creation?

For the first time the study showed that new technologies like cloud computing can be effectively implemented in training and education applications of agriculture.

16. Expected benefits and economic impact(if any)

- Since the findings amply demonstrated that a cloud infrastructure can be successfully employed for online courses and evaluation. This study can be scaled further more number of courses.
- The findings show that, the training preparation time for conducting training programmes of varied nature can be substantially reduced as the virtual machines can be prepared on the fly to suite different training programmes.
- Since the virtual machines on the clouds from any terminal in a network, it remarkably avoids the technology obsolescence and improves the IT resources utilization.

17. Specify whether the project requires submission of RPP-IV for up scaling of research output.

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18. Future line of research work/other identifiable problems

The work can be extended for cloud feasibility studies of memory intensive applications in agriculture/ data analysis/ parallel computing etc.,

19. Details on the research data (registers and records) generated out of the project deposited with the institute for future use

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20. Signature of PI, CC-PI(s), all Co-PIs

Signature of the Project Investigator

(P.D. SREEKANTH)

Signature of the Project Co- Investigator

(G.R.K Murthy)

(M. Balakrishnan)

21. Signature of Head of Division

22. Observations of PME Cell based on Evaluation of Research Project after Completion

23. Signature (with comments if any along with rating of the project in the scale of 1 to 10 on the overall quality of the work) of JD (R)/ Director

ANNEXURE-I

Developed content for Geospatial Information System (GIS) courses:

A total of 208 pages learning resource material for Geospatial Information System (GIS) on open platform by using Quantum GIS software (Fig.1). It's give a immense exposure on self learning integrated methodology for geospatial database management, analysis, image processing, spatial modeling and visualization.

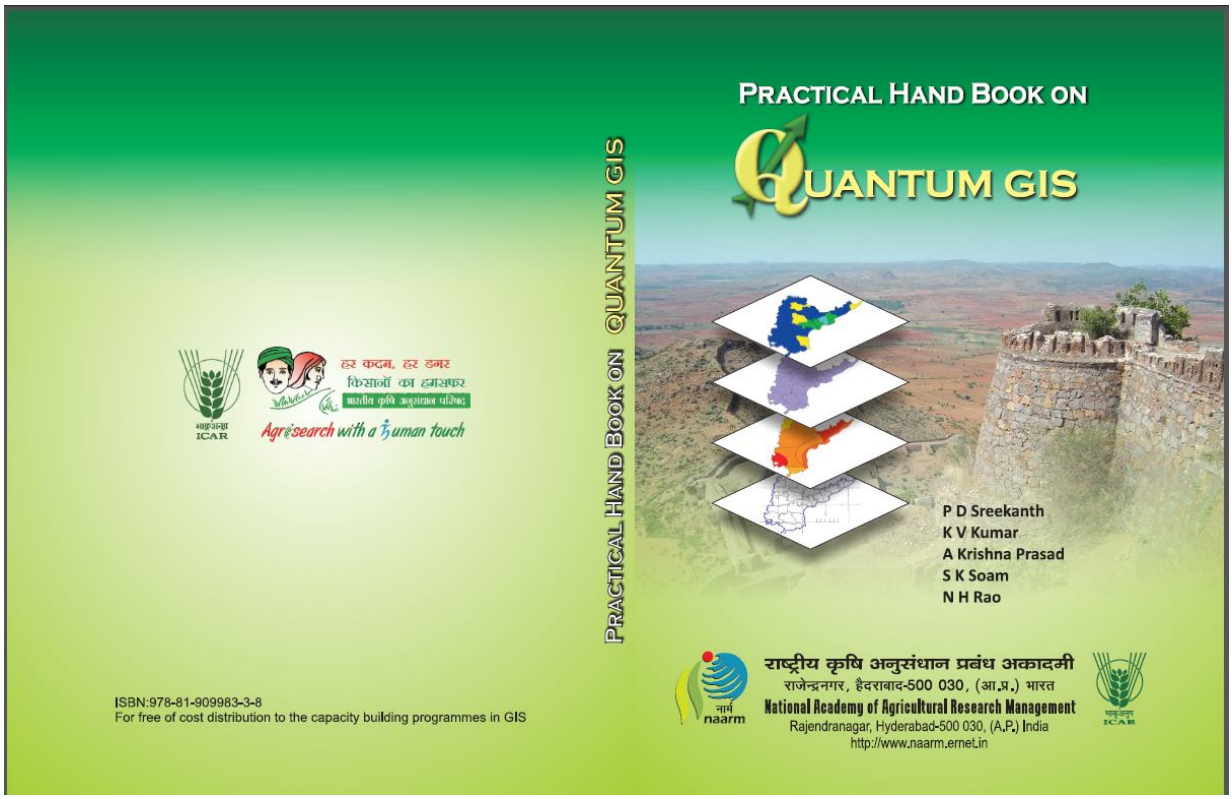


Fig.1: Learning resource material on Geospatial Information System cover page

Built desktop based virtual class room facility and study its effectiveness

Desktop based virtual classroom machines were configured for PGDMA course at NAARM, Hyderabad. Total 24 virtual desktop machines were created on VMWareESxi 5.1 platform on Fujitsu hardware server. These virtual machines are accessed using RDP (Remote Desktop Protocol) from standalone Windows computers as well as Hardware thin clients for PGDMA GIS in Agribusiness course. The course content was ArcView Exercise **-** Query, Link and Join spatial and attribute data,

preparation of Charts, Summary information, Thematic maps, Layout for thematic map and summarized data. The server and virtual machine configuration is given below

Virtualization server	Virtual machines	VXL Itona hardware thin clients
• Intel Xeon E5-2.7 GHz processor with 8 cores – 2 Nos • 128 GB RAM • 600GB x 6 SAS hard drives • VMWareEsXi 5.1 Hypervisor	• Windows XP Professional with SP3 • 1 GB RAM • 40 GB Hard disk	• Via nano 1.2 Ghz processor • 1 GB DDR3 RAM • 1 GB Flash

Development of web-based learning ecosystem based on cloud computing framework

Establishment of cloud infrastructure/environment

To demonstrate the feasibility of cloud applications in agricultural education, online evaluation was done for FOCARS probationers of 98 batch in cloud ecosystem. System performance factors were also assessed while conducting the cloud-based online evaluation. The cloud ecosystem as shown in fig.2 comprises 22 student machines each of 1 GB RAM with preloaded Operating system and client software and one teacher machine with preloaded server software for evaluation. All the machines are created virtually and accessed through remote desktop systems or thin clients.

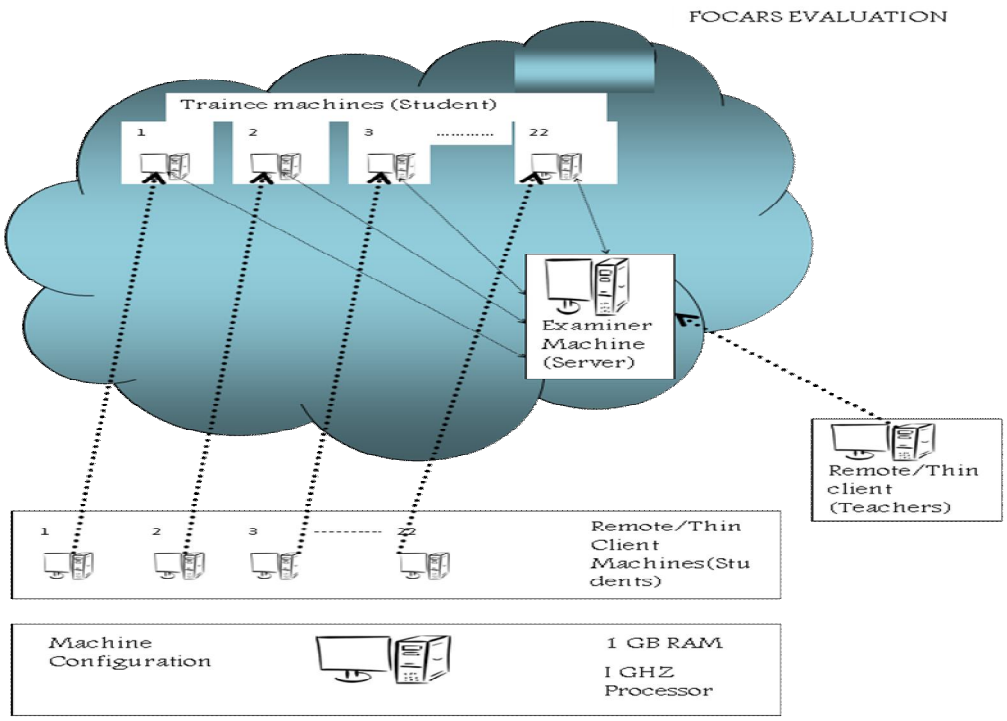


Fig 2: Cloud framework for online evaluation

Feasibility study of Cloud based online evaluation

After establishing the cloud, probationer trainees of 98 FOCARS were provided access to client machines on cloud through any terminal in local area network of the Academy. Teacher machine also was accessed through cloud and entire online process was initiated on the cloud. Advantage of this is that any power interruption on client/teacher accessing terminals will not stall the evaluation process. The performance parameters like memory usage were monitored on student, teacher machines and cloud ecology in totality. As shown in fig. 3, memory utilization shot upto 80 per cent on a teacher machine during the student connection process to the teacher machine, after which the utilization came down to 25 percent and stabilized there through the evaluation process.

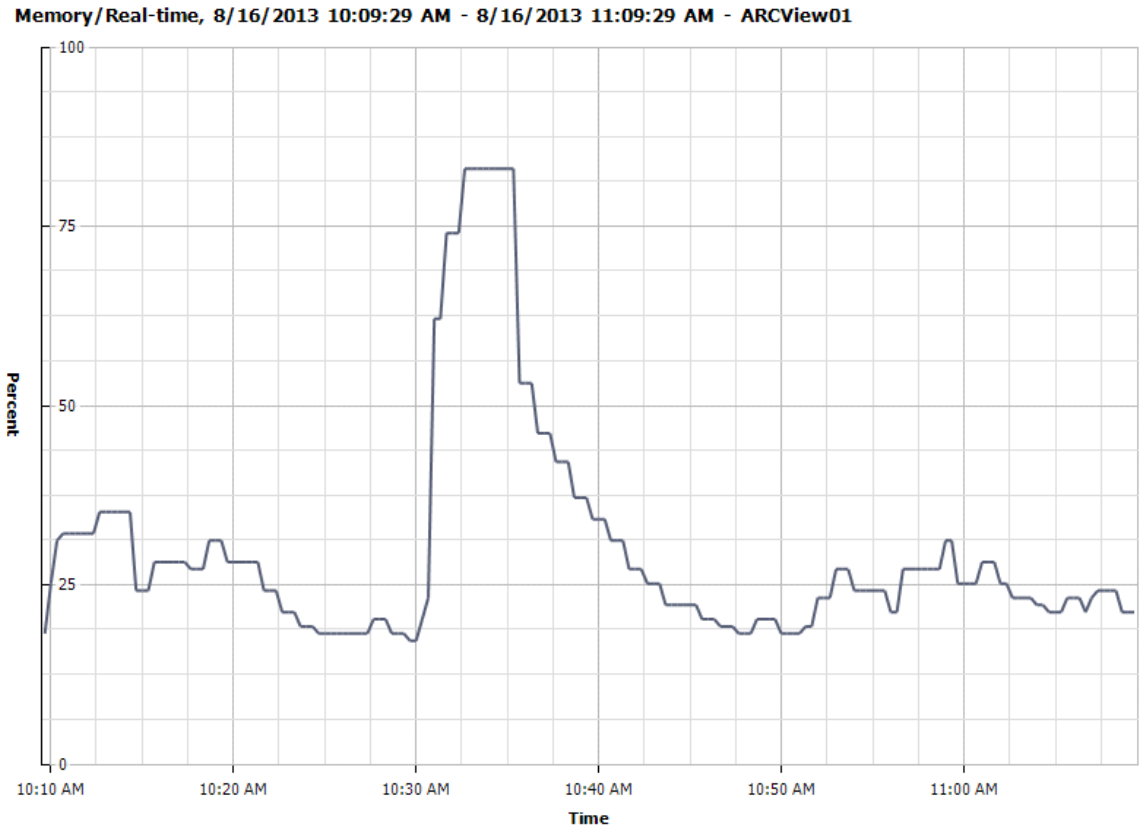


Fig. 3: Overview of Teacher Resource Utilization in Cloud Environment

Similar observation on student machines as shown in fig. 4 showed memory utilisation in the range of 15-25 per cent through the evaluation process.

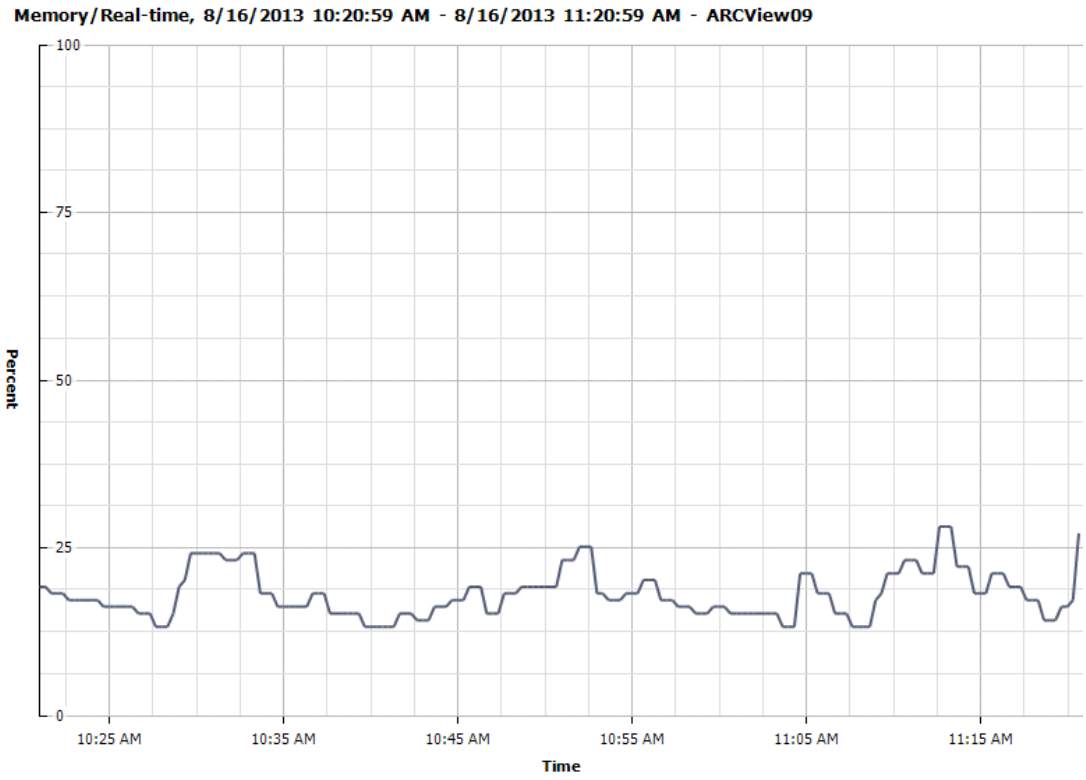


Fig. 4: Memory Utilization of Trainee machines

Overall resource utilization on server side was observed in terms of CPU utilization in cloud environment as shown in fig 5. It clearly shows that CPU utilization was only around 15 percent during the evaluation process and all the systems requirements were well met by the cloud.

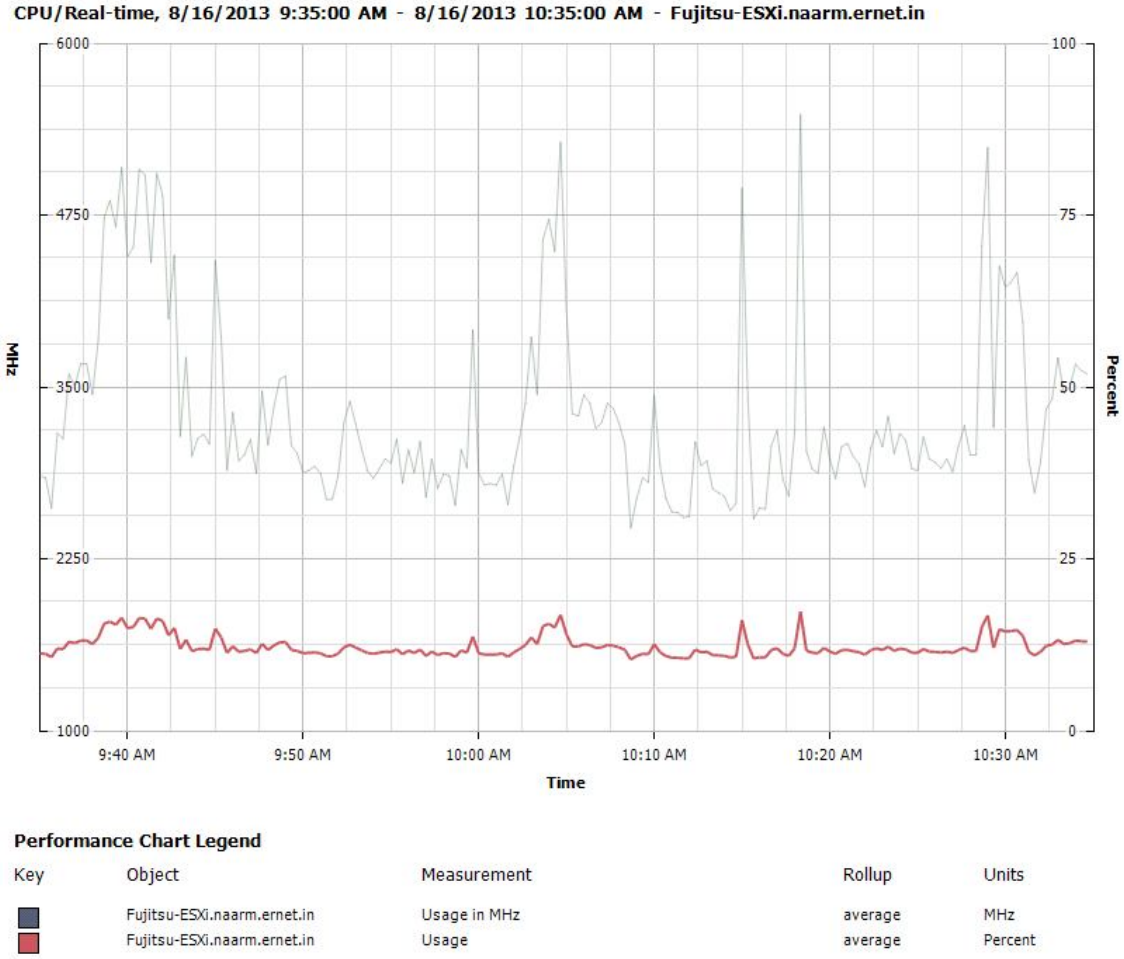


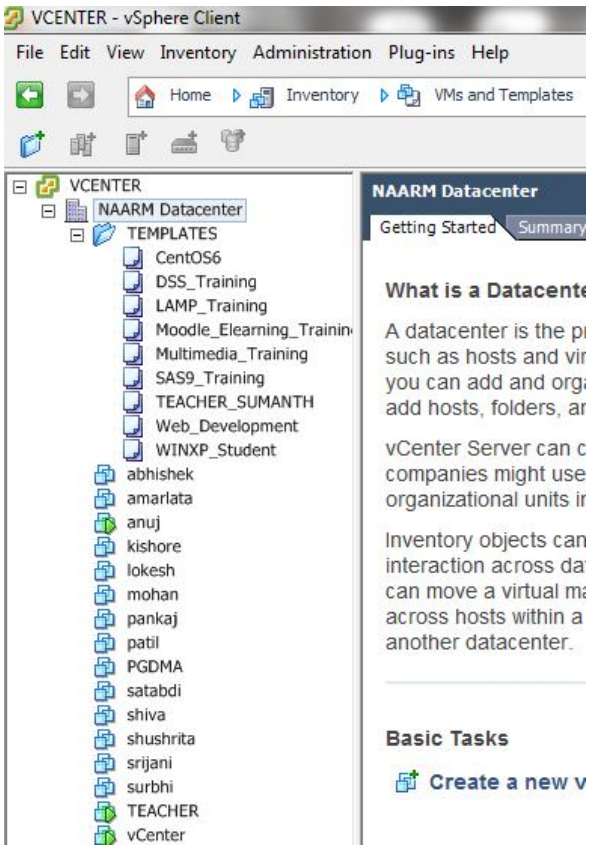
Fig. 5: Overview of Server Resource Utilization in Cloud Environment

Thus the study has ably highlighted the feasibility of conducting online evaluations on cloud for effective resource utilization. It also demonstrated the fact that the resources (memory and CPU) were sufficient enough to meet the total evaluation process requirement.

ANNEXURE-II

There is lot of time and money being invested into the maintenance of physical machines and software for providing the same to students of regular courses like PGDMA and trainees of various training programmes. There is a need of maintaining specific set of software required for each training and for each course of PGDMA. The coordinators of the training programmes has to ensure beforehand that all the machines are working fine and all the software required for that training got installed in all machines and working without any issues. NAARM has to provide one machine per user for the entire training period/course. This requirement of preparedness for each training programme has been avoided completely by using small hybrid cloud at our organization which will provide Infrastructure as a Service (IaaS). We have to design various templates, where a template meets the needs of a specific training programme. A template is a master image of a virtual machine that one can use to create and provision new virtual machines. Using these templates can save the time of configuring a new virtual machine and installing a operating system & required software upon that. Based on the number of participants of a training programme, we have to create the same number of Virtual Machines [VMs], where a single VM can be assigned to a single participant. We can create logins required for a each user, so that un-authorized access can be avoided completely. Training Participant has to browse the web URL of control node of the NAARM cloud and has to provide the username & password provided to him. After logging in, he/she gets access to all the resources provided to him/her. Trainee can start and shutdown the machines [VMs] assigned to him as his personal computer. The policy is to allocate a single machine to each user with all the required software.

Whenever a new training programme starts, we can start creating machines [VMs] from the concerned template which are already designed and can be hosted in our Datacenter. The only input required for Cloud is the name of the template/base image and the numbers of machines need to be created out of that. We have simulated a small cloud using the existing hardware and trail software on testing basis. Typically the cloud takes a 15 minutes time for creating 20 machines, which is less than a minute per machine. The scenario without cloud is few dedicated staff has to install OS and all the required software in all the systems of lab. This activity has been completely avoided by using cloud computing. The following figure where the templates developed for NAARM training programmes are seen.



Templates & VMs hosted at simulated hybrid Cloud.

Participants of the training programme can interact with the teacher by using virtual classroom facility. With a combination of LMS, Cloud infrastructure and VCR we can completely provide the all the three i.e Content(LMS), Platform to practice(Cloud) and online class(VCR).