

The Business Value Of Virtualization

A commissioned study conducted by Forrester Consulting on behalf of VMware

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Executive Summary

In May 2009, VMware commissioned Forrester Consulting to evaluate the business value of x86 server virtualization. In particular, Forrester interviewed individuals responsible for the IT infrastructure architecture, including VP and C-level individuals, at 29 large enterprises about why their company invested in virtualization and the specific ways it has improved IT efficiency or flexibility. In particular, we asked executives to rate the benefits received from consolidating servers, performing business continuity/disaster recovery, reclaiming data center capacity, and executing similar initiatives.

Key Findings

Based on our executive interviews, Forrester found that server virtualization technologies have delivered benefits that executives could clearly explain. Overall, Forrester found that:

- **IT becomes more efficient.** Beyond just hardware savings from consolidation, virtualization optimizes infrastructure costs and increases operational efficiency. Plus, firms were able to reclaim capacity (space, power, and cooling) in their data centers, postponing costly expansion plans.
- **Time-to-market is faster.** Virtualization speeds server and application deployment, makes configurations more consistent, and simplifies the staging of applications across test and development.
- **IT services are more predictable.** There will always be failures and downtime, but virtualization makes recovery from these faster, easier, and lower cost.
- **Companies leave savings on the table.** Overall, our study respondents virtualized between 10% and 30% of their physical servers and are happy with the results. Despite having achieved rapid return on investment through hardware savings, firms appear to slow down after their initial successes, with many planning to virtualize just 50% of their systems. Upfront planning can result in increased long-term savings.

Today's Dilemma: IT Inefficiency Reigns Supreme

Most companies dedicate the majority of their IT budgets to what Forrester calls MOOSE spending: maintenance and ongoing operations of systems and equipment. Forrester includes the following kinds of IT spending in its definition of MOOSE:

1. Depreciation of previously purchased computers and network equipment and for software licenses or development costs if these are treated as capital investments.
2. Maintenance fees for purchased software.
3. Salaries and benefits for IT staff who maintain and operate existing IT systems, but not staff dedicated to managing new projects.
4. Existing outsourcing agreements.
5. Ongoing IT consulting and integration payments for IT projects carried over from the prior year.
6. CIO and core IT senior staff, as well as security, enterprise architecture, vendor management positions that would continue even if there were no new projects.
7. Any other expenses that would be ongoing even if there were no new IT projects.

On average, the cost of MOOSE consumes about 65% to 70% of firms' IT budgets, leaving just 30% to 35% for new investments.¹ By controlling MOOSE spending, you can significantly reduce your overall IT budget or free up funds for more innovative uses, such as supporting new business initiatives or projects. But it's not so simple, since inefficient and inflexible technologies leave you few opportunities to remove cost from the system — everything seems to be inextricably linked to some "must-have" service. To make progress, there are three key culprits that you must address:

- **Bad utilization.** Most firms struggle to consolidate systems. You can't seem to find any servers to pull the plug on, and yet overall utilization hangs around 10%.
- **Massive cost of management.** Every new application you bring in the door demands a unique system configuration, and you now have hundreds of slightly different variants.
- **Inflexible application design.** If only all your applications were built with the latest componentized technologies and had fault-tolerance designed into them. Instead, most applications are difficult to scale up and down and don't have resiliency built in.

Bad Utilization

Although x86 systems made scale-out computing cheap and ubiquitous, they have a serious side effect — very low system utilization. The average utilization of an x86 server is generally around 10% to 15% of its capacity, although it may occasionally spike up to its maximum. We got to this point slowly, since on an individual basis, no one cried over wasted capacity on a cheap server, and there was little you could do about it anyway. But now that most of your business runs on these commodity servers, the wasted capacity is really starting to pile up. There are several underlying causes for this wasted capacity:

- **Almost every application gets its own server.** Typically, IT dedicates a server to every application because it simplifies management by eliminating the chance that applications running on the same machine could compete for resources, causing users to experience poor performance. It also makes configuration and patching easier, since many applications require slightly different — and incompatible — system settings and patches.

- **IT selects server hardware based on peak load.** If an application requires the performance of a \$20,000 server for one week out of the month, that's what it gets — even if it could get by with a tenth of that performance on any other day. That's because there's no easy way to move workloads around your x86-based infrastructure. Mainframes and high-end Unix systems have done this for years but come at a significant price premium.
- **Storage is not immune from waste.** Direct-attached storage is largely wasted in most data centers. Each server has some number of disks dedicated to it that are not shared with other systems. This leaves storage capacity stranded across all the servers in your environment. Networked storage systems run at much higher utilization since storage is provisioned from a centralized pool. Even so, there is still wasted capacity as the result of duplicated data and storage volumes that are over-provisioned. This is common practice, since storage administrators need to leave room for data growth so that volumes don't have to be taken offline and enlarged every time they reach capacity.

Massive Cost Of Management

The cost of managing IT is extremely high for most enterprise IT organizations. Many enterprises run on a large scale yet — unlike large Internet companies such as Google or Amazon — must dedicate many more administrators to running their systems.

A major difference between enterprise IT and that of service providers is the number of system variants. Most enterprise IT shops try to standardize on as few hardware platforms, operating systems, and configurations as possible. But even with standards in place, many waivers must be given to applications that can't run or be supported on one of your standard setups. Each one of these setups must be individually configured, tested, and repeatedly patched and upgraded throughout its lifetime. In addition to the added administrative overhead, this makes large-scale automation difficult, since there is significant overhead involved in automating each new variant. You wouldn't set up a factory to build 10,000 completely unique cars, and it's the same with automating IT. A more standardized environment can be effectively automated, whereas a highly customized environment requires more manual labor.

Many Applications Aren't Designed For Flexibility

Most enterprises have very diverse application environments consisting of off-the-shelf applications in addition to homegrown software spanning many years of different development tools and methodologies. New service-oriented applications can be more resilient and easier to scale, but most commercial and custom-built software isn't built this way. As a result, many of your apps:

- **Lack resiliency.** Since most applications do not have built-in ability to tolerate failures, critical systems require add-on products to protect them. High-end products like clustering and replication can provide excellent availability, but they require additional standby systems that perform no useful work under normal conditions.
- **Can't easily scale up and down.** Today IT can't adapt to changing business conditions quickly, since server, storage, and network infrastructure is inextricably intertwined with our applications. You can't simply sell off 30% of your servers to reduce costs, and likewise, scaling up requires you to purchase yet another dedicated server.

Key Capabilities Provide Far-Reaching Benefits

Virtualization frees IT from the shackles of the complex environment we've created in many important ways. Before getting into greater detail, though, first there are a few fundamental reasons that allow virtualization to deliver better economics and improved IT flexibility:

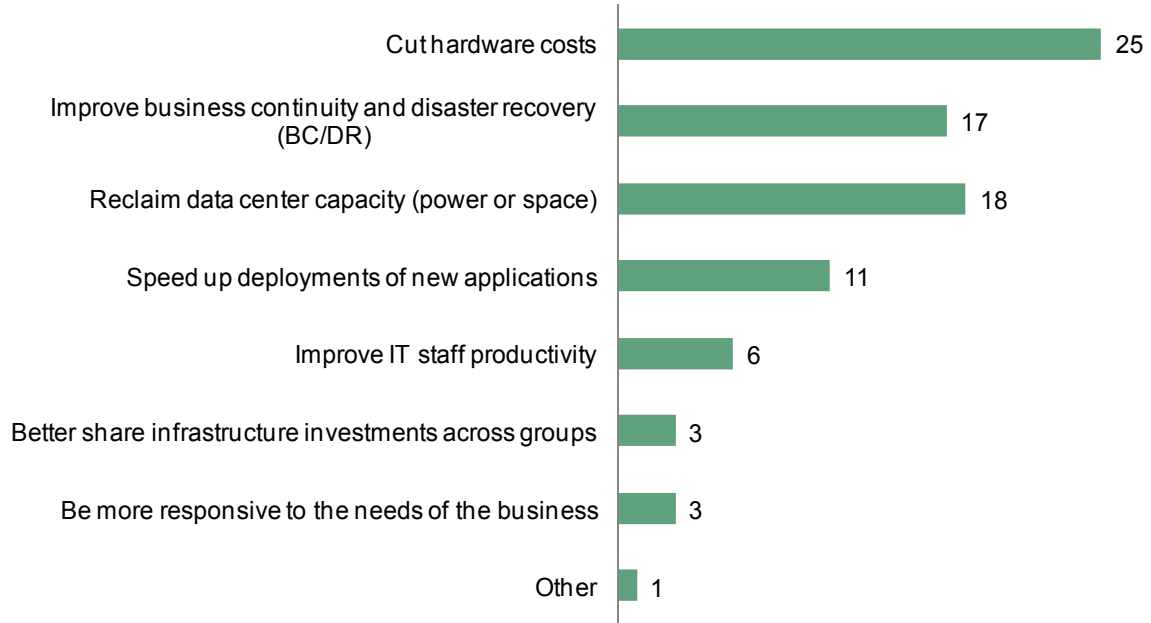
1. Virtualization permits a single physical server to run multiple server instances in isolation from each other as "virtual machines" (VMs).
2. Automated management tools can allocate any amount of a physical server's capacity to a VM, allowing it to scale up and down as necessary while sharing that server with other VMs.
3. The entire operating system and application environment is stored on a virtual disk, which can be easily duplicated to create new VMs.
4. VMs are highly portable, allowing IT to quickly migrate them between physical machines to allow maintenance on the physical hardware or balance workloads across your entire infrastructure. In addition, if a physical server fails, its VMs can be quickly restarted on another system.

Virtualization Frees IT To Do More

When making the business case for server virtualization, most firms interviewed by Forrester preferred total cost of ownership or short-term return on investment (<12 months) as their primary decision-making tools (see Figure 1 and Figure 2). The majority of the interviewees we spoke with said that they recouped their investment in virtualization within one year, with some companies breaking even within a few months. While most companies built their business case on a foundation of cost savings, better business continuity/disaster recovery and faster time-to-market for new applications were top motivators as well.

Figure 1: Cost Reduction Remains The Key Driver

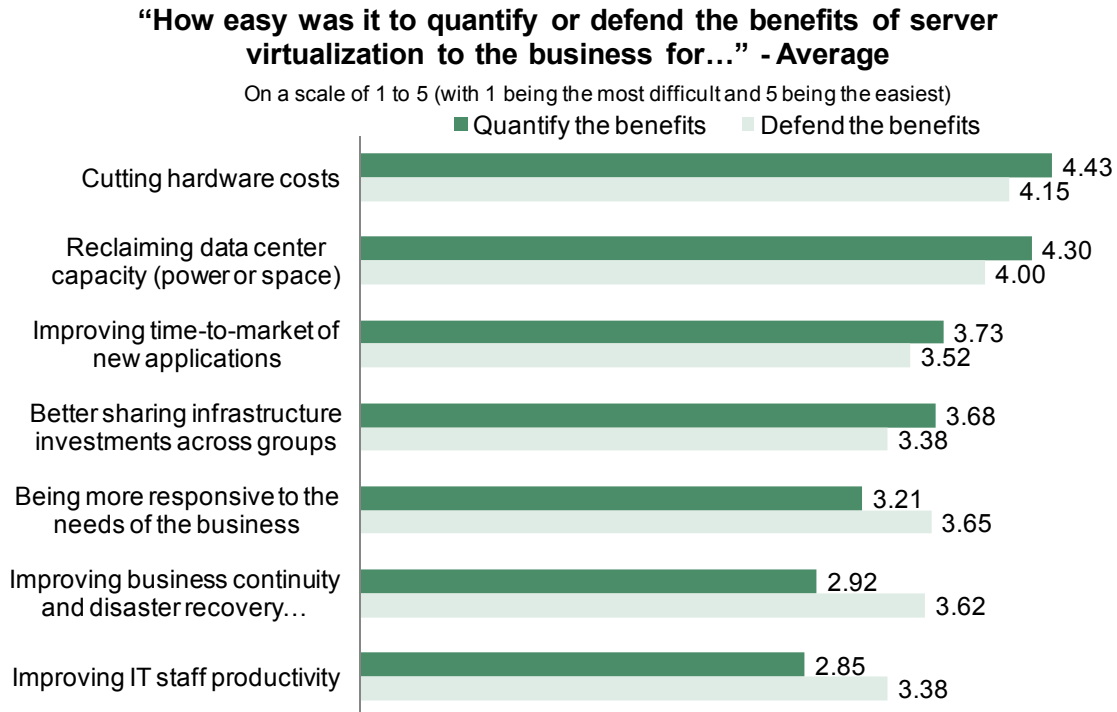
"What were the business reasons you invested in server virtualization?" (select all that apply)



Base: 29 respondents responsible for IT infrastructure architecture
(multiple responses accepted)

Source: A commissioned study conducted by Forrester Consulting on behalf of VMware, July 2009

Figure 2: Cost Categories Are Easiest To Measure And Defend



Base: 29 respondents responsible for IT infrastructure architecture

Source: A commissioned study conducted by Forrester Consulting on behalf of VMware, July 2009

Cost Savings

The desire to reduce costs is the top reason most firms begin virtualizing servers. In fact, 25 out of the 29 enterprises Forrester interviewed said that cutting costs was among the business reasons they had invested in virtualization. Although the firms we interviewed named a variety of other benefits, savings on infrastructure are the easiest to measure and offer quick return on investment. In addition, interviewees said that savings on server costs and reclaiming data center capacity were the easiest to quantify and defend.

“[The CFO] didn’t understand what virtualization was, so there was education first. Once that was achieved, it was easier. We laid out what it meant in terms they could understand; in a way that would resonate with the business. Then we could get down to how many physical servers we’d be replacing, energy saved, and our projection of consolidation ratio. We exceeded the original ratio.”

— US telecommunications provider with \$2 billion plus in revenues

“The theory was that we needed a new data center under construction by December, or we’d be out of space. Removed 300 [servers] in three months — pushing out the date by 12 months. There was \$2 million for construction in the budget that we’re not spending.”

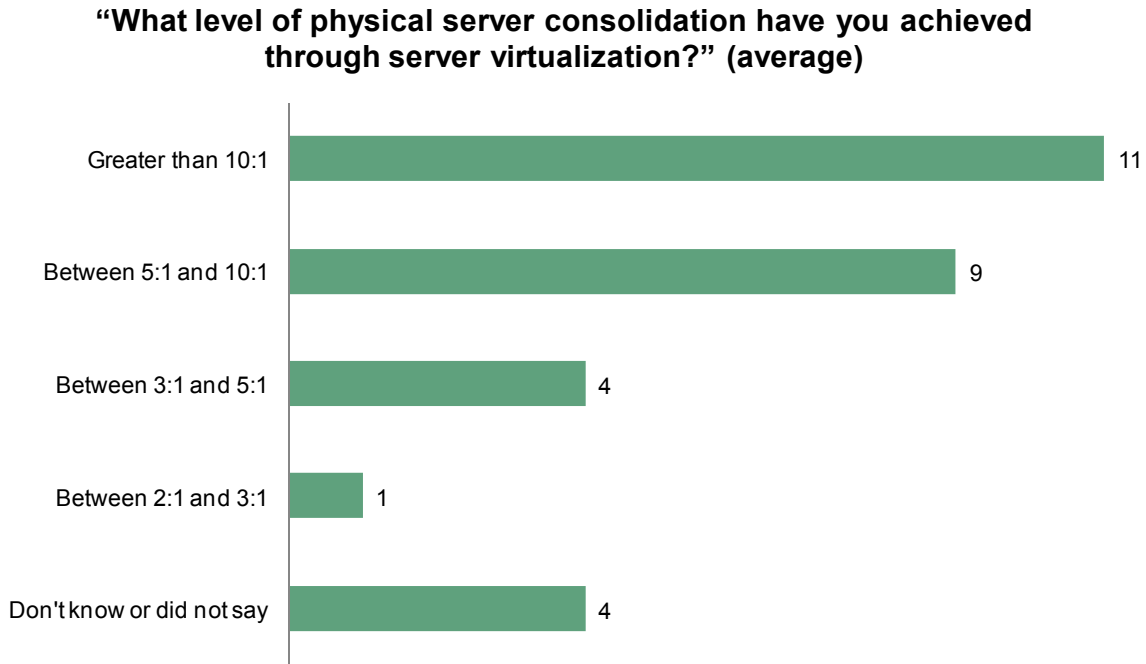
— US interactive content provider with \$1 billion plus in revenues

How Virtualization Delivers Cost Savings

The most obvious benefit of virtualization is reduced server infrastructure costs. Of the firms we spoke with, 11 had consolidated more than 10:1, with nine others achieving between 5:1 and 10:1 consolidation ratios (see Figure 3). The virtualization of physical servers also provides other cost savings as a result of:

- **Increased administrator productivity.** Applications running in VMs have ready access to additional processing resources when spikes occur, and can be automatically restarted on new hardware if a failure occurs. The net result is fewer emergencies that send administrators on wild goose chases looking for that elusive performance problem. In addition, VMs are very easy to build and launch from templates, reducing the amount of administrator time it takes to build or upgrade a server from days to under an hour.
- **Reclaimed network ports.** Most servers use at least two high-speed Ethernet ports, as well as two Fibre Channel SAN ports. Like the servers themselves, these ports can be underutilized. The VMs on your virtualization hosts will share a smaller number of network ports, allowing you to reuse thousands of dollars worth of network connectivity for every physical server you unplug.
- **Reclaimed data center capacity.** By consolidating servers, you will clearly be able to reclaim space in your data center. You'll also reduce your electrical bill – perhaps more than you thought. Every watt used to run a server gets turned into heat that must be removed from the data center at about the same cost – so a server using 400 watts is effectively using 800 watts. According to Forrester's interviews with data center engineering and construction firms, every 1,000 watts (1 kilowatt) of IT load you support will cost roughly \$12,000 to provide today, in addition to the cost of the building itself. At that rate, a single low-density rack might consume 4 kilowatts – or \$48,000 worth of infrastructure.

Figure 3: Consolidation Density Is Ratcheting Up



Base: 29 respondents responsible for IT infrastructure architecture

Source: A commissioned study conducted by Forrester Consulting on behalf of VMware, July 2009

Better Business Continuity And Disaster Recovery

Beyond direct cost savings, the firms we interviewed also rated better business continuity and disaster recovery (BC/DR) as a top reason for investing in server virtualization. Many of the firms we spoke with struggled with quantifying the value of better BC/DR, putting it among the hardest benefits to measure. This is not surprising, since any BC/DR investment is essentially an insurance policy against an improbable but very disruptive event. Knowing how much to spend in order to mitigate such an unlikely event is difficult, especially if you don't know your cost of downtime. However, given the seriousness of such a disruption, our interviewees found it significantly easier to defend better BC/DR, even if they could not quantify it as accurately as server consolidation.

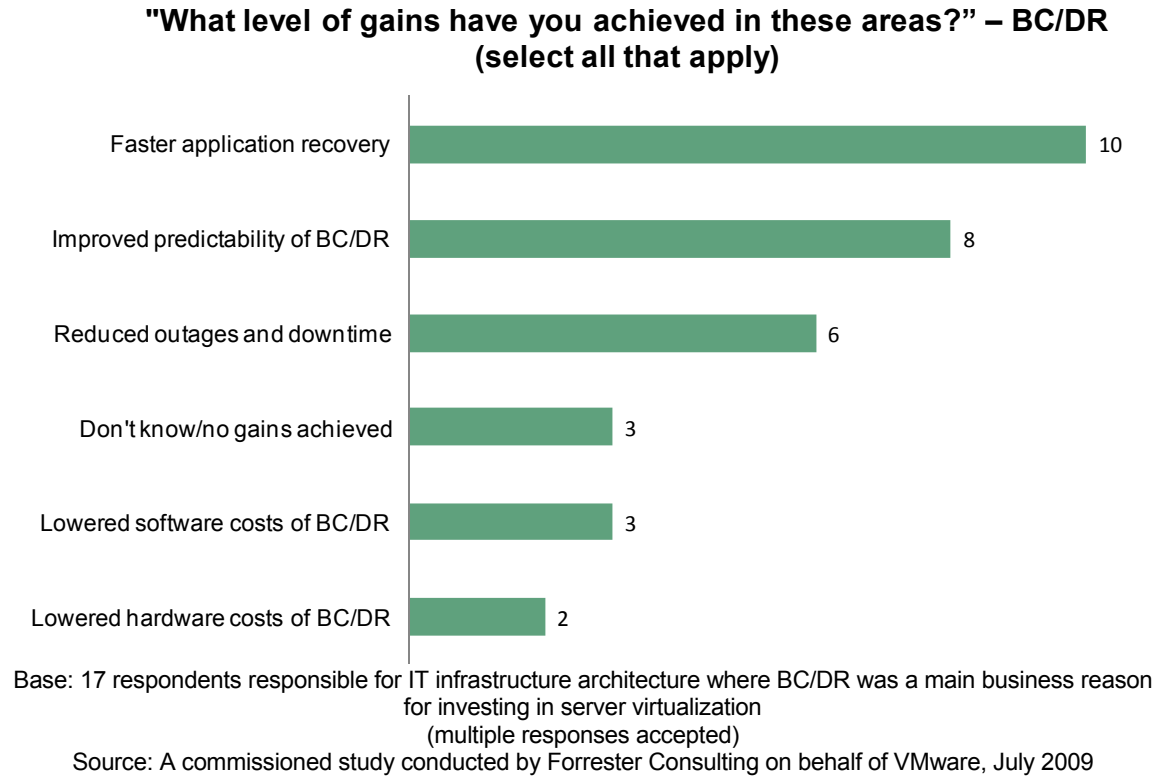
How Virtualization Delivers Better BC/DR

Of the 17 interviewees who had invested in virtualization for better BC/DR, most believed they achieved faster application recovery or improved predictability (see Figure 4). By virtualizing servers, companies found:

- **Improved service levels for more systems.** Your most critical applications are protected by expensive BC/DR solutions that work quite well, but the majority of your systems have little more than tape backup. Virtualization provides a much better level of service by allowing failed systems to automatically restart on new systems.
- **Virtual machines can run almost anywhere.** Because of their portability, VMs can be easily copied to another location for DR purposes. Unlike backups or snapshots that won't reliably run on dissimilar systems, VMs can be started on any server that has your virtualization software running on it.

- **Virtual infrastructure can protect physical systems, too.** Many IT organizations are using virtual infrastructure as a backup to their physical servers. By converting backup images of their primary systems into VMs, these firms have the option of restarting their applications on virtual infrastructure.

Figure 4: Fast Restart Is Equal To BC/DR value



Faster Time-To-Market For New Applications

Server virtualization helps IT respond to internal customer requests for resources much faster than physical servers. Whereas internal customers don't always see that the environment costs less or is easier to manage, faster time-to-market is a vast improvement that is outwardly visible. As a result, our interviewees found it easier to quantify and defend their investments in virtualization based on this improved turnaround time.

How Virtualization Delivers Faster Time-To-Market For New Applications

In our executive interviews, 11 of the firms told Forrester that speed of application deployments was a major reason for their investment in server virtualization. In every case, those 11 interviewees can now deploy servers in fewer than six days, with many in 24 hours or less (see Figure 5). Compared with three to five weeks in most physical server environments, virtualization is faster because:

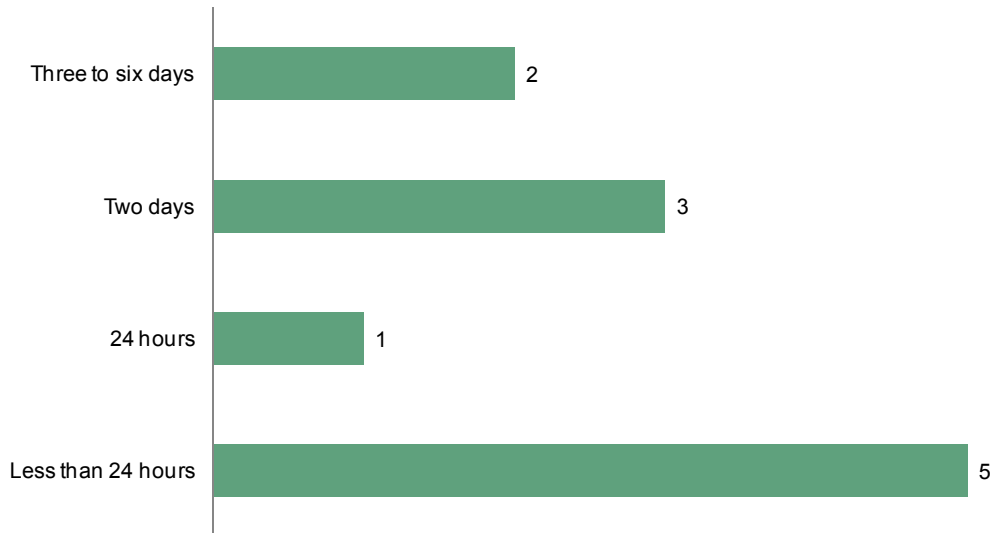
- **Many steps are eliminated from the build process.** Ordinarily, building a physical server takes a number of steps that begin with procuring a server, putting the system in a rack, and connecting it to various networks such as your data center Ethernet and Fibre Channel SAN. This requires multiple technicians and administrators to touch the system, and it's a major reason as to why the process takes weeks to complete. In a virtualized data center,

the procurement, physical racking, and networking steps all happen in software and take place in a matter of minutes.

- **Applications live in a library of templates.** Many IT shops do not have automated provisioning tools that allow them to build a server from a stored configuration. This requires administrators to load applications from DVDs or networked images and configure them by hand by running a variety of scripts. In addition to being time-consuming, the process can be error-prone and lead to systems that are not consistently built. In contrast, virtual machines are built from templates that store your production server configurations. These templates are applied in a sequence that layers on operating systems, management agents, and finally application images.
- **Apps move rapidly from test to production.** Once an application is successfully tested, administrators must somehow transport the final tested configuration into your production environment. In many cases, this means applying a list of changes from the test environment or building a new system from scratch. In the case of virtual servers, the same VM that passed through quality assurance can be simply copied into the production environment and started right up.

Figure 5: Time-To-Deploy Is A Big Benefit

“What level of gains have you achieved in these areas?” – speed of deployment of new applications



Base: 11 respondents that chose speed of deployments of new applications as a main business reason for investing in server virtualization

Source: A commissioned study conducted by Forrester Consulting on behalf of VMware, July 2009

Study Conclusions

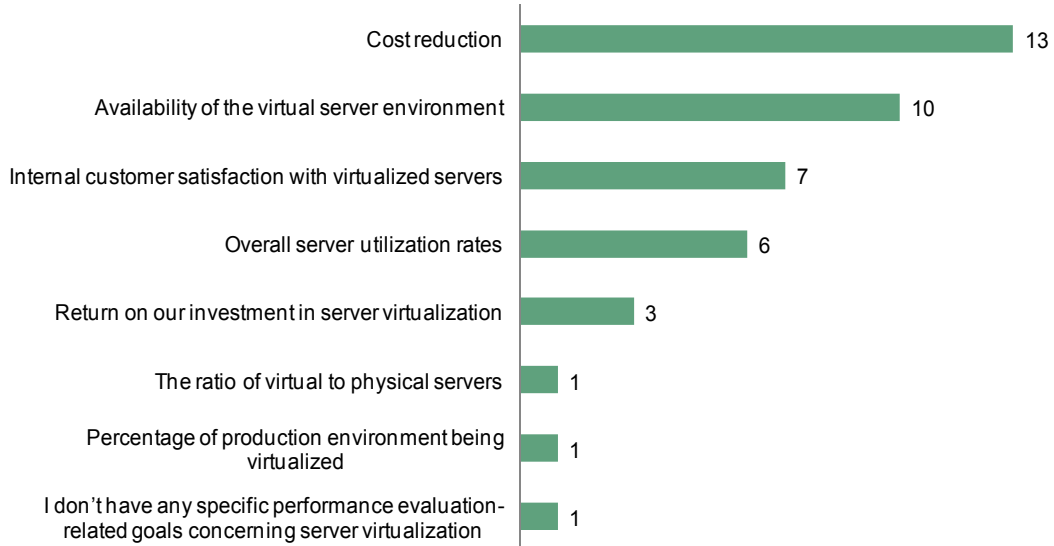
The 29 firms interviewed by Forrester have already virtualized between 10% and 30% of their x86 systems today and realized rapid return on their investment — most in less than 12 months. The surprising thing is that so many firms seem to rapidly virtualize their infrastructure, but only up to a point before slowing down. Just about every firm we spoke with was happy with its production use of server virtualization — only two said that they were dissatisfied. Furthermore, as a result of their

successes, our interviewees will continue expanding their virtual infrastructure, planning to achieve an average of 50% of their servers virtualized one year from now. The question is that in spite of these gains, why do many firms slow down their progress and target just half of their servers? Sure, a handful of those applications may not be supported on virtual infrastructure, but not many. A common excuse is fear of negative performance impact — though virtualization has matured to the point of having a negligible effect on performance. We believe that many of our interviewees are held back by outdated thinking that restricts virtualization to less-critical applications where performance is less of an issue. They are also hampered by organization structure issues that inhibit the use of virtualization and outdated processes that must be evolved. As a result, many companies find the barriers to get from 10% to 30% to 80% to 100% difficult to overcome, and they wind up leaving money on the table. To get the maximum value out of virtualization, you can establish a plan that overcomes these barriers by focusing on:

- **Making IT more efficient, both today and in the future.** Although you'll build your business case on hardware cost savings and reclaimed data center and network infrastructure in the short term, don't ignore long-term operational savings from streamlined management processes. To wring the maximum cost out of your operational costs, you'll have to re-evaluate the tools and processes you use to run your environment today — decide which of them can be streamlined after servers are virtualized.
- **Break down barriers to rapid deployment.** Once you have the ability to get applications live within a day, look for additional improvements. For example, consider self-service portals that developers can use to create virtual machines for test or pilot purposes. Most companies that enable this type of self-service also implement a credit system or "expiration dates" to prevent excessive numbers of virtual machines.
- **Roll out BC/DR services to all your apps.** Only a precious few of your applications receive complete protection today. Using virtual servers, you can offer basic restart capabilities on new hardware to all of your customers at no additional cost. Consider creating a menu of chargeable BC/DR services that will include higher-end options such as storage replication, server clustering, or off-site recovery.
- **Build virtualization-related metrics into staff evaluations.** Every interviewee but one was evaluated on some element of his or her organization's virtualization effort. Many were evaluated according to the cost reduction generated by their virtual environment, as well as the availability of the virtual servers and customer satisfaction with them (see Figure 6).
- **Track financial performance of virtual infrastructure.** Surprisingly, a significant number of our interviewees don't measure the financial performance of their virtual servers. As the size of your shared virtual environment grows, this will be your primary means of preventing over-provisioning of resources in the future. Of the 19 interviewees who did track the performance of their virtual servers, tracking the utilization and virtual-to-physical consolidation ratio were the most popular measures (see Figure 7).

Figure 6: Cost Reduction Is Key

“What are the top three criteria your manager uses to evaluate your job performance concerning virtualized systems?”

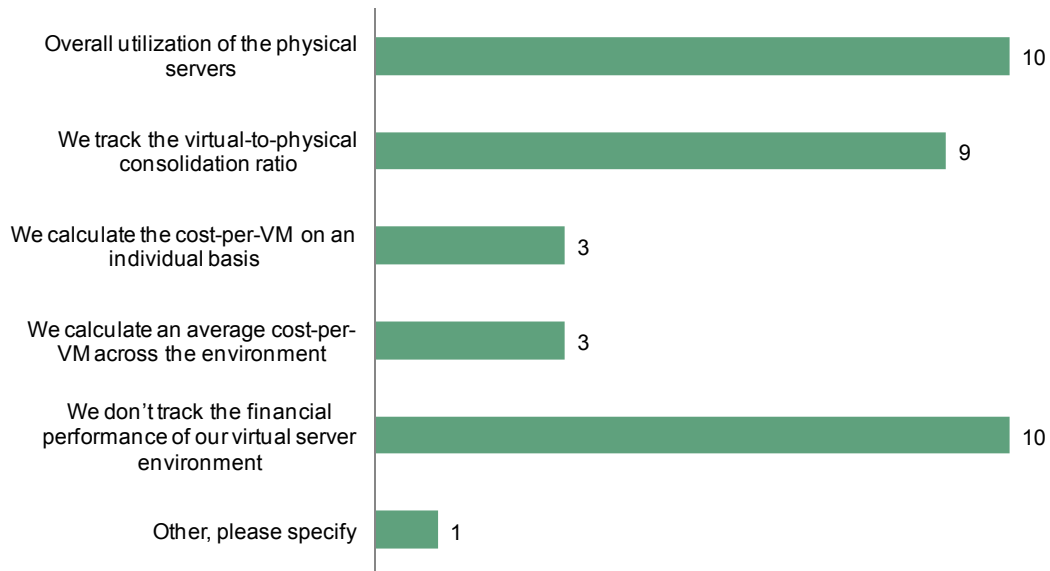


Base: 29 respondents responsible for IT infrastructure architecture
(multiple responses accepted)

Source: A commissioned study conducted by Forrester Consulting on behalf of VMware, July 2009

Figure 7: Consolidation Gains Are The Key Measures

"How do you measure the financial performance of your virtual server environment?" (select all that apply)



Base: 29 respondents responsible for IT infrastructure architecture

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(multiple responses accepted)

Source: A commissioned study conducted by Forrester Consulting on behalf of VMware, July 2009

Appendix A: Methodology

In this study, Forrester interviewed 29 VP and C-level executives with knowledge of their organization's virtualization efforts to better how virtualization has helped them make IT more efficient. Interviewees were from enterprises with revenues of \$500 million or more, located in North America, EMEA, and Asia Pacific. Questions provided to the participants asked about their motivations for virtualizing and the benefits of server virtualization such as reduced cost, better disaster recovery/availability, greener IT, and time-to-market for new applications. The study began in May 2009 and was completed in June 2009.

Appendix B: Endnotes

¹ For more information see, "US IT Spending Benchmarks For 2008", Forrester Research, Inc., December 23, 2008



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