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Strategies for Successfully Implementing a Virtualization Project: A Case with Vmware

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ABSTRACT

Virtualization has become one of the hottest information technologies in the past few years. Yet, despite the proclaimed cost savings and efficiency improvement, implementation of the virtualization involves high degree of uncertainty, and consequently a great possibility of failures. Experience from managing the VMware based project activities at several companies are reported as the examples to illustrate how to increase the chance of successfully implementing a virtualization project.

INTRODUCTION

Virtualization typically involves using special software to safely run multiple operating systems and applications simultaneously with a single computer (Business Week Online, 2007; Scheier, 2007; Kovar, 2008). The technology initially allows company to consolidate an array of servers to improve operating efficiency and reduce costs (Strassmann, 2007; Lechner, 2007; Godbout, 2007). It has since been applied to dealing with data storage as well as desktop systems (Taylor, 2007).

Owning to the success of tools developed by VMware Inc., the technology has become one of the most talk-about technology, and has draw attention from both IS professionals and non-Is executives in virtually all industries. Despite the potentially significant impact on company's operations, this technology has virtually been ignored by the academic researchers. Almost all articles addressing this technology and its potential effects on company's IT/IS management have been done by the practitioners. The technology, however, is not a panacea, and just like most other information technologies, it comes with a great deal of risks (Dubie, 2007). For companies considering virtualization projects will have to follow solid guidelines to help minimize the risks associate with the project.

This study attempts to develop strategies for successfully implementing virtualization project. Lessons learned from the implementation of a VMware based virtualization project will be used to formulate the strategies which may be used by companies to reduce the uncertainty associated with managing their virtualization projects.

Literature review of the virtualization technology will be presented in the following section. Lessons of implementing the virtualization projects at several companies are reported to compare VMware and other virtualization solutions throughout the paper. Strategies for successfully implementing such a project will then be presented. A brief summary of major lessons learned and some directions for future studies will conclude this paper.

LITERATURE REVIEW

A server is a computer used by multiple users for a specific application or multiple functions. The benefits of servers include centralized location, ability to control the air conditioning, consistent data archiving and speed. For example, a print server can eliminate the need for each user to have a personal printer. This would improve the efficiency of using network printer and reduce the cost of maintaining multiple printers. Application servers, while similar to file servers, are unique in that they run executable applications from the central location. By using application servers, costs of application software are reduced (Sportack, 1998).

Reports pertaining to virtualization range from presenting basic concepts and the fundamental knowledge about this technology (Conry-Murray, 2007; Hassell, 2007; Hayes, 2008; Kovar, 2007; Watson, 2007) to more advanced skills of managing the implementation strategy (Dubie, 2007; Gruman, 2007) and the analytical approaches to dealing with visualization projects (Hiller, 2006). Almost all these reports were published in trade magazines and written by the practitioners.

The interdependency between servers and datacenter networks are one of the key drivers for server management costs, even including LANs and SANs. For years, blades have been the choice as the chassis backplane. The connectivity problems associated with blades require IT personnel to get involved every time an existing blade was replaced or a new one is installed. This involvement required lots of scheduling activities to ensure the impact to the company was minimized and thus wasted a great deal of time for those involved. The older blade servers suffered from "Fibre Channel rates" which in the working environment limited the usefulness. In order to get past the peak traffic, the IT department would have to over-provide connectivity which resulted in underutilized networks thus causing a waste of resources.

There are two solutions for optimization; blade servers or virtualization. The blade servers are a hardware solution while virtualization is the software solution. The blade option allows each server to have their own processor and memory but can share power supplies, cabling and storage. The software virtualization simply pools the server resources and allocates those resources as needed in a more efficient manner. There are companies who may choose the hardware route as well as other companies who may choose the software route. In some cases the two can be used together to complement each other, (Goodchild, 2007).

Hewlett-Packard (HP) has designed a blade system which allows:

1. Just-in-time provisioning where servers are preprovisioned and wired once with reconfiguration done quickly and easily
2. Automated coordination which isolates the domain and the people from change
3. Virtualization which is when devices are managed as pools of resources
4. Lights-out "1:n" management which reduces management overhead by streamlining processes
5. Capital management and efficiency due to the Blade System c-Class servers being less expensive then the current conventional IT infrastructures, (Humphreys, 2007)

Servers utilize operating systems in order to support the multiple tasks that are required of a server. With the amount of task management needed, a multitasking operating system is the most natural solution. Since servers require many concurrent operations, the operating system will handle task preemption, task priority, semaphores (i.e. synchronization mechanisms used to keep tasks from bumping into other tasks when sharing a resource), and efficient memory management in addition to others (Orfali, Harkey & Edwards, 1994).

VIRTUALIZATION FUNDAMENTALS

Virtualization can be considered IT asset optimization. There are four parts to asset optimization: rationalization which is the removal of "slack" from the system and match expenditures with actual needs, optimization, which is the complement to rationalization by altering actual requirements to gain efficiency and economies of scale, consolidation which is the process of combining data or applications in an attempt to increase resource utilization and finally virtualization which is the process of "combining several operating systems images into a single virtualized platform, providing economies of scale in resource utilization while maintaining a partition between operational environments," (Hillier, 2006).

Storage virtualization allows all hard drives on the system to act like one large pool of storage drives. This increases the efficiency of storage by allowing files to be stored wherever there is space, rather then allowing some drives to go underutilized. With virtualization drives can be added or replaced on the fly since the virtualization software will reconfigure the network and the affected servers. Mirroring the image and backup are faster since the only data that

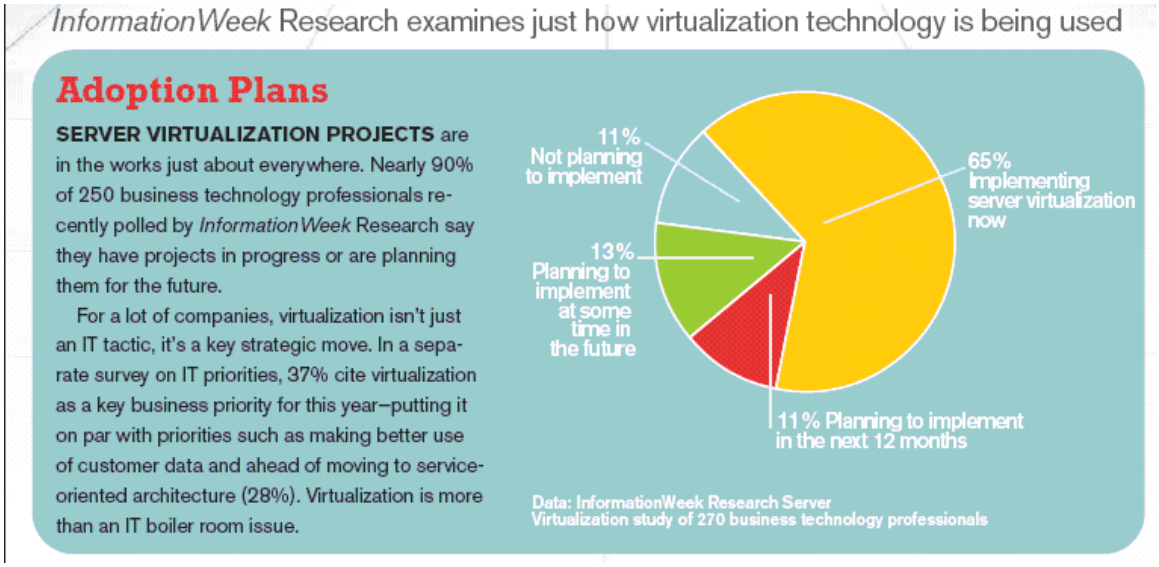
is copied is the data that was changed. Such capability will significantly reduce the scheduled downtime caused by handling these tasks (Gruman, 2007).

Virtualization software enables companies to use one physical server with the capability of delivering the performance of multiple servers. Without virtualization, departments needing more resources would have to get the cost of additional equipment approved, followed by the time to order and receive, then install. Virtualization allows IT Managers to maximize resources by combining them on a single server (Mullins, 2007). With virtualization, new applications will be made available within a few minutes and without the expense of additional equipment (Connor & Mullins, 2007). VMware states that one server can be a consolidation of 10-15 production systems. Although some applications are labeled as "non-mission" critical, when a significant amount of users are affected it becomes mission critical (Stratus Technology, 2007 a and b).

Research shows that with virtualization, many existing strategies governing the implementation/management of IS projects may not work any longer. For example, Microsoft is known for its operating system. But with virtualization the operating system is not as an important issue as it used to be. Third-party vendors making applications can use a virtual environment and run their own microkernels which eliminate the conventional operating system. Since the hypervisor is becoming the intermediary of the data center, vendors are building their layers to tap straight into the hypervisor. This does not always prevent the dependency on operating system, however it does limit its influence (Conry-Murray, 2007).

As Chart 1 below shows, 90% of 250 companies surveyed by Information Week are either already using server virtualization or are planning to in the future. The rest 10% not planning on implementing virtualization cite the lack of funds as the primary reason. Some additional reasons are lack of skilled IT personnel and the training that would be required for the staff to handle the complexity of the virtual environment (Smith, 2007). To illustrate how to assess the feasibility of implementing a virtualization project, and how to choose the right technology provider, experiences reported by managements at several companies are included.

Chart 1: How Virtualization technology is being used.



SOME REAL WORLD EXPERIENCES

To see how to handle the implementation of a virtualization project, let's start by examining the case at Triton Systems Inc. The company currently has forty servers supporting the needs of all users. These servers range in age from one year to five years old. All servers have a warranty of five years and due to the critical nature of the data they contain, the servers are replaced just prior to the warranty expiring. As new servers are required to be

purchased, they are considering purchasing servers which will allow them to take full advantage of server virtualization.

VMware is the top virtualization solution under consideration. Industry researchers reported that 80% of companies improving utilization by using virtualization chose VMware software when using x86 servers. VMware offers a "site-recovery manager" which allows the IT manager to reproduce machines virtually at other locations. The control layer allowing the flexibility to put data in a remote site or sites would be invisible to the users (Gruman, 2007). Another possible solution is the "Windows Server Virtualization" from Microsoft, which will be released the latter half of 2008 as an add-on to its Windows Server 2008 (Mullins, 2007).

VMware has proven itself a reliable solution that IBM, Hewlett-Packard and Dell all have plans of embedding virtualization software in their x86 servers. This will allow for easier setup for companies wanted to use virtual servers (Thibodeau, 2007). Information Week has states that four out of five companies using virtualization software are using VMware. It is believed that business technology professional would prefer to buy from virtualization software vendors instead of system management vendors. Some statistics state that one in five companies use virtual software from more than one vendor with a third stating that when utilizing several different vendors, problems are introduced (Smith, 2007). For all these reported results, the VMware solution was adopted by management at Triton Systems.

There, however, have some concerns with VMware virtualization project. These include a different way of managing the disks, in which the IT staff will not be able to copy volumes with partial files but must copy the actual files for backup. Another concern occurs with setup. Care must be taken when dealing with high and low performance drives. If lower performance drives are accidently place in high-performance virtual servers, this could hinder the overall performance including critical applications. While using virtualization tools is not difficult, it is just a different way than what most IT professionals have become accustomed to. Choosing the right storage form is also critical. There are two options, network-based which are utilized by server-based software or array-based which typically is part of storage management software. The downfall to array-based is the need for array storage having to be purchased which may create an expensive vendor lock-in. Network-based seems to be the most flexible and can be managed from anywhere provided they are available via the storage area network (SAN) (Gruman, 2007).

George Scangas, manager of IT architecture at Welch's, stated had Welch's not had virtualization, they would have had to build a new data center which could have costs of the high six figures. By using virtualization, Scangas stated there is an immediate cost savings from using less cable not to mention the amount of power, although other data disagrees with this, and rack spaced saved. It is estimated that Welch's saved at least $300,000 in hardware costs alone, not including the reduced power bill due to the need for less cooling. Welch's currently runs 100 virtual machines and they expect to add an additional 10 or 20 in the next quarter. Scangas stated his confidence has grown with VMware as their technology matures such that they are more willing to place "business-critical programs on VMware". A study by "The Strategic Council, in June 2007, reported that 45% of companies considered their virtualization deployments unsuccessful." To take that survey a step further, more than one quarter failed to realize a return on investment and less than ten hit their targeted cost savings. With all this being said, virtualization is not going anywhere and there is hope that when Microsoft finally makes its entry will provide an additional boost and spur more adoption of the technology (Watson, 2007).

In a September 2007 whitepaper, CiRBA stated that virtualization is not just a sizing exercise, but an effort to ensure all constraints which govern and impact the companies IT environment are considered during the planning process and how to manage the virtual environment. The article credited VMware as the industry-leading virtualization solution but that a company may consider combining it with "accurate intelligence and focused analytics", which will allow the current servers into the new virtual configuration (CiBra, 2008).

Dell states seven reasons of how virtualization can help an IT department:

1. Lower hardware, power and space requirements.
2. Quickly and easily provision new servers into the environment.
3. Reallocate resources with no downtime.
4. Ensure applications stay up in a highly available architecture.

5. Prioritize the most important applications to ensure they receive the resources required to meet business needs.
6. Simplify systems management and operations.
7. Simplify and improve the disaster recovery process.

Some research states a major problem that may be overlooked is the high consumption of power in addition to the high output of hear when using a physical server hosting the virtualized servers. Virtualized servers force the hardware to run at a higher rate thus meaning the required power goes up as does the output of heat.

Backing up the servers in a virtualized environment is another issue to take into consideration prior to virtualization. The amount of data could be incredible. Without a robust SAN, backing up would be extremely slow and inefficient.

Security can be more difficult in a virtualized based on the fact that it must be down on two tiers; the virtual machine and the physical host securities. If the physical host server were to become compromised, all virtual machines being utilized by that server would be impacted. In addition, a compromised machine may wreak destruction on the physical server in turn causing issues on other virtual machines utilizing that same host.

When running monitoring software on virtualized servers, performance can be impacted due to the use of valuable memory and the CPU cycles which may be consumed by the virtual machines. It is recommended that the resources used by monitoring software be calculated to ensure they can be spared (Marshall & Knezevic, 2007).

RESULTS SUMMARY

The site-recovery manager by VMware could prove very beneficial in the event of an event similar to Hurricane Katrina. Virtualization would allow for services to be switched to a remote location in a matter of minutes allowing the business to continue running with little or no interruption.

Chris Dickson, vice president of marketing for virtualization metering software maker Virtugo stated that "prior to virtualization, individual department applications ran on separate servers, making IT billing relatively simple." Dickson went on to state that virtualization could cause chargebacks to get complicated as utilization fluctuates over time for the different applications (Connor & Mullins, 2007). Since Triton does not currently use chargebacks, this is not an issue. In the event chargebacks are implemented the virtualization may present a problem.

VMware has a Global Hardware Alliance Partner program which allows leading hardware to support and sell the VMware products. They also have a community source program which provides resources and tools which allows the chosen vendors to interface their products with the VMware ESX Server. "This program is an innovative approach to quickly building added value for customer" according to Allan Jennings of Stratus Technologies (Stratus Technology, a and b).

In addition to the emergence of virtualization, some things that are making it easier for companies to accept and move towards virtualization is the hardware that is becoming available. Dell offers Quad-core processor servers which has increased performance over the dual-core predecessor and even the older single-core servers. Dell has stated that through their testing, "Power Edge servers with Quad-Core Intel® Xeon® 5300 series processors provided up to 63% better performance than Power Edge servers with Dual-Core Intel Xeon 5100 series processors". Dell's testing went one step further with a specific "VMware test, using three 2-socket quad-core Power Edge 2950 which outperformed two 4-socket dual HP DL585 by 44% more performance, with 57% more performance per watt and an average of 95% better price/performance" (Dell, 2007).

Intransa reports that VMware offers management of data capabilities ranging from backup of data to numerous high availability features including snapshot, clustering, and VMotion in addition to HA, Distributed Resource Scheduler (DRS) and VCB. ESX servers are required to access the shared storage system (Intransa, 2007).

While Intransa recommends VMware, they stated using multi-core high speed processors would allow a company to achieve a level of consolidation. The new style servers can deliver three to five times the performance of servers

purchased as recently as 12 months ago. (Intransa, 2007) VMware does have its pros and cons as summarized in Chart 2 below.

Chart 2: Pros and Cons of VMware.

Pros and Cons of VMware Storage Management Technologies

Category	VMware ESX iSCSI Initiator	VM iSCSI initiator Direct Storage Access
VM Storage Access Method	Hypervisor Storage Stack	Hypervisor Network Stack
Configuration	Single iSCSI initiator for one physical server Quick and Easy VM creation Less LUNs to manage	Many iSCSI initiators per physical server (one for each VM)
VM-Storage Integration	None	Snapshot, VDS, VSS Storage Array Snapshot
Multipathing	NIC Teaming	MPIO and/or NIC teaming
iSCSI HBA support	Yes	No
VMware Consolidate Backup (VCB)	Yes	No

(Source: Intransa, 2007)

Another virtualization option available is the Citrix XenServer which is based on Xen hypervisor which is an open source application. This system has gained support from the industry with its simplicity design. There is some research which states that the VMware is a single point of failure but Xen stores the management state redundantly in all hosts involved in the event one pool leader fails one of the others can assume the leader role without loss of any state information. Xen servers can be located in separate locations in order to protect from disasters which could be site wide. (Crosby & Melnick, 2007).

MANAGEMENT IMPLICATIONS

There are some things to be taken into consideration before deciding to move forward with server consolidation as it is a complex responsibility requiring very detailed knowledge of both static and dynamic characteristics of the environment. Information that is required for a typical analysis includes:

- Hardware Inventory & Configuration
  - System models
  - CPU architectures
  - Non-volatile (EEPROM) settings
  - Device settings
  - Serial numbers
- Operating System Settings & Files
  - OS versions and rev levels
  - Kernel parameters & Registry settings
  - Name service parameters
  - Locale and Time zone settings
  - Scheduled job configurations
  - Library versions
  - Local user accounts

- Installed Patches/Hot fixes
  - Security patches
  - Infrastructure software patches
  - Patch application frequencies
- Application Inventory & Configuration
  - Application versions
  - Application configuration settings
  - Application usage
- Middleware Configuration
  - Middleware versions
  - JVM versions in use
  - Heap settings
  - Class Paths
- Database Configuration
  - Database versions
  - SGA parameters
  - Data dictionary
  - Formatting and locale settings
- System Capacity and Utilization
  - CPU utilization
  - Network I/O
  - Per-process statistics
  - Device and resource statistics
  - Platform benchmarks

Consolidation when using multiple time zones may cause a problem, since applications may be sensitive to the locale settings. This issue must be kept in mind when considering stacking servers in different locations must be part of the overall strategy.

Motivation that is behind asset optimization is generally a very clear process. When identifying the license costs fees and any excess capacity, budgets will contain initiatives. A self-guided approach makes more sense then turning to the hardware vendors since it will be more accurate (CiBra, 2008).

When considering VMware there are some things that should be considered when defining the clusters:

- the maximum ESX servers is 16
- Servers in the cluster must share common storage and networking
- Servers should have similar hardware specifications including CPU and memory
- Blade servers share common resources so they are suitable for clustering.

HP offers Virtual Connect which virtualizes the Blade System connections to both LAN and SAN type environments. This is done by defining a server connection profile before the server is installed for each server bay. This is done by using the media access control (MAC) addresses for the network interface controllers (NICs) for each bus adapter. The MAC addresses are then assigned to the new server. The profiles also can be moved from one bay to another which allows for quick substitution in the event of a failure. The switching a server from a development to test environment or even moving a group of servers to a different subnetwork is simply a few mouse clicks by an IT personnel. With the Blade System environment, HP states the following benefits can be achieved: Reduced server provisioning and management effort, simplified networks, and simplified server connections (Humphreys, 2007).

There are some barriers which must be taken into consideration prior to the final acceptance of the Blade System. These barriers include the need to prove general applicability across organizational and mission-critical applications. Another barrier is the lack of standards in blade servers as well as additional complexity which may be introduced to the networks by the customers. Due to the fact that the market is just entering the adopter phase, HP as well as other

vendors must overcome the perception of blades in the market as the exclusive domain for specialty solutions (Humphreys, 2007).

Challenges may occur when applying patches to the physical servers and the virtual machines. When system reboots are required, it impacts the entire business as opposed to having to reboot a machine that merely serves as one server. When virtualization is not used, a company can handle a Windows update patch very easily with minimal impact to the business; however when using virtualization, patching becomes a significant task and would need to be scheduled accordingly to minimize the impact to the business (Marshall & Knezevic, 2007).

There are certain phases that must be achieved for a successful consolidation. The first phase when planning a consolidation is the need for a thorough inventory of all servers currently being used. This will allow you to make informed decisions when considering the workloads which are being considered for migration. The second phase data must be collected to develop a workload profile. This data includes monitoring the changing resource demands. The demands may be heavier at certain times of the month as is usually the case at month's end. Monitoring will allow the workload profile in order to see trends and anomalies in server utilization. The third phase will analyze workloads to provide a deeper understanding so managers can make a more informed decision which will allow the organization to gain greater control thus see improvements with regard to speed and quality of initiatives for consolidation. The fourth phase identifies the consolidation candidates by examining the data gathered from the analysis. This will point out under or over-utilized servers. Phase five is the development of a consolidation plan.

It is recommended that instead of attempting to make guesses, a data center planning solution should be considered to automate the plan. After the plan is established, the sixth phase is testing the consolidation plan. Comprehensive testing will provide both the IT department and the end-users a level of confidence that the new system will in fact still perform as they are expecting. Phase seven is the migration of the workloads. This phase will stream the production workloads to either platform, physical or virtual. The final phase the optimize phase. With the migration complete, it is time to keep it running in the most optimum fashion. This is done by continuing to monitor and rebalancing of the workloads and necessary resources (PlateSpin Ltd., 2007).

CONCLUSION

Based on the data gathered throughout this paper, VMware is a solution that Triton should give serious consideration. While it appears Microsoft will be moving forward with their virtualization software, it will have to be debugged for some period of time. VMware has already gone through most debugging processes and has been proven effectively in many businesses. VMware has high accolades from some large technology companies like Dell and HP. There are also companies like Stratus who are promoting their server systems which thrive on the importance of uptime in combination with VMware.

Research has proven that numerous companies have successfully put into place VMware virtualization. Although research has some negative comments, the positive does outweigh the negative. With the expectations of a hypervisor that will not need an operating system per say, opens up the types of applications which can be run.

When considering the VMware virtualization software, it is also recommended to utilize two dual-socket, quad-core processors. The will provide a very good price-performance if used in rack-mounted or blade servers. All the recommendations presented in managerial implications section may serve as the general guideline for company considering the virtualization initiatives to increase the chance of successfully implementing the project. Additional strategies dealing with storage and desktop virtualization will be the focuses of our studies in the future.

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