First In A Series of Three Forrester Consulting Thought Leadership Papers Commissioned By Hewlett-Packard

Ramp Up Your Virtualization Benefits – Part One

By Optimizing Your Infrastructure And Maturing Operations You Can Achieve Significant New Efficiencies

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FORRESTER®

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Executive Summary

You've delayed or completely avoided future capital expenditures through virtualization and consolidation, but are you achieving all the benefits that a virtual environment offers? Most organizations aren't. But you can by standardizing and in some cases upgrading your server, storage, and network infrastructure and making changes to how you operate your virtual server environment — adapting your processes to virtualization management best practices and increasing the consistency with which you follow them. In January 2010, Hewlett-Packard commissioned Forrester Consulting to evaluate the infrastructure and operational practices used for the virtual server environments of small and medium-size businesses (SMBs).[1] This research confirmed prior Forrester findings that as organizations optimize their infrastructure and mature their processes for operating their virtual environments, they are able to achieve significantly greater efficiencies and cost savings.

As organizations optimize their infrastructure and mature their processes for operating their virtual environments, they are able to achieve significantly better efficiencies and cost savings through virtualization.

Through in-depth interviews with numerous IT professionals across North America, Europe, and Asia Pacific, Forrester found that the companies that had optimized their infrastructure and that had more mature practices achieved higher return on investment, greater administrator productivity, substantially faster provisioning of new applications, and simpler problem identification and resolution.

Key Findings

Forrester's study yielded the following key findings:

- **Building out a standardized, scalable infrastructure configuration yields outsized gains.** Most SMBs initially build out their virtual server environments using existing server hardware and available storage capacity — sometimes internal server capacity, sometimes direct attached storage (DAS), and in a few cases, available capacity in an existing storage area network (SAN). Due to budget constraints, SMBs take this ad hoc infrastructure approach in order to deploy virtualization sooner rather than later but find that greater efficiencies come from standardizing this environment. Some key moves that deliver strong gains include migrating the virtual server environment to a homogeneous, consistent server infrastructure, shifting storage to an iSCSI or FC SAN, and booting VMs from the network. Some of the organizations we interviewed also standardized on a single vendor recommended by their value-added reseller (VAR). The main driver was simplified support: If an issue arose in the environment, the organization only had to make one phone call; plus, this led to a faster time to resolution because there was no finger-pointing among vendors.

- **Taking advantage of new virtualization capabilities streamlines management tasks.** Many IT organizations don't want to take on too much change at once so they not only use existing hardware to support the virtual environment, they often use existing processes to manage virtual machines (VMs) as if they were still physical machines. In a virtual environment, the time required to perform traditional tasks such as provisioning, configuring, patching, auditing, and protecting can be dramatically reduced with enforcement of standards but also with such capabilities as being able to rapidly provision or clone VMs from templates, as well as snapshot, clone, and replicate VMs. In addition, since all of the IT professionals that Forrester interviewed for this report currently had and planned to have physical servers as well as virtual servers for the foreseeable future, IT

professionals must also consider how to manage both the physical and virtual environment and the supporting infrastructure holistically. The more essential system and device information displayed and correlated within a single pane of glass, the better. This will reduce the number of point management tools administrators will need to consult for status monitoring, performance monitoring, alerting, troubleshooting, root cause analysis, capacity planning, etc. This is especially important for SMBs since they typically only have between three to five personnel in the entire IT department.

- **Dedicating time for knowledge transfer delivers these results faster.** There's certainly merit to learning on the job, but the interviewed organizations that received on-site knowledge transfer and training for their staff from either their VAR or server vendor achieved greater operational efficiencies faster and are poised to outpace their competitors. While the management interfaces of various infrastructure components and the hypervisor itself are increasingly intuitive, with the rapid pace of hardware and software upgrades, organizations aren't always fully versed in all the capabilities and hence all the benefits they can achieve through virtualization. There are always new features for rapid provisioning, workload balancing, migration, automation, availability, and continuity. Knowledge transfer and training is not a one-time occurrence. As vendors at every layer of the virtualization stack (application, hypervisor, server, storage, network, etc.) upgrade their systems, they are adding additional capabilities and points of integration with other parts of the infrastructure. IT organizations need to stay on top of these changes and experiment with them in their development environments. For those organizations that have standardized on a fewer number of vendors in their environment, proven interoperability, documented best practices, and detailed administrator guides can reduce the time it takes to understand what can and can't be done.

The Benefits Of Virtualization Are Proven

It used to be simply an IT consolidation tool for large enterprises. Now, server virtualization has proven substantial benefits for organizations of any size. It helps control capital costs as your business expands, but more importantly, it delivers flexibility benefits that let your organization more quickly adjust and respond to changing market conditions, adopt new applications, and do more with a limited IT staff. And in the current economy, best characterized as a slow recovery, virtualization is a high priority for nearly all businesses (see Figure 1). SMBs interviewed for this research reported the following benefits from virtualizing their servers:

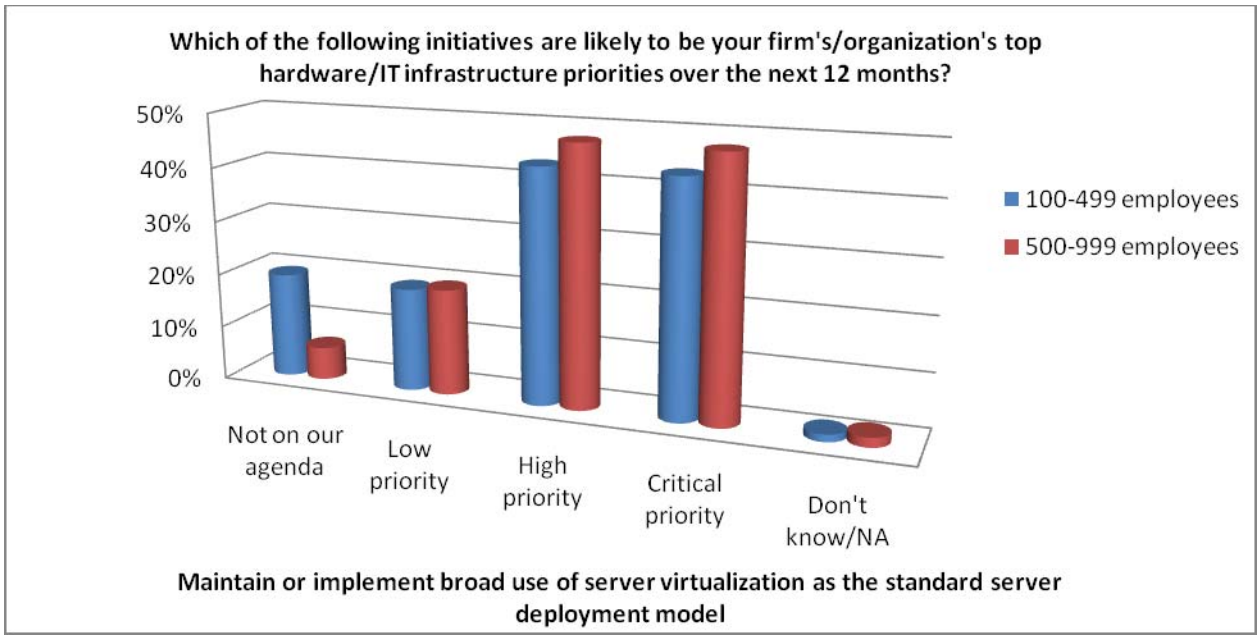
- **Lower capital expenditures and space savings.** The organizations interviewed all reported that by virtualizing their server applications they were able to decrease the number of servers they had to manage and delay or completely avoid new purchases. One organization reduced the number of server racks in its environment from seven to three. Another avoided the purchase of 12 more servers in 2009. The consolidation not only saves money on capital expenditures but also reduces footprint — a precious resource in computer rooms and data centers that are running out of space. One company based in the UK reported that because of consolidation, it avoided expansion of its computer room and saved approximately $65,000.

- **Lower power bills and enabl greener business practices.** As a result of consolidation, the organizations we interviewed substantially reduced the amount of power they consumed each month. One company based in the US reported that before virtualization, its uninterruptible power supply system (UPS) was at 99% capacity, but

after virtualization and consolidation, it cut utilization to 50% and avoided the purchase of another UPS. Another company based in the UK reports that because it can rapidly restart VMs, it powers down one-third of the systems over the weekend and starts up systems remotely.

- **Responding quickly to business and application owners.** It's a constant complaint in most organizations that IT can't provision new systems or roll out new services fast enough. Those who have virtualized are winning this battle. The companies interviewed for this report stated that they can now roll out new VMs in minutes versus the days or weeks it used to take.

Figure 1
Virtualization Is A High Priority For SMBs



Base: IT decision-makers at 447 small businesses (100 to 499 employees) and 281 medium-size businesses (500 to 999 employees) in North America and Europe, Q3 2009

Source: Forrester Consulting

Four Pitfalls To Avoid In Your Virtual Environment

Nearly every organization that deploys server virtualization achieves the above benefits. But the degrees of efficiency can vary significantly from organization to organization. Forrester Consulting set out to examine these differences and uncover the secrets behind the success of those who are getting the most from their virtualization investments.

As organizations gain experience with virtualization, frustration is often the prologue to greater efficiency. And those that have passed through this painful period are quick to reflect on their mistakes and discuss how they would have done things differently. Some of their biggest pain points included:

- **Taking the piecemeal approach to infrastructure build-out.** While virtualization does indeed abstract the application from the physical environment underneath, it doesn't shield the administrator from the headaches that can come from an overly complex infrastructure. Organizations interviewed for this study consistently stated that they would have deployed a more standardized infrastructure and coordinated server and storage upgrades. Storage in particular was a major pain point. Many of the businesses we interviewed used internal server capacity or direct attached storage in their virtual environment. Without a SAN or even network attached storage (NAS), these businesses could not take advantage of advanced virtualization capabilities such as the ability to rapidly restart failed VMs on alternate physical hosts or workload balancing or migrating VMs across their physically hosts nondisruptively. In addition, in many cases, because they had not made the business case for additional storage capacity together with the initial virtual server deployments, the businesses could not increase the ratio of VMs to physical hosts. Bottom line, to get the most out of your virtual environment, you have to take a holistic approach to server, storage, and even the network infrastructure. Without a solid infrastructure foundation, your ability to take advantage of some of the most value-added features of a virtual environment and the ability to increase consolidation without sacrificing performance would not be possible.

- **Sticking with outdated processes.** Many IT organizations see virtualization primarily as an abstraction of things that previously were deployed physically, and thus all the processes used with physical servers simply translate to this new world. That holds true to a point, but sticking with physical server processes ignores many of the unique benefits of a virtual environment. And you need to throw out some of the old lessons to achieve greater efficiency. Most of the companies we interviewed dramatically improved provisioning times, but that's as far as many have gone toward adjusting traditional server administrator tasks to reflect the capabilities of the new environment. In addition, current outdated processes that are good enough today may hamper future scale. Because most of the organizations we interviewed average three to four VMs per virtual host, backup was not troublesome. In the future, as the organizations seek to achieve greater efficiency and consolidation by increasing this ratio, they will likely find that they can no longer back up 10 VMs simultaneously — there is just not enough server bandwidth. But organizations that have a SAN have the opportunity to perform off-host backups or even use storage-based snapshot and cloning features to quickly back up their VMs.

- **A longer learning curve that translates into slower gains.** Most of the companies we interviewed did not receive any knowledge transfer or training prior to or during deployment. Only one or two of the companies we interviewed received a day of knowledge transfer or less from either the VAR or the vendor as part of the deployment. Without any kind of knowledge transfer, you don't learn the full capabilities of new software or infrastructure — capabilities that can yield greater efficiencies. Server virtualization brings features such as virtual machine templates, cloning, and thin provisioning, new tools that administrators need to understand to be more effective. Whether it's from the VAR or the vendor, organizations should ask for knowledge transfer through on-site and online training, solution papers, product documentation, demos, communities, and other resources. As organizations seek to standardize on a fewer number of vendors in the environment, these strategic vendors should offer resources that highlight the integration of their products and services.

- **Struggling through product compatibility headaches.** When you have a small IT staff that must wear multiple hats, it's a significant drain when someone has to be on the phone with multiple vendors struggling to determine who's at fault when the environment isn't working. All you want is for *someone* to step up and help you solve it. All of the SMBs interviewed for this report had three to at most seven IT staff to cover servers, storage, and networking. Many of these SMBs decided that it was best to avoid this headache entirely and limit the number of vendors in the environment. Those who purchased the servers and storage from the same vendor (and who bought software support from this same vendor) reported lower support costs and faster time to resolution of issues.

The Headaches Are All Too Common

"We bought DAS to meet our immediate capacity needs. Cost and expediency were the main drivers; we didn't put much thought into the storage environment." (IT manager at an Australian company in the tourism industry)

"We have not changed our IT management practices to take advantage of the benefits of virtualization. We still manage our virtual servers the same way as physical servers." IT manager at a US company in the financial services industry)

"If there is something we would have done differently, we would have recommended training for the system administrators." (IT manager at a UK company in the retail industry)

Maturing Your Virtualization Practices Is the Key

This study and prior Forrester research have shown that nearly all organizations go through stages of virtualization administration that yield greater efficiencies at each level of maturity (see Table 1). The key to passing from one stage to the next is not only technology but operational improvements that take greater advantage of the unique features of the virtual environment, adapt existing practices to these new capabilities, and create new procedures that virtualization makes possible. Organizations can often take years to move from one stage to the next, as proficiency in each stage of the progression is required to ascend to the following stage.

Table 1
Forrester's Four Stages Of Infrastructure Virtualization Maturity

Stage 1: Acclimation • Get comfortable with it as a concept and tool • Deploy for test/dev • Deploy for non-business-critical DR • Some production deployments — but tactical • No change to operations processes • Limited virtualization tool deployments	**Stage 2: Strategic consolidation** • Comfortable with concept, use, maturity, stability • Shift mindset from server to virtual server • Spread production deployments widely • Begin deployment for some business-critical DR • Painfully transition from server sprawl to virtual server life-cycle management • Experimenting with VMotion and Distributed Resource Scheduler (DRS)
Stage 3: Process improvement • Using VMotion, starting to trust DRS • Can utilization rates be increased? • Deploy for business-critical DR • Begin bifurcating applications between priority and nonpriority • Developing new operational efficiencies • Process improvement spreading/butting up against network, storage, security, development	**Stage 4: Pooling and automation** • Trust DRS • Implementing production policies for automation • Some mission-critical DR deploys • Pooling and internal cloud development • Chargeback/utility tracking • SLA and QoS focus

Source: *Assess Your Infrastructure Virtualization Maturity*, Forrester Research, Inc., July 10, 2009

Stage 1: Acclimation

During the first one to two years of their virtual environment experience, organizations concentrate on learning the capabilities of their new environment and gaining confidence in its reliability. The focus is on proving its value to the organization and ensuring that the transition does no harm, as IT's first priority must be to ensure the ongoing function of the business. Thus the focus of IT administrators in stage 1 are:

- **Proving virtualization delivers gains worth the investment.** The primary challenge in stage 1 of the adoption of nearly any transformative technology is to prove that the gains that come from the investment don't negatively impact the business. Virtualization is initially viewed as better for the IT department than it is for the rest of the business. Each application will be lifted from its own server, will have to share resources with others, and a new layer of software will be placed beneath the application. On the surface this sounds bad, so IT has to prove that performance and reliability are not impaired. This requires a lot of testing, and repeat testing, to prove that all apps can safely make the transition.

- **Learning how to leverage it.** Some of the key benefits of virtualization, such as consolidation, fast restart, and nondisruptive migration, are must-use capabilities that didn't exist in the physical server world. Administrators must gain proficiency with these tools before they can truly optimize their virtual environment. Fast restart, for example, becomes a low-cost disaster recovery tool. And nondisruptive migration can save multiple applications from a hardware failure.

- **Planning the transition for production.** Once the administrators have gained proficiency with the tools, they are ready to start moving business-critical applications into VMs. A key characteristic of stage 1 companies is that with each new deployment they are making the case for whether *this* workload should be virtualized yet.

Stage 2: Strategic Consolidation

The key characteristic of a stage 2 IT department is seen in how it views new application deployments. While in stage 1, IT is proving that virtualization will deliver benefits, not compromises. The stage 2 company virtualizes by default and pushes back on the business to make a case for why an application should *not* be virtualized. It is during this phase that organizations dramatically expand their virtualization footprint and start to see the significant cost savings of server consolidation. The focus during this stage is on:

- **Delivering consolidation gains.** Stage 2 companies begin to rapidly virtualize their production environment, shifting their mindset from server to VM. They focus on the VM-to-server consolidation ratio and start learning about capacity planning — what's the right number of VMs per server that won't undermine performance.

- **Drastically improving high availability.** Increasingly, organizations of all sizes and industries demand greater levels of availability due to near 24x7 operations, increased competition, and increased customer expectations. Virtualization provides several improvements in availability, starting with application isolation and encapsulation. With centralized storage (SAN or NAS), organizations can dynamically move live workloads from one virtual host to another to avoid planned downtime or performance degradation or can rapidly restart VMs on another virtual host in the event of unplanned downtime.

- **Lowering the cost of advanced disaster recovery.** SMBs have historically relied on tape for disaster recovery, primarily due to reasons of cost and complexity. Virtualization can address both. With virtualization, organizations can replicate from physical machines to VMs at the recovery site or replicate from VM to VM but increase the ratio of VMs to virtual host at the recovery site; this means you spend less on redundant server hardware at the recovery site. It can also drastically improve time to recovery. When VM configuration files are replicated from the production site to the recovery site, it enables a rapid recovery at the recovery site, and it reduces the need to rigorously monitor system configurations between data centers. The system configurations are always in sync because any changes are continuously replicated to the recovery site.

- **Speeding time to market.** IT becomes a hero to the business in stage 2 because new applications can be readily deployed to existing systems. As administrators become more proficient with the environment, they are able to deploy new VMs in minutes and clone known-good configurations to rapidly deploy updates. The only limits are the capacity of the environment and the skills of the administrator.

Stage 3: Taking Efficiency To The Next Level Through Process Improvement

You know a company is beginning to transition from stage 2 to stage 3 when the euphoria of the VM movement turns into the administrative nightmare of VM sprawl. It's one thing to deliver amazingly fast time-to-market for the business. It's another when you have so many VMs that you run out of capacity to deploy new ones and can't determine which VMs to park, reduce in size, or just plain kill. There are also new pains that come from triaging this now rapidly

sprawling environment and trying to standardize configurations and processes, protect it, and maintain it. The focus during this stage shifts to:

- **Determining what's different and how to adapt.** Although most of what administrators have done with physically deployed applications can be maintained in a virtual environment, there things that are different or should be changed. Take backup for example. You can certainly follow your traditional backup procedures with VMs, but if you have 10 VMs on a single server, initiating a backup of all of them at once can bring that server to its knees. The focus in this phase is on identifying the processes that should be changed to drive up efficiency from here.

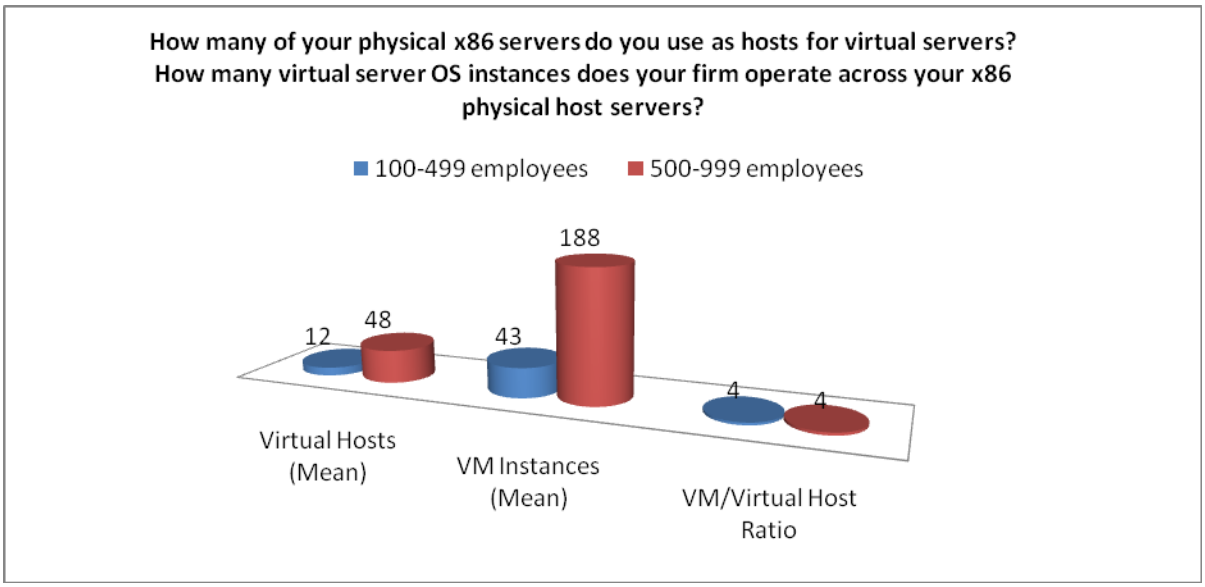
- **Optimizing the infrastructure.** It's only when you have a ton of VMs that you realize how painful it can be when you have to restart a physical server and all its VMs after a crash. It's only then that you realize how difficult it is to maintain your collection of VMs when they are spread across 10 different direct attached storage volumes. These pains become catalysts for changes in the environment to make administration more efficient, such as migrating all VMs to centralized, networked storage and booting them and backing them up from this storage architecture. This is also when the benefits of blade servers, which share a common network backplane, become valuable in managing congestion. Because so many organizations take a piecemeal approach to their environment, most of the organizations we interviewed were on a path to standardization and optimization — standardizing server infrastructure, upgrading to networked storage, and even consolidating the number of vendors in the environment. This more holistic approach helps organizations take advantage of all the capabilities a virtual environment offers as well as all the infrastructure underpinnings to meet the organization's future scalability, performance, and flexibility requirements.

- **Driving up consistency of operations.** During this phase, deviating from standard procedures becomes painful. Not only does inconsistency make it difficult to determine what was done, but it becomes difficult to determine what *to do* to solve problems. VM drift is a common problem — where the version of operating system, application, middleware, and other components shifts with each new VM deployed into the environment. Companies in stage 3 start to enforce the use of VM templates and build consistent processes for tracking and applying updates.

- **Automating routine tasks.** A great way to ensure that new process standards are followed every time is to hand them over to automation tools — especially if they are routine tasks. The use of policy-based administration tools climbs during stage 3 as organizations start to trust the software to take on tasks that can free up an administrator or drive up the efficiency of the overall IT environment.

- **Rightsizing the environment.** Organizations in stage 3 also start to realize that the excitement of virtualizing so many workloads might have yielded an impressive server-to-VM ratio but didn't achieve the infrastructure utilization gains they were hoping for. The typical stage 2 SMBs (including most of those interviewed for this report) have server consolidation ratios of three or four VMs to one physical host, yet server CPU and memory utilization only average 30% to 40% (see Figure 2). This is certainly better than the typical 10% to 20% utilization of nonvirtualized environments but not the big gains sought. In stage 3, raising use, and thus the return on investment for the virtual infrastructure, becomes a big focus.

Figure 2
Virtual Machine To Server Ratios Are Typically Pretty Low



Base: IT decision-makers at 93 small businesses (100-499 employees) and 80 medium-size businesses (500-999 employees) in North America and Europe, Q3 2009

Source: Forrester Consulting

Stage 4: Efficiencies Prepare You To Become An Internal Cloud

With a focus on ratcheting up efficiency comes the need to compare your degree of proficiency with those whom you wish to emulate. And in the world of virtualization, the pinnacle is the infrastructure-as-a-service (IaaS) cloud computing provider.[2] These hosting companies provide their customers with the ability to self-provision into the pool, track the consumption and costs of each deployment, and operate in a nearly fully automated fashion. They also happen to be your biggest competition and potentially the biggest threat to your job. Companies in stage 4 focus on driving up their efficiencies to cloud-like levels, and that means:

- **Automating everything routine.** "If you can standardize a procedure, you can automate it," is the mantra of stage 4 companies. From deploying new applications and applying patches and updates, to managing the placement and movement of VMs to achieve efficiency targets, automation tools can take the place of manual intervention.

- **Enable self-service and leverage life-cycle management.** Companies in stage 4 rabidly enforce the use of VM templates, so administration is simple and predictable. They provide simple portal-based tools so business users can deploy their own applications when needed. They bake life-cycle management into the process by requiring exit dates for short-term workloads and use automation to manage these reservations.

- **Track consumption.** Stage 4 organizations focus on maximizing the use of resources so they can hold off new capital purchases and keep power bills low. To do this, they track the resource consumption of their VMs and use policy-based automation tools to resize VMs according to their actual resource needs, migrate VMs to fewer physical machines when utilization lulls arise, and report back to business owners their consumption of resources so additional capital investments are easy to justify.

DETERMINE WHAT'S NEXT IN YOUR QUEST FOR EFFICIENCY

Forrester's research into the infrastructure and operational practices of virtual environments has found that the key to increasing the efficiency of your virtual environment is optimization of infrastructure, evolution of process, and experimentation. But you won't simply do this because it's right. You'll do it to overcome stages of growing pains as you gain experience managing a virtual environment. So the first step in this process is to determine where you are in your journey today and build a path of improvement that gets you where you want to be as efficiently as possible.

Of the numerous SMBs that Forrester interviewed for this report, most had approximately two years of experience and were in late stage 1 or early stage 2 of virtualization maturity. With two years of experience behind them, most of these firms should be able to move to stage 2 or fully realize the benefits of stage 2. But time is not the only factor, and time doesn't guarantee that your organization will reach a higher stage of maturity. In fact, Forrester has found that some companies with four and five years of experience have not progressed beyond stage 2 or stage 3.

For all organizations to achieve greater levels of efficiency from their virtualization investments, Forrester provides the additional recommendations for each stage:

- **Stage 1 organizations should use test and development environments as your proving grounds.** If your organization's production environment is stage 1, your test and development environment should be a stage ahead. In this noncritical environment (for most companies) you can prove out new processes and tools. When this compute pool operates like a cloud, you will know how to turn production into one.
- **Stage 1 and stage 2 organizations must standardize and optimize the physical infrastructure.** The more standardized and scalable the physical underpinnings, the more predictably it will behave — and the less time and money you will spend on diagnosing problems, dealing with corner cases, and working around these inconsistencies. One necessity: Move all VMs to a networked storage infrastructure such as an iSCSI or FC SAN or NAS. The majority of the SMBs we interviewed for this report did not make significant adjustments to their network as a result of virtualization. This could change as the environment grows. Even SMBs should consider a 10 GbE network down the road.
- **Stage 2 organizations should continue to keep the vendor count low.** Even a standardized infrastructure can be a pain to manage when there are multiple support contracts and too many players that have to be called to determine a root cause and apply the right fix. Many of the companies interviewed for this report stated that they benefited from buying servers and at least storage from the same vendor. In addition, if they had legacy infrastructure from multiple vendors, they planned to consolidate to one or two strategic infrastructure vendors across servers (physical and virtual), storage, and networking as this legacy infrastructure became obsolete. There's a lot of value in having just one throat to choke with support, interoperability, and knowledge transfer.
- **Stage 2 and stage 3 organizations should concentrate less on server consolidation ratio and more on utilization.** Pop quiz: Which is the more efficient environment — one with a VM-to-server ratio of 3 to 1, or one with 20 to 1? The answer is you can't tell because you don't know whether these are low or high consumption applications. Twenty print servers might only consume 10% of a server's resources, whereas three transaction-heavy applications might consume 90%. Focus on how well you are consuming the capital you have, not how many applications are on the average server.
- **Stage 3 organizations should prepare to automate.** Wherever you are in your maturity, chances are you still aren't as efficient as you could be, and a likely culprit is the degree of consistency of your operations. Document how you perform each routine task, and start locking these processes into automated workflows to ensure they are followed every time. When a problem arises in your environment, it will be that much easier to determine what went wrong.

Appendix A: Methodology

In this study, Forrester interviewed 15 small and medium-size businesses (companies with fewer than 1,000 employees but more than 100) in North America, Europe, and Asia Pacific to evaluate the benefits of a virtualized environment and the impact virtualization had on server, storage, and networking selection. Survey participants included decision-makers in IT infrastructure and operations, including IT directors and managers. Questions provided to the participants asked about their current virtual server deployments, storage deployments, network deployments, the organizational impact of virtualization, and the quantitative and qualitative benefits of virtualization. Respondents were offered a copy of three Forrester syndicated reports and an executive summary of the results as a thank-you for time spent on the survey. The study began in November 2009 and was completed in December 2009.

Appendix B: Endnotes

[1] Businesses interviewed for this research reported having between 100 and 999 employees.

[2] *TechRadar™ For Infrastructure & Operations Professionals: Cloud Computing, Q3 2009*, Forrester Research Inc., October 2, 2009.