IT Audit
Report

EMC IT: Leading the Transformation

EMC's IT Transformation Blueprint

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ESG Lab Reports

The goal of ESG Lab reports is to educate IT professionals about data center technology products for companies of all types and sizes. ESG Lab reports are not meant to replace the evaluation process that should be conducted before making purchasing decisions, but rather to provide insight into these emerging technologies. Our objective is to go over some of the more valuable feature/functions of products, show how they can be used to solve real customer problems and identify any areas needing improvement. ESG Lab's expert third-party perspective is based on our own hands-on testing as well as on interviews with customers who use these products in production environments. This ESG Lab IT Audit report was sponsored by EMC.
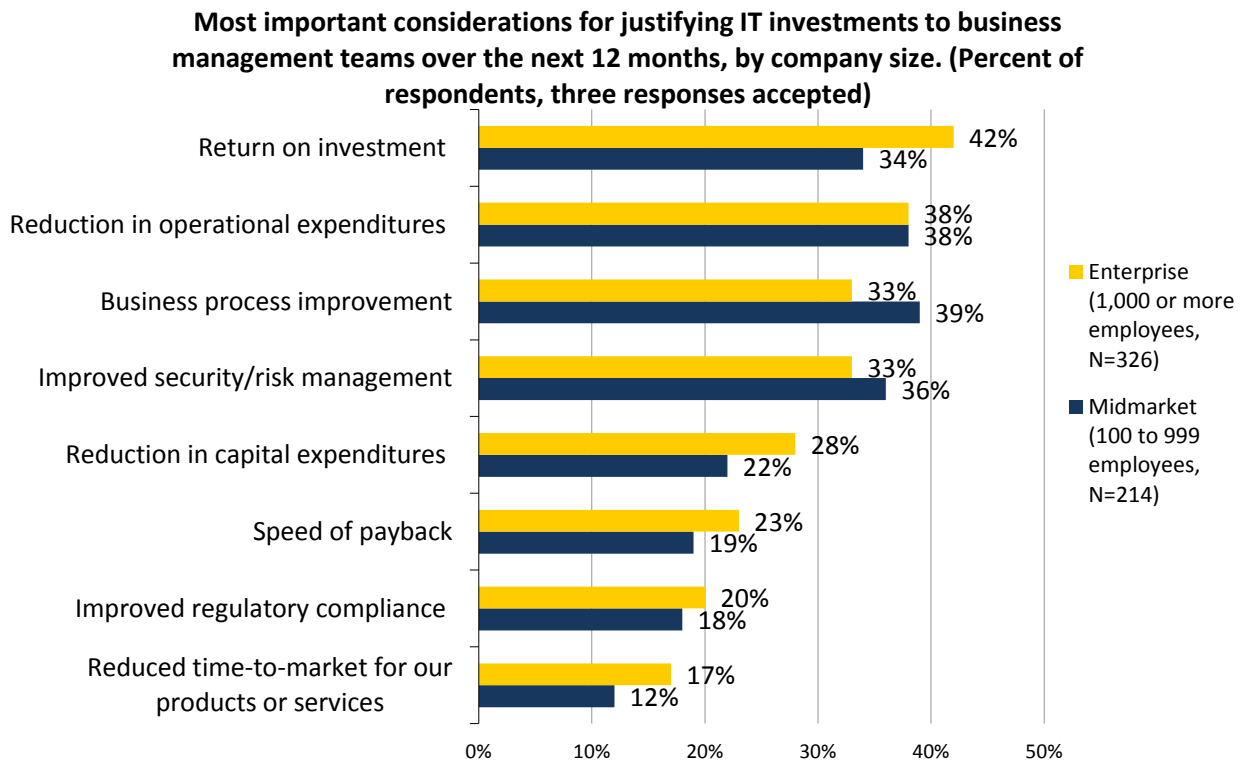
Reaping the Benefits of Cloud Computing

EMC Corporation's IT organization launched a transformational journey toward cloud computing beginning in 2004. In 2009, ESG published an initial audit of EMC's achievements, documenting their impressive initial savings on equipment and power as well as improvements in productivity, efficiency, and resource utilization. We published an update in 2010 as EMC reached important milestones in its server virtualization, tiering, and automation efforts.

This 2013 update finds EMC leveraging the firm foundation of efficiency they have built; a key focus is on new levels of agility and productivity that EMC can achieve through a new cloud operating model for offering IT-as-a-Service (ITaaS). By sharing its experience through its EMC IT Proven program and a series of IT Audits, EMC offers a valuable service to other organizations that may have a vision for such a transformation but are struggling with what steps to take and what results to expect.

Background

After enduring several years of global economic uncertainty, organizations large and small are beginning to increase IT spending. The pressures, although by no means gone, have begun to recede. ESG research indicates that for both enterprise and midmarket organizations, just reducing costs—while still important—is no longer the top priority.[1] As Figure 1 shows, for enterprises return on investment (ROI) has moved to the top of the list, followed by OPEX reduction, business process improvement, and better security. This move for ROI indicates that enterprises are taking a longer-term view of IT spending decisions, no longer focused solely on cost reduction tactics designed for a particular point in time. The increased attention for the midmarket is on generating revenue and savings by improving processes, a strategy for the future that can be woven into the fabric of the company.

Figure 1. Most Important Considerations for Justifying 2013 IT Investment, by Company Size

Most important considerations for justifying IT investments to business management teams over the next 12 months, by company size. (Percent of respondents, three responses accepted)

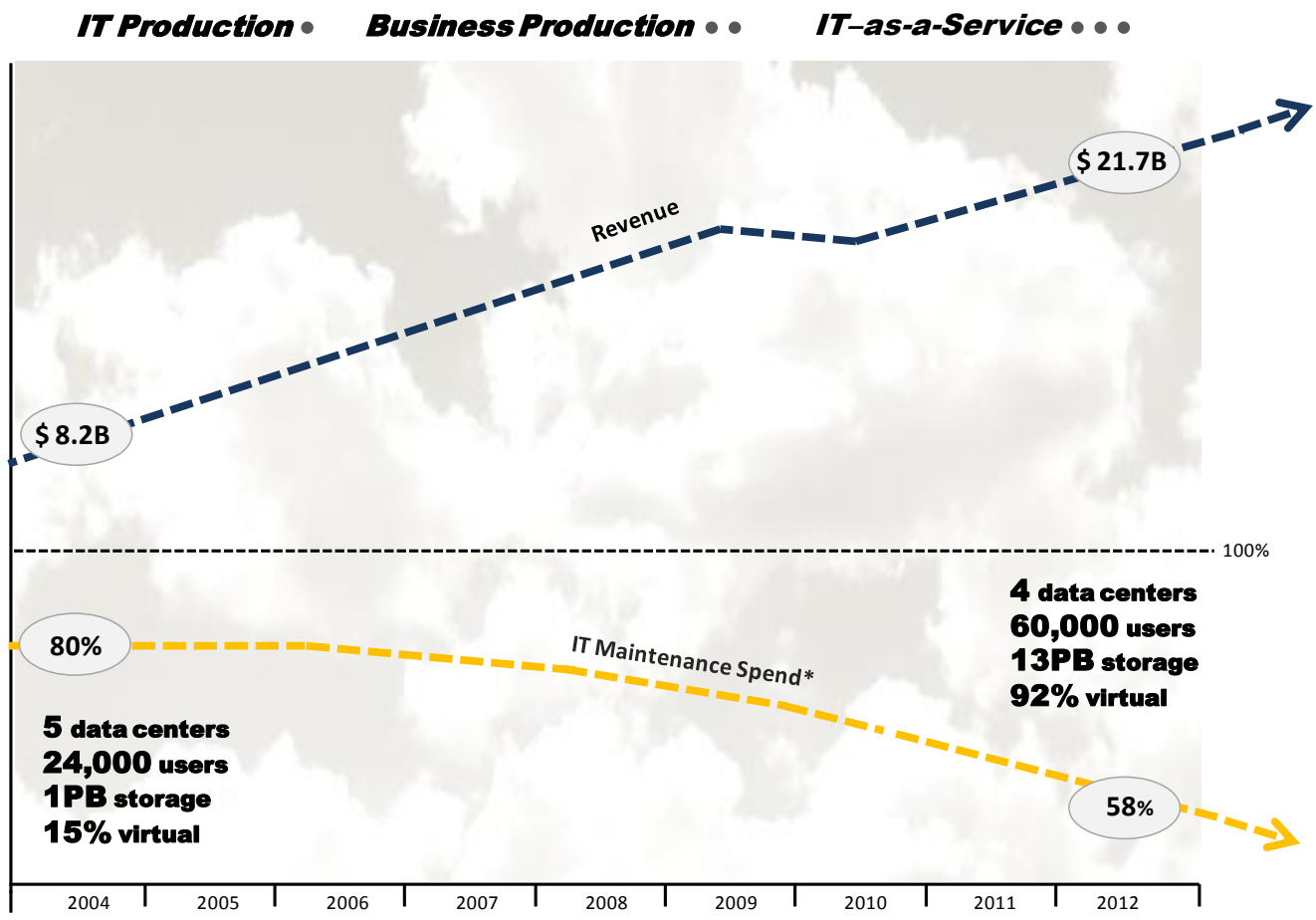| Consideration	Enterprise (1,000 or more employees, N=326)	Midmarket (100 to 999 employees, N=214)
Return on investment	42%	34%
Reduction in operational expenditures	38%	38%
Business process improvement	33%	39%
Improved security/risk management	33%	36%
Reduction in capital expenditures	28%	22%
Speed of payback	23%	19%
Improved regulatory compliance	20%	18%
Reduced time-to-market for our products or services	17%	12%

Source: Enterprise Strategy Group, 2013

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[1] Source: ESG Research Report, *2013 IT Spending Intentions Survey*, January 2013.

Overview of EMC's Operational Achievements

Figure 2 provides a high-level overview of what EMC has achieved operationally in the context of corporate growth. As you can see, between 2004 and 2012, EMC grew substantially. In addition to an increase in the number of users IT supports, EMC revenue grew from $8.2 billion to $21.7 billion, and total information managed grew from 1PB in five data centers to 13PB in four data centers. These achievements required smart investments in IT. However, all IT investments are not equal. Money must be spent "keeping the lights on" to ensure that the IT engine runs and employees can do their jobs. However, the more money it takes to simply maintain current applications and infrastructure, the less there is for innovation, new capabilities, and initiatives. For EMC, IT maintenance spending has dropped from 80% to 58%, enabling an increase in innovation spending from 20% to 42%. At the same time, revenue has increased—the result is that EMC has been able to reclaim significant financial resources to invest in new projects. The deployment of a private cloud infrastructure that includes 92% virtual servers has been a primary driver of these results.

Figure 2. EMC Revenue vs. IT Maintenance Spending

IT Production ●   **Business Production** ● ●   **IT−as-a-Service** ● ● ●

Revenue

$ 21.7B

$ 8.2B

100%

IT Maintenance Spend*

80%

4 data centers
60,000 users
13PB storage
92% virtual

5 data centers
24,000 users
1PB storage
15% virtual

58%

2004   2005   2006   2007   2008   2009   2010   2011   2012

*Percentage of IT Spend on Lights-on vs. New Capabilities

While these numbers fit EMC, a large, successful IT infrastructure and services company, the relationship between revenue and IT maintenance spending can reveal opportunities for any organization. This chart simply proves that such an effort can pay off in a big way. The savings generated can be reinvested, and those savings increase if you are making changes and growing revenue at the same time. But not every organization grows continually. In fact, the business impact of efficiency improvements may be even greater for those organizations with flat or declining

revenues—efficiency and virtualization efforts could provide the cushion they need to navigate successfully through a difficult business climate. The point to take from this graphic is that consolidation, virtualization, and automation efforts can deliver savings that can be invested in the business in whatever way is meaningful for your organization.

Three Phases of EMC's Cloud Journey

EMC's journey over time tells an impressive story. In 2004, the company launched an initiative to improve IT efficiency and business agility while improving security and enhancing choice of IT services for the business. Over the past eight years, the company has transformed IT. The journey has been exciting and educational, and provides a guideline for any company, large or small, that is interested in achieving similar objectives.

Phase 1: IT Production (2004 through 2008). The primary focus of this phase was on consolidating the IT infrastructure and virtualizing servers for Test/Dev and IT-owned applications. At the start, the environment was serving 24,000 internal users and IT consisted of five data centers with 168 separate, purpose-built infrastructure stacks, including 1PB of storage and 2,000 physical servers. The company was running almost 400 applications and tools, with management and security solutions bolted on after the infrastructure was set up. Windows was the only end-user platform offered. Some of the chronic operational challenges were:

- Long time to provision IT infrastructure—greater than three months
- Low (30%) storage capacity utilization, with more than 60% annual storage growth
- Under 10% CPU utilization, with more than 20% annual server growth
- Insufficient data center space and power
- IT staff overwhelmed by demand

These challenges are not unique to EMC, or even to large companies or companies in a given sector. Poor utilization rates, long provisioning times, limits on floor space and energy, and stretched IT staff are common among IT organizations of every size around the globe.

A key decision was made early in the journey to standardize on x86 architecture, and server virtualization was introduced. The company also transitioned to disk-based backup. Several key programs were implemented to continually increase the virtual to physical server ratio. The consolidation, virtualization, and storage tiering efforts provided IT with experience and exposure to the technologies that would be the engine of transformation.

Phase 2: Business Production (2009 through 2010). This phase was focused on virtualizing mission-critical applications such as MS Exchange, Active Directory, Oracle 11i E-Business Suite, business intelligence/enterprise reporting, and many more, and by the end of that phase, EMC had virtualized 70% of its servers. Legacy infrastructure stacks were eliminated and replaced with tiered, shared VMware clusters with integrated management and security, and the islands of virtualization began to converge into a cohesive, strategic platform. In addition, EMC instituted deduplicated backups using Avamar and Data Domain solutions.

Between 2004 and 2010, other important improvements were made. For example, EMC improved optimization through SAN storage virtualization, standardized on VCE VBlock reference architecture (converged infrastructure), and created an integrated cloud environment. Improved authentication and data loss prevention technologies have made the private cloud more secure, along with improvements in monitoring and automated management of the cloud. Phase 2 resulted in additional cost reduction as well as better application performance, higher availability, higher end-user productivity, and reduced risk.

Having put in the time and effort refining the technology aspect of the journey, EMC has built a virtualized, consolidated, tiered infrastructure.

Phase 3: IT-as-a-Service, (2011-present). The goal of this phase is on achieving business agility by offering IT-as-a-Service. While all efforts continue, the focus is on changing to a service delivery model. As a result, much of the effort is now on people and processes rather than technology, as ITaaS requires that EMC run IT as a business. That change in view requires that IT add product management, marketing, and value selling to its list of tasks, as well as measuring customer service and satisfaction.

The company has generated significant results that deserve mention. EMC now has 60,000 internal users and five data centers with 13PB of storage, and yet they have only increased the number of applications and tools from 400 to 500. Globally there are 9,000 OS images (virtual machines), but they have reduced the number of physical Intel x86 servers from 2,000 to 1,500 Intel x86 servers. At this time 92% of servers are virtualized, and the objective of 100% virtualization is very much within reach. It is also worth noting that EMC IT has standardized its IT infrastructure on the VCE Vblock architecture.

Deeper Dive into EMC's Remarkable Results

The results that EMC has achieved are truly stunning. The company has completely transformed its infrastructure, and along the way has generated tremendous cost savings and efficiency improvements, improved the flexibility and agility of the business, and enhanced the services and information security they provide. These changes place EMC on the threshold of the next phase of transformation, as they transition to service-oriented IT.

Creating an Efficient Environment

Cost Reduction

EMC's efforts have resulted in avoiding capital costs and saving on operational expenditures. Here are some details of cost reduction achievements since 2004:

- $157M in capital expense avoidance. Virtualization and consolidation of servers and storage has enabled a drastic reduction in physical hardware needs. In addition, while revenues have increased significantly, *the data center footprint remains the same*. As a corollary, IT infrastructure utilization rates (i.e., compute, storage, network) have increased to about 75%. Doing more business while running less equipment with higher utilization rates is evidence of dramatic efficiency improvements.
- $66M in operational expense savings. This was primarily the result of deploying a private cloud with pervasive virtualization while achieving a virtual machine to physical server consolidation ratio of 14:1. Systems are now designed to support a higher consolidation ratio, offering the opportunity for even greater savings.
- Because of virtualization and consolidation, the IT infrastructure budget has generated savings that have been returned to the CFO for reinvestment. As mentioned earlier, EMC has reduced the ratio of IT OPEX to EMC revenue by 28%, freeing up those funds for new projects.

Staff Efficiency

Recent implementations of improved and automated management tools have enabled EMC to use IT staff more efficiently. For example, EMC IT Operations Intelligence (SMARTS) is providing better visibility and control of the entire cloud infrastructure and its health to avoid impact to critical services. Moreover, since 2009, during a period of strong revenue growth, the number of total IT employees has remained stable.

Energy Efficiency

The consolidation and reduced physical infrastructure have resulted in a 34% increase in energy efficiency, as well as a reduction in CO_2 production by 100 million pounds. The new virtualized data center in Durham, North Carolina is a model of energy efficiency. For example, by harvesting rainwater it has reduced its use of city water by 40%, and for 57% of the year it uses outside air for cooling. The data center uses Flywheel UPS, enabling the complete elimination of batteries in the facility. Despite increased server and storage demand, they have saved 271 watts per server with virtualization, reduced power per TB of storage by 73%, and have saved enough energy to power 2,000 houses.

Backup Efficiency

By leveraging EMC solutions, the company has transformed backup and restore. They have eliminated backup for certain applications by providing live archiving, removing more than 1PB of e-mail, file system, and database data from the backup schedule. In the data center, deduplication (using Data Domain for databases and Avamar for VMs and file systems) has further reduced the amount of data to be backed up—and reduced backup times by 75%. Avamar is also used to centralize backups for 121 remote sites, increasing data availability and eliminating offsite backup costs. Backup failures have been reduced by 99%. Finally, users are more productive (and help desk calls have been reduced) with Avamar desktop backup and self-service file restore.

The benefits of deduplication deserve a longer look. As you can see in Figure 3, from Q3 2009 through 2012, the total amount of data being protected rose from 7PB to 17.2PB, including temporary data copies required for migration to the Durham data center. However, because of the deduplication efficiency of Avamar and Data Domain, the backup capacity required to protect that data only increased from 3PB to 5.2PB.

Figure 3. EMC Deduplication Reduces Backup Capacity
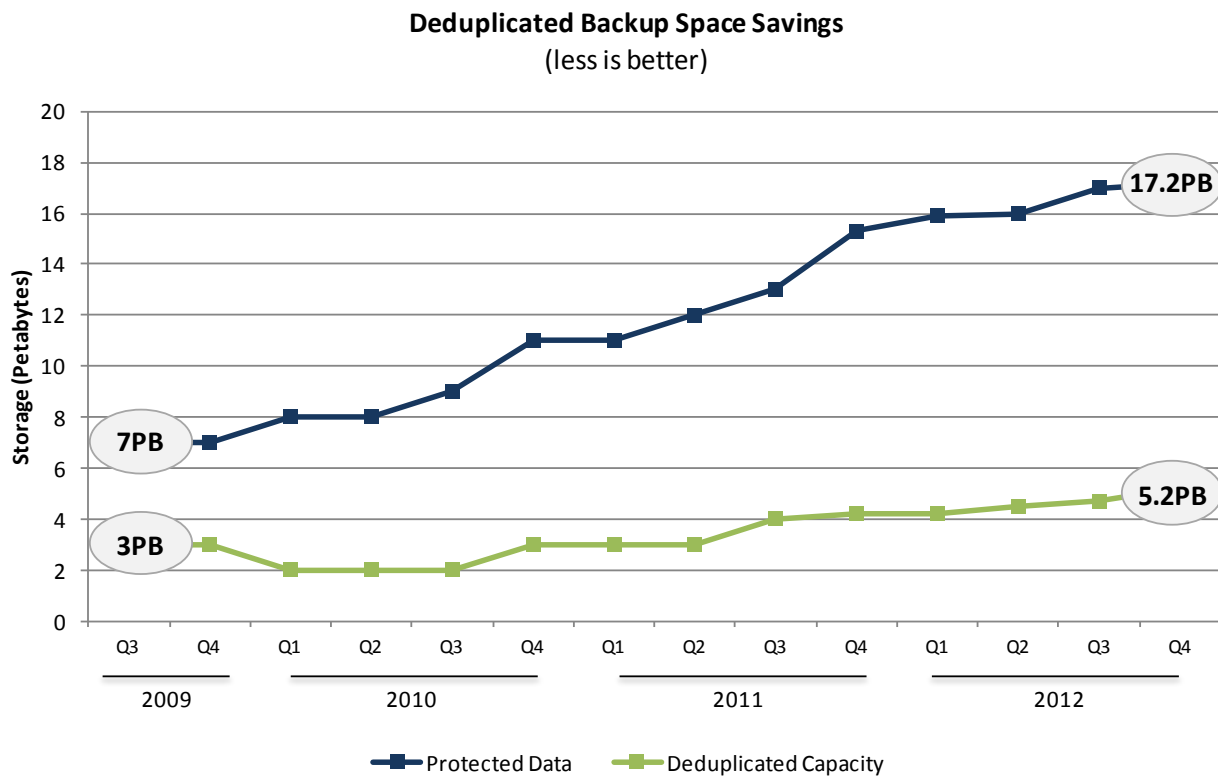
Mission-critical Application Efficiency with VCE Vblock

EMC has some tremendous examples of virtualization delivering efficiency in mission-critical applications. Its CRM suite touches almost every EMC division, including manufacturing, finance, quoting, customer service, professional services, and sales and marketing. The environment is huge—with 70+ application tiers, 8.8 billion rows of data in a 12TB database, and 57 million daily transactions conducted by 40,000 named users (and 4,000 concurrent users at peak). EMC migrated the aging physical infrastructure (which suffered from CPU spikes, poor performance and scalability, and degraded user experience) to a virtual infrastructure with 7x24x365 availability. This started with the migration of 210 physical servers to 20 multi-tenant ESX servers in a vBlock architecture with Cisco UCS servers, Red Hat Linux and VMware vSphere, and Symmetrix VMAX tiered storage. The results include 60%-90% better productivity; $7M in environmental, licensing, maintenance, and support savings; and 10X better performance.

EMC has also fully virtualized its new SAP-based ERP system, consolidating 50+ legacy systems on a VCE Vblock converged infrastructure consisting of 14 Cisco UCS blade servers with a total of 280 cores and 3.5TB of RAM. The Application Integration Cloud (AIC), SAP applications, and databases are on 100 virtual hosts, where 18,000 users leverage VMware ThinApp application virtualization. The 32-node cluster has a total of 68 power, network, and SAN connections—a traditional architecture would use 448. This architecture provides a smaller footprint and fewer configuration points (and therefore fewer chances for error). It is more flexible—stateless servers mean that replacing or adding servers happens in hours instead of days. In addition, repurposing servers can be accomplished without physical reconfiguration, and new VLAN configuration tasks have been reduced by 10x.

Financial Transparency and Chargeback

Demonstrating IT's value is a key part of running IT as a business. Customers evaluate products and services by what they offer and at what price, and EMC IT must identify those features to help sell the value. As EMC IT begins to deliver ITaaS, they must be able to compete with external cloud services and mitigate the risk of "Shadow IT"—that is, if IT is difficult to work with, business units may go online with a credit card and buy application or infrastructure services in the cloud.

As a result, EMC embarked on a financial transparency effort to offer a clear picture of true IT costs and the corresponding business-unit IT spending based on actual consumption. This information makes both the business units and IT more prudent and less likely to over-allocate resources, and as a result more closely aligns technology consumption with demand. EMC created a new set of processes for IT service costing, pricing analysis, and metering/invoicing. The company defined service categories and allocated fixed and variable costs, while determining the unit drivers and unit costs. And out of that information, EMC created IT service prices that reflect corporate goals. They began by showing business units the invoices of their monthly service usage, and then provided a simple fund-transfer mechanism for payment.

This cost transparency has resulted in increasing chargeback of services from 54% to 89%, with those additional funds used to increase spending on innovations. This adds benefit to the enterprise as a whole rather than to individual business units.

Creating Business Agility

These efficiency improvements have enabled EMC to spend more of the IT budget on new applications and functionalities, instead of on maintaining and simply "keeping the lights on." While spending to keep the infrastructure functioning will always be needed, the chance to spend more strategically on new capabilities changes the equation and moves the company forward. The efficiency gains EMC is making are driving innovations that result in agility that increases competitiveness and profitability**.**

Time-to-provision

Many organizations find it difficult to adjust to changing business conditions. The long provisioning process is often a key inhibitor—you want to launch a new application to gain a competitive edge, but when weeks go by waiting for the application to be deployed, the competitive advantage may dissipate. In 2004 it took 90 days to provision a server environment. Over the past eight years, as Figure 4 shows, cloud computing and virtualization took hold and the provisioning time dropped dramatically. At this juncture, close to 92% of servers are virtualized—and the provisioning time is less than a day. Because of virtualization, IT can respond much more quickly to any business application needs.

Figure 4. Virtual Environment Speeds Provisioning
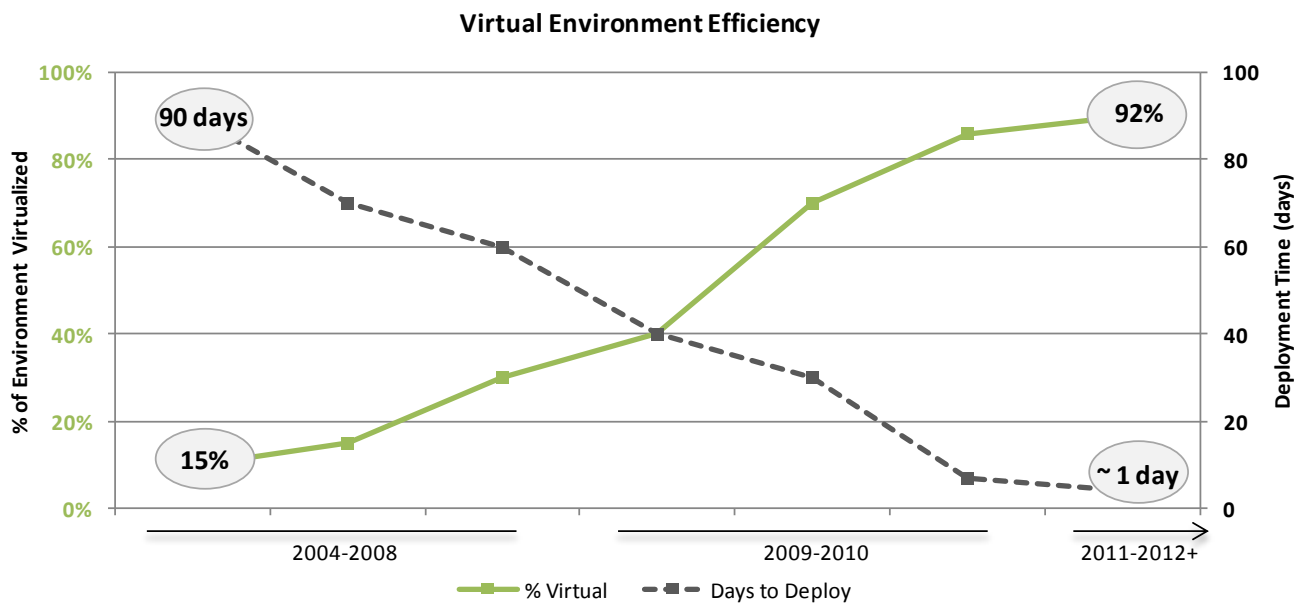
Big Data and Better Business Intelligence

Agility is also enabled by getting faster answers to questions. EMC's cloud infrastructure has made it possible to leverage the Greenplum scale-out database, plus Hadoop for unstructured data and SAS for analytics, to create an elastic, scalable business intelligence (BI) platform. This platform provides BI as a service and collaborative analytic tools, plus the services of data scientists as needed. The business gains from new access to advanced predictive capabilities and real-time decision-making. EMC business managers appreciate this "big data" platform as it enables them to find more ways to compete and ensure a quality customer experience. With data volumes, types, and complexity increasing, these enhanced analytical capabilities are providing fuel for the business engine. For example, the direct marketing organization at EMC uses the BI platform for predictive analytics and to understand the 170 million social brand interactions occurring—which translates to about 130TB of data. The ability to analyze that is critical to marketing effectiveness.

As another example, the big data platforms have reduced the batch job run times for EMC Customer Service by 87%, allowing them to speed the acquisition of territory details and more quickly generate contracts.

Figure 5. Big Data Platform Speeds Batch Jobs

Average CS Batch Job Run Times
(shorter is better)

■ Before Big Data Platform ■ After Big Data Platform
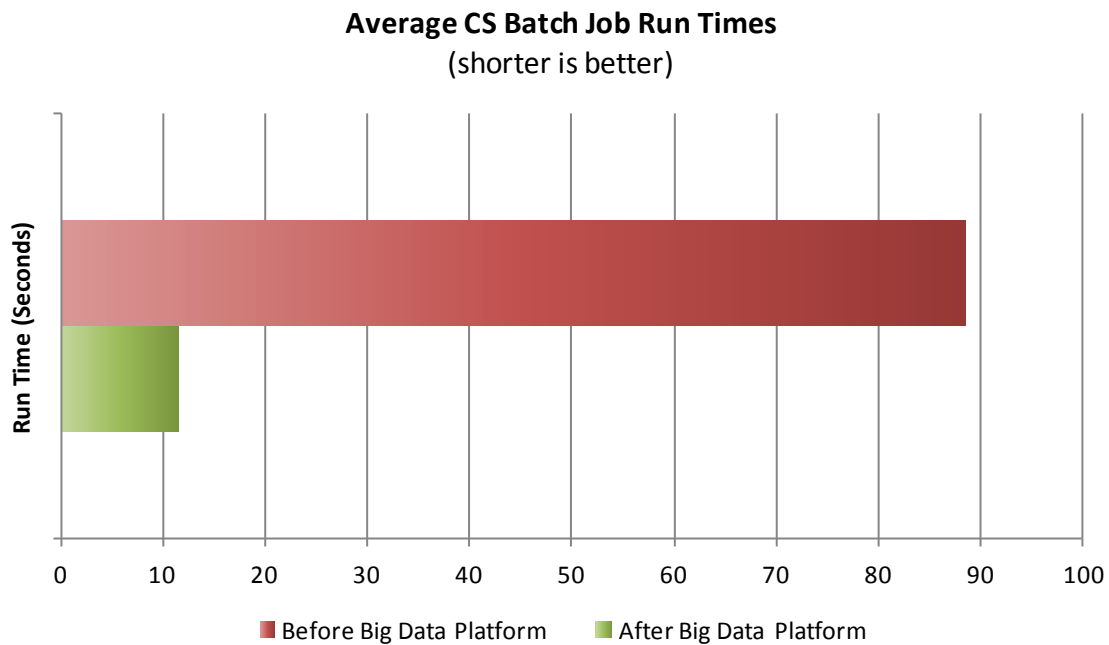
Delivering a Quality Experience

Delivering high-quality IT services has always been a goal, but ITaaS makes that objective even more important. Running IT as a business means delivering and measuring service quality and customer satisfaction. EMC IT does not want business units to unilaterally procure public cloud services such as file sharing or other cloud-based solutions. The new ITaaS delivery model offers EMC IT the opportunity to bring any such "Shadow IT" services back in house. IT understands the reality—regardless of cost, efficiency, agility, and quality improvements, if business units find that internal IT is too slow in meeting their needs or is difficult to work with, then they will continue to source around them. As long as that is antithetical to IT's funding model, they must discourage it. To that end, EMC's ITaaS efforts are helping them transform their image from a collection of technology silos to a solution provider and business partner. The infrastructure now supports that, and EMC's efforts are directed toward becoming a broker of quality value to the business. But in addition, they are layering automation onto the private cloud, in order to optimize IT production for informed business consumption. Automation will enable the self-service, speedy provisioning, and service delivery that their internal customers demand. This is part of EMC's transformation effort—that is, transforming themselves into a competitive provider of IT services to the business.

Customer Satisfaction

Efficiency gains can affect end-users in very concrete ways, enabling an increase in productivity. A real world look at business processes proves the point. The efficient, cloud-based architecture is enabling the sales organization to shrink OLTP transaction times for tasks such as configurator launches and saves, opportunity creation, and quote approval (see Figure 6). These are real-world performance gains that speed productivity and improve customer satisfaction. As one EMC Sales employee commented, "I don't know what you did to Direct Express [the product configurator application]—but it's screaming!"

Figure 6. Sales OLTP Transaction Times
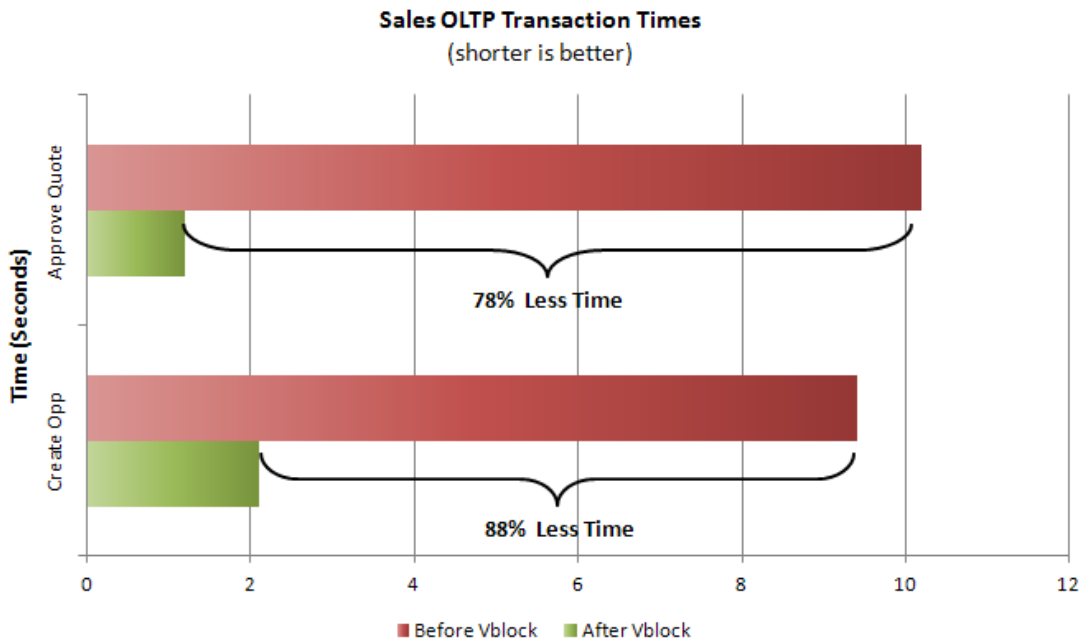
Securing the Cloud

Aware of the very different security needs in a cloud-based environment, EMC has taken security to the next level. Management of all data centers is centralized in the Global Command Center with state-of-the-art EMC and VMware infrastructure management tools. In addition, a Critical Incident Response Center (CIRC) keeps watch with intelligence designed to pre-empt a cyber threat. Advanced tools and analytics from RSA technologies—as well as skilled security analysts—work to prevent breaches and remediate events as needed. With the new architecture leveraging a Greenplum database and other applications, the CIRC can sift through huge amounts of data—such as 100GB of proxy logs per day—in ten minutes to prevent security breaches. Before this architecture was in place, this type of analysis was almost impossible—attempts at the task would take 26 hours, and often fail due to insufficient memory.

Figure 7. Security Event Analytics
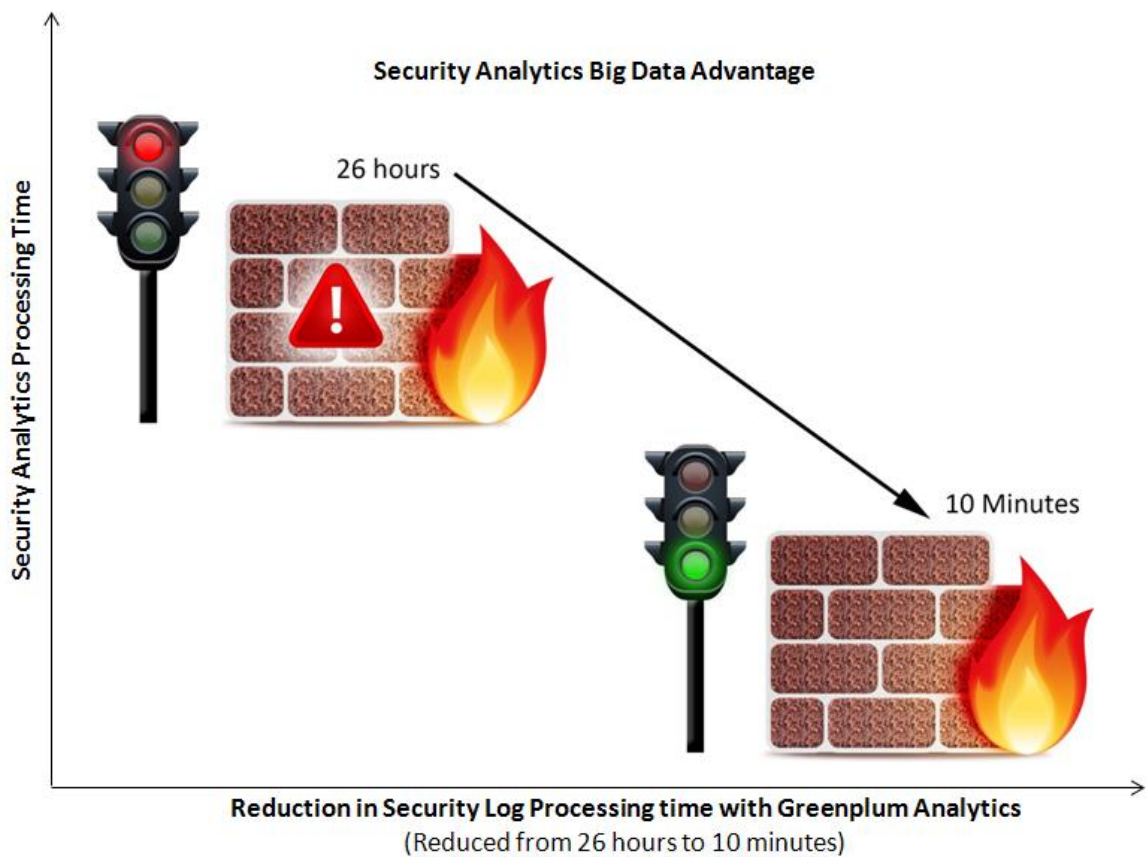
Today, security is starting to be built into EMC's infrastructure. In the beginning, understanding risks and controlling the environment with identity and access management were the focus, but over time virtual tools with integrated controls became part of the fabric. The maturation of the core infrastructure has brought with it repeatable, scalable, and measurable security implementations. With those come greater predictability and a better understanding of behaviors, resulting in better security. Security is being woven into both products and processes, making protection more effective and easier to ensure.

This is critical when infrastructure becomes fluid in a cloud environment, where maintaining controls becomes difficult. New systems are easily spun up and down, collaboration and social media are normal business activities, and users are accessing applications from multiple locations, endpoint devices, and networks. Where security is still enforced by the OS and application stack, it is complex and less effective. EMC is working to push security into the virtualization, network, and storage domains. This will enable applications to move between servers and data centers while retaining measurement and reporting for visibility and governance.

As EMC puts it, "people are the new perimeter" due to greater mobility and an increasing number of endpoint devices. This makes it difficult to provide a good user experience while ensuring external access control. Managing data protection, antivirus, and the like on a device-by-device basis is almost impossible, particularly as many devices are not provisioned by IT—this leaves big vulnerabilities. The company is working on building cloud-aware applications in secure containers that can run anywhere in the EMC hybrid cloud, based on predetermined compliance and governance policies that will migrate with the container. For example, application developers are adding data loss prevention into APIs, and doing malware analysis as a file is received from a device. The project requires great collaboration among teams, to ensure security while enhancing usability, performance, and reliability. It will relieve IT of having to provide perimeter protection and enable greater endpoint device choice for users.

Next Up: Delivering IT-as-a-Service

EMC defines ITaaS as a "delivery model that leverages cloud technologies to enable business agility and value-based choice through readily consumable IT services that have transparent prices and established service levels." ITaaS can provide a rapid, agile deployment of customer environments or applications, reducing infrastructure and energy costs due to resource sharing. ITaaS is dependent upon building a foundation to support a service delivery model. EMC has spent the past eight years building this foundation, with tremendous results. The company is now beginning the next phase transformation: becoming customer-centric and service-oriented, with standardized products. With EMC's cloud-based infrastructure, IT can offer on-demand provisioning and services using a self-service catalog. This is a more market-driven approach that empowers business units to consume IT for maximum benefit and value, with greater choice in how they spend their allotted IT budgets.

EMC's ITaaS framework outlines the various services they plan to deliver. Using their new private cloud infrastructure, for example, they can offer Infrastructure-as-a-Service—including compute, storage, network, and backup. At another level is Platform-as-a-Service, such as database platforms for security integration, application/web server development tools, content management, and business intelligence. Software-as-a-Service will provide business applications, and User-Interface-as-a-Service will include virtual desktops, choice of endpoint devices, and mobility services. All of these depend on service management built with standardization and automation.

This evolution is a huge effort that includes all aspects of IT—from the client-facing staff to development, engineering, operations, and new IT business operations staff. IT roles are changing, and new skills are needed, but at the same time new opportunities are available for IT staff as IT begins to align its organization and measurements with the larger goals of IT and the company as a whole. Part of the next challenge is to define measurements for business value, agility, competitiveness, risk mitigation, etc.

The Bigger Truth

The lessons learned from EMC's IT transformation provide a blueprint from which any organization can benefit. Creating a more efficient private cloud infrastructure built on virtualization can lead to dramatic changes in the IT organization and throughout the enterprise. EMC's journey outlines steps to take, challenges to avoid, expected and unexpected outcomes, and methods of measurement. Each step along the way leads to new opportunities.

Figure 8 represents some of EMC's major achievements. Since 2004 EMC's revenue has increased from $8.2B to $21.7B. During this time the company has spent less and less on maintaining the IT infrastructure, freeing up funds for new projects. The company has been able to take those savings—including $157M in CAPEX and $66M in OPEX—and invest in value-creating innovations. It has reduced its environmental impact, including reducing CO_2 emissions by 100M pounds, through efficient and innovative operations. The number of EMC users has increased dramatically, as has the amount of storage in the environment—but by virtualizing the bulk of the infrastructure, EMC has achieved efficiency and cost benefits that make the company more agile and productive. For example, the use of cloud resources has resulted in 88% faster sales opportunity creation, improving sales productivity. As an example of greater agility, there has been a 9X improvement in application provisioning times. The overall picture makes it clear that improvements begun in IT are now making a big impact throughout the company.

Figure 8. Transformation Results
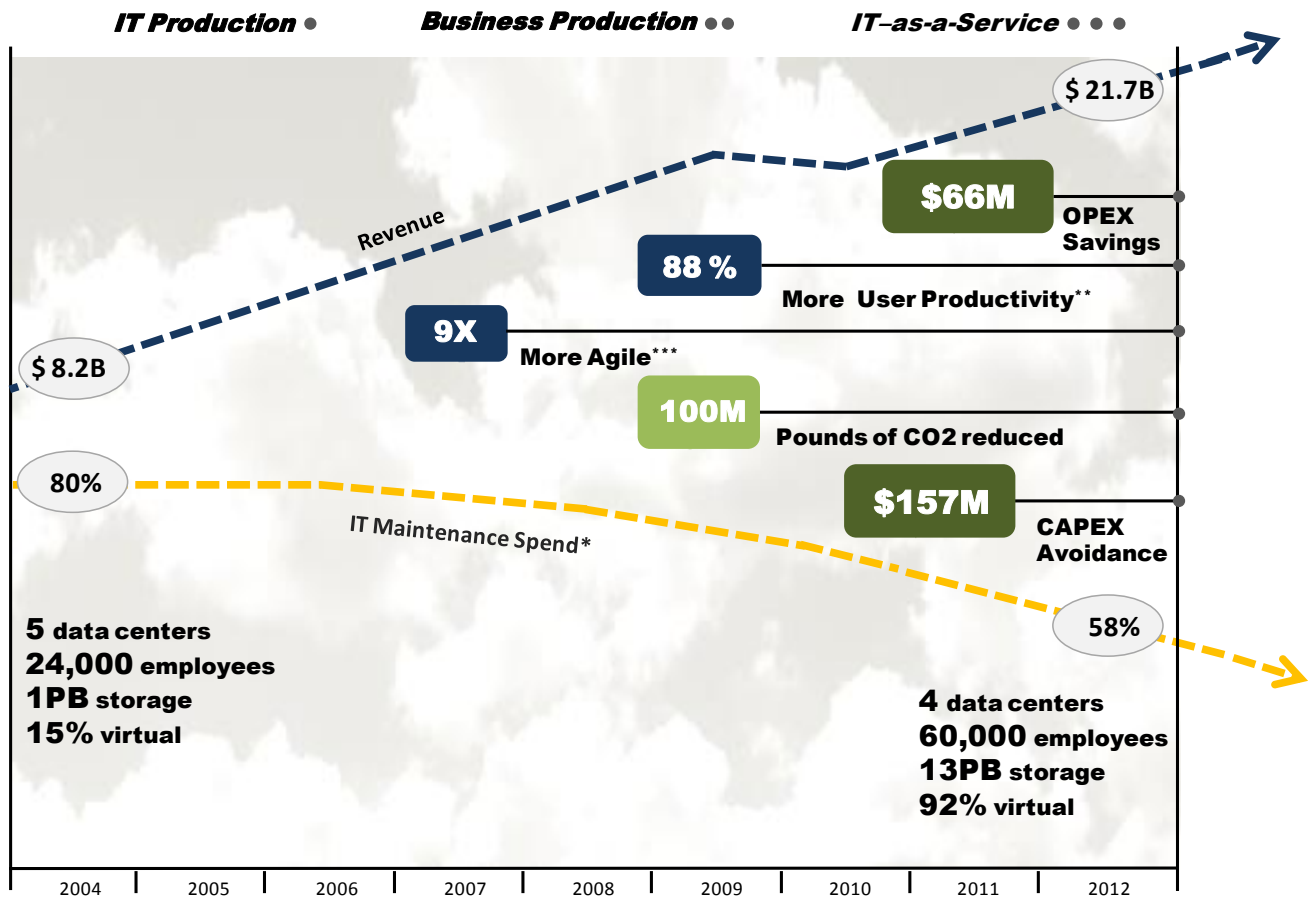
*   Percentage of IT Spend on Lights-on vs. New Capabilities
**   Improved sales order creation time due to vBlock architecture deployment
*** Reduced deployment time due to virtual infrastructure efficiencies

These numbers are impressive. But what is behind the numbers is equally impressive: EMC IT's new way of conducting business. EMC sums it up with three directives: Transform IT, Transform the Business, Transform Yourself. These are guideposts along the journey that organizations can learn from.

- *Transform IT* – EMC's efficiency efforts built on consolidation, virtualization, and automation have made IT resources easier to deliver. Now the company is moving on to making resources easier to consume. Delivering IT-as-a-Service requires running IT differently: identifying needs and customer demand, developing and marketing products and services, demonstrating value to the customer, and delivering on commitments in a way that encourages their internal customers to keep coming back.
- *Transform the Business* – Agility, efficiency, and productivity improvements are required as the business learns to handle today's very large and varied data volumes that must be analyzed, leveraged, and retained for long periods. These changes are felt across the enterprise.
- *Transform Yourself* – The changes in IT and the business as a whole provide opportunities for employees to learn new skills and contribute in new ways. Roles such as cloud architects and data scientists are emerging, IT employees are becoming technology brokers, and greater collaboration is necessary. The faster employees at all levels can shift their ways of thinking, the faster the transformation will be.

EMC has proven that virtualization, "hybrid" cloud computing, and a new cloud operating model for IT (aka IT-as-a-Service) can transform an organization, creating a foundation of efficiency and agility that permeates the enterprise. ESG—as well as organizations looking for guidelines for their own transformations—look forward to seeing what EMC can do next – especially in the realm of mobile- and big data-enabled business applications!