

AWARDS SCHEME FOR EXEMPLARY IMPLEMENTATION OF e-GOVERNANCE INITIATIVES

IX. NAME OF CATEGORY- 'INNOVATIVE USE OF ICT BY CENTRAL GOVERNMENT PSUs'

1. **Coverage – Geographical and Demographic :-**

(i) Comprehensiveness of reach of delivery centres,

Plant wide – for all the employees of the Steel plant.

(ii) Number of delivery centres

One, Central Computer Centre, VSP

(iii) Geographical

(a) National level – Number of State covered

(b) State/UT level- Number of District covered

(c) District level- Number of Blocks covered

Please give specific details:-

(iv) Demographic spread (percentage of population covered)

For all 18000 users of the steel plant.

2. **Situation Before the Initiative** (Bottlenecks, Challenges, constraints etc with specific details as to what triggered the Organization to conceptualize this project):

KUSHAL - the Efficient, Do MORE with LESS a “Server Virtualization & Desktop Virtualization (VDI) Initiative” at RINL, Visakhapatnam Steel Plant.

What triggered the conceptualization of project

Need to:

- Embrace virtualization technology and realize its benefits.
- Implement an *efficient yet economic* virtualization environment.
- Implement the virtualization major features like High Availability and Live Migration on a 3-server-node HA cluster of Virtual Machines without the costly SAN component for common cluster storage.
- Maximizing UPTIME & Business Continuity of all application & services.
- Automatically protect applications / services from server H/W failure.
- Have Superior Performance with Maximum Resource Efficiency and Minimum Operating Costs.
- Improve User Response Time.
- More efficient & reliable backup / recovery mechanism.
- Have an easy-effective monitoring and managing mechanism.
- Have the flexibility of H/W maintenance without affecting the services.
- Replace the old obsolete server H/W with powerful Virtual Machines.
- Consolidate legacy servers and convert them into virtual machines.
- Protect Investment in existing legacy system (o/s & other licensing)
- Provide Virtual Machines instantly on demand for new projects.
- Machine independence to the services and applications.
- Provide pre-configured Virtual Desktops with different O/S, IDEs / development platforms for:
 - a) IT Lab,
 - b) Training Environment,
 - c) Test & Quality Environmentusing VDI – Virtual Desktop Infrastructure.
- Ensure zero data loss for desktop contents.
- Have 24X7 availability of desktop anywhere / anytime
- Have Ready-to-Deploy Desktop templates

3. Scope of Services/ Activities Covered (Relevance of choice of application for clients/ PSU, extent of e-enablement in terms of number of processes/services, extent to which step in each service/process have been ICT- enabled #)

What Applications / Services are parts of Virtualization

- EIS – Employee Information System for VSP that provides Pay, Medical, Township Complaints, etc related information for all the 18000 VSP employees.
- Symantec anti-virus services that caters to all the N/W node PCs with regular update of the virus definitions to keep all the PCs in the organization virus-protected
- Microsoft .net Application Server to host various web based applications for the various departments of the steel plant.
- ISO, DIN, BIS standards data hosting for the reference of the steel plant personnel.
- IMG (Infrastructure Management Group) Dashboard Application to monitor the healthiness of Server and Network H/W Resources 24X7.
- Vspace services – a Personal Productivity Tool that allows users to configure their desktop with various widget based applications.
- Windows 2008, 2012 server templates that enables us to quickly deploy the required VM platform on demand by the project team.
- Town Administration Call Centre Application to register and display status of the Employee quarter complaints.
- Virtual desktops with varying operating systems like Windows XP, Windows Vista, Windows 7, Ubuntu and programming frames works like dotNet (.Net) and runtime application environments were created to cater to the needs of development and customer communities.

4. Strategy Adopted

(i) The details of base line study done,

1. Server Virtualization :

- 1.1. Legacy servers, which are critical, were identified based on their priority, warranty status and spare support.
- 1.2. Requirements' sizing was done for weighing different options available as replacement.
- 1.3. Suitable options and technologies are identified:
 - a) One-to-one replacement of existing servers,
 - b) Virtualization with SAN support for storage pooling,
 - c) Virtualization without SAN and leveraging internal storage of host machines.

2. Desktop Virtualization :

- 2.1. A virtual IT lab based on VDI is envisaged to meet different user needs and to provide virtual testing environment and virtual training environment.
- 2.2. Sizing of hardware and software required for implementation was carried out based on projected requirements and future needs.

(ii) Problems identified & resolved,

1. Server Virtualization :

- a. Success of the Conversion tool for converting the physical server image to the VM image on VMware platform is tested.
- b. Extra three NIC cards are procured to make dedicated data transfer link connections between the internal disks of the cluster servers and tested for their functionality.
- c. Functioning of the common storage made out of the three cluster server internal hard disks is tested.
- d. Cluster Node Servers' RAM and internal Hard Disks capacities are increased by providing additional HDDs and RAM.
- e. A separate server is provided for installation of VMware Vcenter Management software that controls the HA cluster.

2. Desktop Virtualization :

- a. Active Directory configuration is done to have authentication mechanism for the virtual desktops.
- b. H/W upgrade is done for the server RAM.
- c. A separate VM is identified for the VMware View implementation that controls the virtual desktop management functions.

(iii) Roll out/implementation model,

1. Server Virtualization :

- a. VMware was chosen as the solution to embrace, as it supports pooling of internal storage disks of hosts and planned and unplanned migration of virtual machines.
- b. Sizing of hardware required for implementation was carried out based on the aggregate computing capacity of the servers to be migrated and future needs.
- c. Procurement of hardware (3 nos. of IBM 3850 X5 servers) and software (VMware Vsphere5 Essentials Plus with VSA) was carried out.
- d. The procured items were installed and implemented in association with implementation partner.
- e. The targeted production servers were converted into VMs and migrated on to the new virtual platform.

2. Desktop Virtualization :

- a. Two nos. of IBM 3850X5 servers and VMware View5 Enterprise Bundles were procured, installed and implemented.
- b. Virtual desktops with varying operating systems like Windows XP, Windows Vista, Windows 7, Ubuntu and programming frameworks like dotNet (.Net) and runtime application environments were created to cater to the needs of development and customer communities.

(iv) Communication and dissemination strategy and approach used.):

3. Server Virtualization :

- 3.1. Legacy servers, which are critical, were identified based on their priority, warranty status and spare support.
- 3.2. Requirements' sizing was done for weighing different options available as replacement.
- 3.3. Suitable options and technologies are identified:
 - a) One-to-one replacement of existing servers,
 - b) Virtualization with SAN support for storage pooling,
 - c) Virtualization without SAN and leveraging internal storage of host machines.

4. Desktop Virtualization :

- 4.1. A virtual IT lab based on VDI is envisaged to meet different user needs and to provide virtual testing environment and virtual training environment.
- 4.2. Sizing of hardware and software required for implementation was carried out based on projected requirements and future needs.

5. Technology Platform used-
(i) Description,

1. Server Virtualization:

- Three mid range servers (IBM x3850 X5) are configured in a High Availability Cluster hosting VMware Vsphere 5 Virtualization software capable of HA and Live Migration.
- The Common storage required for HA & Live Migration capabilities is configured using the VMware Vsphere Storage Appliance (VSA) feature. This VSA feature integrates the internal disks of servers into a common storage for the cluster.
- Dedicated NIC cards are provided in all three servers of the cluster for implementing data link between the servers' hard disks.
- VMware convertor tools enable conversion of physical server to a VM on the HA cluster.
- VMware Vcenter Management interface allows managing and administering the Cluster resources and VMs created.
- A separate server is provisioned for Vcenter management interface.
- In case of breakdown / planned shutdown of a HA cluster node, the VMs are migrated to the remaining two running nodes of the HA cluster thru Live Migration feature.

2. Desktop Virtualization:

- Two mid range servers (IBM x3850 X5) are configured hosting VMware View 5 VDI software.
- VMware View Management interface is used to create, configure and manage virtual desktops and users.
- Desktops with varying operating systems like Windows XP, Windows Vista, Windows 7, Windows 8, Ubuntu, Fedora etc are created.
- Templates for IT Lab, Test and Quality desktops are created in order to deploy the required desktop type instantly.

(ii) Interoperability

1. Server Virtualization:

- a. The conversion tool provided by VMware for converting a running physical server configuration into a VM capable of running onto the VMware Vsphere Cluster.
- b. The issues related to the H/W compatibility, O/S and other application S/W does not arise. The conversion process takes a few hours and after the VM is created it is totally independent of the original server H/W resources/constraints.
- c. VMware provides the Backup-Recovery mechanism for the VMs running on the cluster. It creates a backup image for all the VMs which can be used in case a recovery is required.
- d. A running VM can be converted to a template, it does not consume resources like CPU and RAM. Later on whenever the need arises a VM can be converted back from the template.
- e. Readymade templates of servers become handy in provisioning a VM instantly.

2. Desktop Virtualization:

- a. The conversion tool provided by VMware for converting a running physical desktop configuration into a Virtual Desktop that is accessible from any node of the N/W may it be a PC or a thin client H/W.
- b. The issues related to the H/W compatibility, O/S and other application S/W does not arise. The conversion process takes a few hours and after the virtual desktop is created it is totally independent of the original desktop's H/W resources/constraints.
- c. VMware provides the Backup-Recovery mechanism for the virtual desktops hosted. It creates a backup image for all the Virtual Desktops which can be used in case a recovery is required.
- d. Readymade templates of desktops become handy in provisioning a virtual desktop instantly.

(iii) Security concerns

1. Server Virtualization :

- a. The cluster server nodes are hosted on ESXi bare metal O/S from VMware which is highly secure.
- b. All servers running as VMs have their O/S hardened and have updatable anti-virus solution installed on them.
- c. All servers running as VMs have are isolated from each other by encapsulation. So security problem with any of the VM is not likely to affect the other VMs which are running on the same physical cluster node.

2. Desktop Virtualization :

- a. The virtual desktop host server nodes are hosted on ESXi bare metal O/S from VMware which is highly secure.
- b. All virtual desktops have updatable anti-virus solution installed on them.
- c. All virtual desktops are isolated from each other by encapsulation. So security problem with any of the virtual desktops is not likely to affect the other virtual desktops which are running on the same physical server node.

(iv) Any issue with the technology used

1. Server Virtualization:

HA Cluster Common Storage:

- * Use of VSA (Virtual Storage Appliance) feature of VMware to configure server internal HDDs into a Common Storage.
- * This has made the HA Cluster Solution much more economical. The SAN cost is saved up-front.
- * It has also helped in avoiding the SAN administration complexities
- * SAN a single point of failure is successfully circumvented.

"Seamless Changeover" to New VMs from existing Legacy Servers:

- * Legacy S/W configuration including o/s could be retained.
- * This allowed reducing the efforts required for migration to new H/W platform which might have included o/s configuration, upgradation and application tuning from the scratch.
- * Savings was done as legacy servers' o/s licenses are reused.

(v) Service level Agreements (SLAs) (Give details about presence of SLA, whether documented, whether referred etc. #)

6. Enhancement of Productivity (Give details about impact on volume of transactions handled per employee, Productivity of machines/ resources#)

1. Server Virtualization:

- * Procurement span involved in hosting a new server is reduced to minutes now. Faster deployment of new IT applications made implementation of business requirements faster.

2c) Time saved for the procurement cycle = 6-9 months.

Time saved for reconfiguration of applications/services on the new platform vs conversion to VM = (12X5) 60 man days

- * HA Cluster Solution using VSA allowed High Availability & Live Migration Features. So planned downtime of the servers is not required now as the VMs can be migrated from one node to another as and when needed freeing the machine for the maintenance.

- * Easy Conversion from physical server to VM with VMware Converter Tool drastically reduced implementation/migration time.

- * Seamless Deployment of the converted VMs into Production assured Business Continuity.

- * Ease of maintenance and management dashboards ensure that the cluster administration is quick and easy.

2. Desktop Virtualization :

- * Creation of Virtual Lab, Virtual Testing Environment, and Virtual Training Environment using the VDI provided a never before freedom to experiment, learn and test many scenarios.

- * Time saved for set up of IT Lab, Development & Testing environments = (40X1) 40 man days.

- * Ease of maintenance and management dashboards for the virtual desktops ensure that the desktop administration is quick and easy.

7. Efficiency Enhancement (Give specific details about the following #)

(i) Volume of transactions processed

- In tens of thousands.

(ii) Coping with transaction volume growth

- VMware Vcenter Management has a very good facility of recording the usage statistics of the various cluster nodes for RAM, CPU, Disks, N/W I/O etc. These alarms, reports are quite handy in identifying resource idling or resource crunch.
- Resources can be freed from the VMs where it is idling, the same can be provisioned to the VMs which are facing response issues due to resource constraints.

(iii) Time taken to process transactions,

- VMs are converted from the running physical servers having obsolete or outdated H/W. These VMs are now running on a powerful cluster nodes servers with possibility of additional resource allocation as and when required.
- The ability to dynamically increase the allocated H/W for a given VM makes it easier to handle the periodic peak loads.
- This ensure a descent response time to end user always.

(iv) Accuracy of output,

- The output accuracy remains 100 % correct.

(v) Number of delays in service delivery

- Absolutely no delays in service delivery, in fact it has improved a lot.

8. **Service Delivery – Business/ Client Centricity** (Give details about improvement in interaction with clients and outcome for clients, relevance of access points, Length and Breadth of services provided online etc. #)

- Applications/services hosted on VMs is responding much faster to the end users as the VMs are running on much powerful H/W then earlier.
- Clear improvement is visible in the applications like Employee Information System where the entire plant employees are the users..
- The availability of the applications/services has become more reliable now due to HA and live migration features of the cluster.
- The backup-recovery scenario is also improved with comparatively very much reduced time for both.

9. Citizen/ Client Centricity (Give specific details on the following#)

(i) Impact on effort, time and cost incurred by user,

- End Users' effort, time is saved considerably.

(ii) Feedback/grievance redressal mechanism,

- End Users' can give their feedback thru mails, sms, or by phone call.

(iii) Audit Trails,

- Remains the same that existed in the application.

(iv) Interactive platform for service delivery,

(v) Stakeholder consultation

10. User convenience (Give specific details about the followings #)

(i) Service delivery channels (Web, email, SMS etc.)

- Thru web based intranet Applications/Services.

(ii) Completeness of information provided to the users,

- End Users / Employees can have complete access to their personal information related to Medical Tests, Pay related Info etc.

(iii) Accessibility (Time Window),

- Applications/Services accessibility 24X7.

(iv) Distance required to travel to Access Points

- Applications/Services available on all the 3500 N/W nodes of the plant.

(v) Facility for online/offline download and online submission of forms,

- Applications/Services have the features of entering the complaints / suggestions etc online. Their status can also be checked online.
- Online reports can be generated and saved / printed as the need be.

(vi) Status tracking

- Applications/Services provide the status tracking information for the user requests / complaints registered.

11. **Innovation** (Give details on how the usage of technology is exemplary, any use of new and emerging technology, impact on number of steps required, identification and removal of bottlenecks/ Irrelevant steps etc. #)

What is Innovative?

* Use of VSA (Virtual Storage Appliance) feature of VMware to configure server internal HDDs into a Common Storage. This has made the HA Cluster Solution much more economical. The SAN cost is saved up-front. It has also helped in avoiding the SAN administration complexities. Moreover SAN a possible single point of failure for all VMs, is successfully circumvented.

* "Seamless Changeover" to New VMs from existing Legacy Servers has allowed to retain the legacy S/W configuration including o/s for the servers. This drastically reduced the efforts required for migration to new H/W platform which might have included o/s configuration, upgradation and application tuning from the scratch. It saved a few man months of efforts of migration to the new H/W server from the scratch. Savings was done as legacy servers' o/s licenses could be reused.

* Virtual IT Lab created with machines having windows XP, windows 7, windows 8, ubuntu, fedora desktops. Machine templates created for temporary training purpose where the training related configuration can be done during the actual training to have hands-on of the theory taught. Virtual Testing Environment created for application developers to do testing on desktops with different o/s and different browsers.

12. **Defined and Achieved outcomes** (Give details about extent of improvement in terms of organizational objectives, output targeted in the beginning of the project and output achieved, extent to which the project is able to reach/ fulfill the requirements of planned beneficiaries etc. #)

Objective	Achievement
Embrace virtualization technology and realize its benefits.	Done for Both server and desktops
Implement an <i>efficient yet economic</i> virtualization environment.	Done with a savings of upto a few lacs of rupees thru innovation
Implement the virtualization major features like High Availability and Live Migration on a 3-server-node HA cluster of Virtual Machines without the costly SAN component for common cluster storage.	Done with the implementation of VSA - Virtual Storage Appliance
Maximizing UPTIME & Business Continuity of all application & services.	24X7 availability of applications / services is ensured
Automatically protect applications / services from server H/W failure.	Live Migration feature of the HA cluster moves the application to another node on the HA cluster
Have Superior Performance with Maximum Resource Efficiency and Minimum Operating Costs.	Eight physical servers converted to VMs successfully and implemented.
Improve User Response Time.	Improved User Response su to powerful H/W
More efficient & reliable backup / recovery mechanism.	Backup window time reduced
Have an easy-effective monitoring and managing mechanism.	GUI based management dashboard makes the administration easy.
Have the flexibility of H/W maintenance without affecting the services.	Live Migration feature of the HA cluster moves the application to another node on the HA cluster, making the present free for maintenance.
Replace the old obsolete server H/W with powerful Virtual Machines.	Done.
Consolidate legacy servers and convert them into virtual machines.	Done.
Protect Investment in existing legacy system (o/s & other licensing)	No new licenses are required.
Provide Virtual Machines instantly on demand for new projects.	VM can be provisioned in minutes.
Machine independence to the services and applications.	Done.
Provide pre-configured Virtual Desktops with different O/S, IDEs / development platforms for: a) IT Lab, b) Training Environment, c) Test & Quality Environment using VDI – Virtual Desktop Infrastructure.	Done.
Ensure zero data loss for desktop contents.	Done.
Have 24X7 availability of desktop anywhere / anytime	Done.
Have Ready-to-Deploy Desktop templates	Done.

13. **Sustainability** (Give details about sustainability w.r.t. technology (technology used, user privacy, security of information shared- Digital Signature/ Encryption etc. #), Organization (hiring trained staff, training etc#), financial (Scope for revenue generation etc. #))

1. Server Virtualization & Desktop Virtualization:

- * Technology used for server virtualization platform is from the market leader in the virtualization area, i.e. VMware. It's a time tested platform having VMs running across the globe.
- * For management of the set up GUI based management facility is given that can manage and maintain the VMs hosted on the HA cluster.
- * VMware provides service and support for the product purchased for any sort of problems.
- * In-house IT engineers are trained on managing the platform.
- * User privacy settings remain the same as they were in independent physical servers.
- * The project is running successfully since its launch without any issues.
- * The VMware management tool also gives the in-depth details about the health of the underlying H/W of the HA cluster.
- * Detailed resource utilization reports are available to know the actual use of CPU, Memory, Disk and N/W I/O etc.

14. **Adaptability Analysis**

(i) Measures to ensure adaptability and scalability

- The conversion tool makes it possible to adapt the physical server to VM transformation.
- The Cluster node servers H/W is scalable with having scope of increase in RAM, Hard Disk etc.
- VM CPU, RAM, Disk capacities can be increased dynamically from the common resource pool of the HA cluster.

(ii) Measures to ensure replicability

- VM level replicability can be done by making a template of the running VM and reuse it for creation of another similar VM.
- Virtual desktop replicability is also possible by creating templates.

(iii) Restrictions, if any, in replication and or scalability

- None observed so far.

(iv) Risk Analysis & mitigating controls.

1. Server Virtualization & Desktop Virtualization:

H/W Risk: The servers used in HA cluster and desktop virtualization set up are reliable ones, having three years of comprehensive warranty from the OEM. H/W redundancy is built in for all major components that may fail. Spares of NIC cards, SMPS, HDDs etc are available.

S/W Risk: The S/W used is from the leader in the virtualization industry. It is quite rugged and reliable.

Data Risk: HDDs are configured in mirrored RAID groups of two levels, hence chance of data loss due to disk failure is negligible.

Unplanned downtime Risk: The HA cluster is configured in such a way that if one of the cluster node server goes down due to any reason, the VMs running on that node will get Live Migrated to another nodes of the cluster automatically.

Technology Obsolescence Risk: The VMs are backed up regularly in a standards image backup format that can be restored on any other standard H/W.

Management Administrator Risk: The Management Tool is very easy to use for creating, managing and maintaining VMs and virtual desktops. Its being mastered by multiple members of the Infrastructure management group.

15. Comparative Analysis of earlier Vs new system with respect to the BPR, Change Management, Outcome/benefit, Change in legal system, rules and regulations

Earlier System	New System
Individual Servers Running on separate physical machines	Multiple servers running on a HA cluster made up of three physical server, providing a common pool of computation resources.
Some servers had outdated/obsolete H/W	All VMs run on latest powerful H/W
User response was slow if the number of users connected was more	User response is very much improved
Applications / services were required to shut down for maintenance or backup purpose	24X7 availability of applications / services is ensured due to HA and Live Migration features of the cluster
Applications / services were not available if the server H/W fails.	No such problem. Live Migration feature of the HA cluster moves the application to another node on the HA cluster
Total physical servers were many.	Total physical servers are three only.
Total cooling requirement was high	Relatively need less cooling
More efforts was required for H/W maintenance	Less efforts is required for H/W maintenance
Amount of rack space utilized was more	Rack space utilization is much less now
Administration/management of servers was required to be done on each and every server separately	A common management tool is sufficient to take care of all VMs hosted on the cluster.
The H/W upgradation was not possible due to aging H/W	Dynamic resource allocation takes care of providing required resources to the VMs
Time taken to procure, install and provide new server was in months	Server provisioning is possible in minutes now
Porting of applications/services on a new H/W required fresh installation of O/S and applications on the new H/W	Porting is done with a few mouse clicks using the converter tool
Backup of desktops was not automatic	Virtual Desktops are backed up automatically
Instant provisioning of desktop was not possible	virtual desktops can be provided instantly
Thin clients cannot be used for resource hungry applications	Thin clients can be used for resource hungry applications also
CPU utilization was very low	CPU utilization is optimized

16. Result Achieved/ Value Delivered to the beneficiary of the project-(share the results, matrices, key learning's, feedback and stakeholders statements that show a positive difference is being made etc):

(i) To organization

Cost Cutting Initiative:

- * HA Cluster Solution without SAN using Virtual Storage Appliance from VMware provided great Cost savings of upto a few lacs of rupees.
- * Legacy Applications could continue running on the new H/W platform without any configuration issues, hence no new licensing costs.
- * Reduced Administration & Maintenance efforts.
- * Reduced H/W maintenance costs.

Embracing New Technology for the Better:

- * HA Cluster Solution with VSA allows High Availability & Live Migration Features that increases the availability of the applications/services.
- * Easy Conversion from physical server to VM with Converter Tool.
- * Seamless Deployment of the converted VMs into Production.
- * Creation of Virtual Lab, Virtual Testing Environment, and Virtual Training Environment using the VDI from VMware.

Green IT Initiative:

- * Reduced Server Foot Print. (Rack space reduced from 24U to 12U)
- * Reduced Cooling Needs.
- * Reduced power Needs.
- * Hence reduced Carbon Foot Print too.

Other Tangible/intangible benefits:

- * Financially Economical Solution
- * Ease of Maintenance of H/W
- * Ease of Management of S/W, Services / Applications
- * Services / Applications available 24X7
- * Non-disruptive time window is available for regular PM of the H/W by migrating the VMs to other cluster nodes, while taking out one cluster node for planned maintenance.
- * Improved User Response Time and Satisfaction.
- * Possible to increase H/W configuration if number of users of the application / services increase.

(ii) To citizen

- Promotes Green IT implementations with less power, cooling and carbon foot print due to reduced number of H/W devices.
- Generation of lesser e-waste after useful life of the H/W equipments is over and it is disposed off.
- New technologies are adapted for improving the IT services that help in reducing the total cost of production of steel for public consumption.

(iii) Other stakeholders

17. Extent to which the Objective of the Project is fulfilled-(benefit to the target audience i.e.G2G, G2C, G2B, G2E or any other, size and category of population/stakeholder benefited etc):

18. Other distinctive features/ accomplishments of the project:

- Project Kushal – the Efficient – Do MORE with LESS has impacted the organization with five “E”s. They Are:
 1. Effective for Users
 2. Economical for Organization
 3. Efficient from the Green-IT angle
 4. Ease of Management
 5. Ease of Maintenance

This is just an indicative list of indicators. Applicant can add on more information based on suitability of the project nominated.