WHITE PAPER

Measuring the Business Value of Converged Infrastructure in the Data Center

Sponsored by: HP

Richard L. Villars
Randy Perry
Other contributors

October 2011

IDC OPINION

One of the key strategies that IT teams are pursuing to reduce capital costs while boosting asset utilization and employee productivity is the transition to highly virtualized data centers. However, IDC finds that expectations for further boosts in IT asset use and operational efficiency often surpass the actual results because of overloaded storage and data network facilities, overprovisioning of storage capacity, and a quantum leap in administration workloads. In combination, these problems can quickly overwhelm any hoped-for benefits as the scope of virtual server deployment expands.

Faced with a future in which they will need to deploy and effectively use hundreds, thousands, and even tens of thousands of server (and/or desktop) application instances in a virtual environment, companies should consider deploying optimally (e.g., densest, greenest, simplest) configured converged infrastructure systems (server, storage, network) that are managed as unified IT assets. In addition, a converged infrastructure is often a prerequisite for companies that want to take advantage of the flexibility and efficiency of cloud computing.

Our research with 22 companies whose levels of convergence and IT asset unification ranged widely indicated substantial business benefits associated with higher convergence and asset sharing. The results showed a marked correlation between higher levels of convergence and reduced IT costs per unit of workload, faster deployment, and reduced downtime. For example, organizations at Level 4 convergence reported costs per unit of IT workload almost 60% lower than those of organizations ranked at Level 3.

HP, a global provider of IT solutions and an early innovator in converged infrastructure systems, provides a complete portfolio of hardware, software, and services for enabling greater/faster deployment of converged infrastructure solutions in data center environments. More important, HP is also delivering the advanced orchestration management software that will make it possible for IT organizations to effectively obtain the maximum business value from these investments.

---

1 The following IDC analysts also contributed to this research: John Daly, Jed Scaramella, Mary Johnston Turner, Lucinda Borovick, Joseph Pucciarelli, Terra Friedrich, and Michelle Bailey.
Continued economic volatility around the world and dramatic changes in many industry dynamics are having a profound and ongoing effect on organizations’ IT investment and operations priorities. Organizations are accelerating their normally long development cycles and making fundamental changes in business practices and IT operations. The tipping point of corporate IT strategy is to transform the data center to be better aligned with the heightened pace of both the business and the market.

Over the past year, IDC surveyed, interviewed, and consulted with a wide range of organizations around the globe to detect changing attitudes toward and priorities for IT investments. We spoke with C-level executives (e.g., CEOs, CFOs, COOs, CIOs), business unit leaders (e.g., vice presidents of sales and marketing, division heads, general managers), and IT leaders (e.g., IT vice presidents, CTOs, senior architects).

Put simply, senior executives want to "operationally" transform IT so that their organizations can react quickly to major positive or negative changes in the business environment while also more reliably assessing revenue gains and cost savings from proposed investments in new technologies and services (e.g., mobile applications, use of cloud services, Big Data analytics).

Virtualization Alone Is Not Enough

Within many data centers around the world, the most visible consequence of these priorities has been the rapid expansion in the use of server virtualization technology. By the end of the year, more than half of all applications deployed will be running as virtual machines on a virtualized server. Based upon typical server replacement cycles and new application deployments, IDC believes that the use of virtualization for application servers will only accelerate in 2012 (see Figure 1).
This rapid virtualization of server assets was and is (especially for small and midsize organizations) a key element in aggressive consolidation efforts to significantly boost asset utilization. However, IDC finds that expectations for continued boosts in IT asset use and operational efficiency (linked to plans to run more virtual machines on new generation servers) often far exceed IT organizations' actual experiences. The shift to virtualized servers often leads to significant disruptions in a number of areas:

- An explosion in virtual machine images (often called virtual server sprawl), which increases server/storage administrative burdens and threatens application performance
- Overloading/overprovisioning of storage and data network facilities, which forces time-consuming, costly, and often unnecessary upgrades
- Unpredictable application performance and recovery behaviors, which stall plans to migrate more business-critical applications to virtual environments
In our conversations with IT teams, IDC consistently heard that these problems can quickly overwhelm any hoped-for benefits as the scope of virtual server use expands beyond a few hundred virtual machines.

**Setting Priorities for IT Infrastructure Investments**

Tackling virtual server sprawl and addressing the "operational" mandates from senior management around agility, increased business value, and reduced costs, IT infrastructure investments need to focus on three key goals to accelerate IT transformation:

- Shifting IT resources — both funding and staff — from operational tasks such as application deployment, application/data migration, performance monitoring, and business continuity to innovation and competitive differentiation

- Getting more value out of both existing and new IT infrastructure investments (e.g., server, storage, and networking equipment as well as facilities and power and cooling)

- Accelerating the delivery of reliable IT services to support corporate business goals — whether on premises or in private/hybrid/public cloud environments

**BUILDING FOR THE FUTURE: CONVERGED DATA CENTER INFRASTRUCTURE**

A converged infrastructure is based on a set of standard elements (e.g., blade servers for compute, modular storage systems for data, and a unified 10GbE fabric for internode and storage connections) placed into virtual resource pools or preconfigured in a "system" to provide a predictable amount of "IT capacity." Good examples of such converged solutions are HP’s VirtualSystem and CloudSystem offerings.

The goal is no longer to deploy each element (server, storage, network) individually but to deploy the optimal (e.g., densest, greenest, simplest) system. Organizations can then manage the unified IT assets in these converged systems (e.g., a rack, an aisle, or an entire data center of converged IT infrastructure) by leveraging their preferred hypervisor, network fabric manager (e.g., HP’s Virtual Connect), storage virtualization (e.g., HP’s LeftHand, IBRIX, or 3PAR products), and IT automation software (e.g., HP’s Insight Control or Matrix Operating Environment).

These systems enable increased automation through dynamic partitioning and automatic load balancing supporting a pool of different business applications. IT teams can also more quickly allocate large chunks of IT resources for critical services-oriented applications (e.g., virtual desktops, data analytics warehouses, or large content repositories). In addition, this approach makes disaster recovery within a data center or across geographically dispersed data centers more predictable and cost effective.
**Charting the Continuum of Converged Data Center Infrastructures**

For many organizations, the most immediate hoped-for benefit from adopting a converged data center infrastructure approach is an up-front reduction in spending on hardware assets. In part, this is because they can avoid wasteful overprovisioning and the continual rebalancing of server, storage, and network resources as applications evolve. Equally important, though less glamorous, they can get rid of much of the cable cluttering up their data centers, which can add up to surprisingly large savings.

In our conversations with CIOs and their IT teams, however, it's clear that savings on hardware spend associated with converged systems shouldn't be the sole justification for a shift to a converged infrastructure (see Figure 2 for these cost impacts). Without advanced, unified, cross-tier management capabilities, organizations have a bunch of hardwired hardware that can't do much — definitely not dynamically. Simply providing an integrated set of existing servers, storage, and network management solutions doesn't effectively address this requirement, however. For example, what good is a converged infrastructure if storage administrators still have to provision and reconfigure every LUN and volume manually?

More savings result when organizations significantly improve the utilization rates for all of the IT assets in the data center. The next stage of converged data center infrastructure maturation is the addition of unified orchestration functions that automate provisioning and enable policy-based resource management for each system and the applications running on them.

Ultimately, a converged data center infrastructure has to extend beyond individual systems. Organizations need to leverage advanced solutions (e.g., HP's FlexFabric and Peer Motion) that extend efficient operations and automated resource management across multiple resource pools in the data center and across multiple data centers. Without this extension, they'll just be creating new stovepipes, albeit at a different scale. They'll also be unable to deliver effective and efficient disaster recovery/business continuity.

**Finding a Converged Data Center Partner**

A big challenge for organizations that want to migrate to a converged infrastructure is finding the right partner(s) to help, especially in the following areas:

- Defining the right architecture and deployment characteristics for systems that meet performance and reliability requirements
- Integrating the converged IT systems with existing IT environments and management systems
- Retraining IT staff to support the more unified approach to provisioning and managing converged IT assets and services
Organizations will need to look for an IT solutions supplier with a broad product and services portfolio (server, storage, network, management), but they'll also need to be certain that this supplier can help them overcome internal inertia in terms of segregated product evaluation, procurement, administration, process, and even culture. Most important, the supplier will need to help them identify and sell the business value of adopting a converged data center infrastructure approach when it comes to IT infrastructure investment decisions.

The remainder of this white paper presents the findings from a field study of enterprise datacenters that assesses their relative level of infrastructure convergence, costs per datacenter workload, and business application delivery speed and resiliency. It provides a foundation for identifying how adopting a converged data center infrastructure strategy based on solutions like those from HP can translate into immediate and sustained business value for organizations.

**ASSESSING THE BUSINESS VALUE OF A CONVERGED DATA CENTER INFRASTRUCTURE**

To identify and assess the business value of a converged data center infrastructure, IDC opted for in-depth interviews to allow extensive profiling of convergence, throughput, and costs. The team screened many prospective respondents to identify and interview managers of enterprise datacenters that satisfied criteria for size, data center ownership, and management. In the final survey, 22 managers of datacenters spanning a range of infrastructure convergence levels were interviewed to quantify the financial benefits of attaining more advanced levels of convergence and to identify a set of key best practices that corresponded to these levels.

**Establish Current Levels of Infrastructure Convergence**

For this study, IDC assessed convergence based on the percent of data center resources (e.g., storage, memory, server nodes, network I/O, virtual OS images) that administrators can deploy from a pooled collection versus the percent of resources dedicated to a specific domain (e.g., a technology island or a separate application or organizational silo).

This high-level view of convergence becomes quite specific and measurable as we assign values to key variables such as those outlined in Table 1.
**How Can We Measure the Effect of Convergence?**

To measure the effect of convergence, IDC analyzed the relationship between the level of convergence (e.g., consolidation, standardization, virtualization, automation) of an enterprise's IT infrastructure components and processes and the cost to deliver IT infrastructure capability (e.g., work/throughput/capacity). To model this, we needed to measure at least three key real-world values for a sample of data centers:

<table>
<thead>
<tr>
<th>Servers&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number Count</td>
</tr>
<tr>
<td>Average # (processors/cores/books) per Node&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Memory</td>
</tr>
<tr>
<td>Virtualized OS</td>
</tr>
<tr>
<td># OS Images</td>
</tr>
<tr>
<td>Storage</td>
</tr>
<tr>
<td>% of Nodes Direct-Attached HBA</td>
</tr>
<tr>
<td>% of Nodes SAN or NAS Attached (Networked)&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
<tr>
<td>% of Nodes (above) with Virtualized Storage&lt;sup&gt;4&lt;/sup&gt;</td>
</tr>
<tr>
<td>I/O</td>
</tr>
<tr>
<td>% Nodes with Dedicated NICs</td>
</tr>
<tr>
<td>% Nodes with Virtual I/O (Virtual Connect, UCS, Blade System)</td>
</tr>
<tr>
<td>Storage Network Protocol (FC, iSCSI, FCoE)</td>
</tr>
<tr>
<td>Provision/Config Automation</td>
</tr>
<tr>
<td>% of Images IT Manages (provisions, configures)</td>
</tr>
</tbody>
</table>

Notes:
1. We define a node as a server, system board (in a blade chassis), or node in a cluster that carries sockets that hold CPUs. Each node runs an operating system or a hypervisor. The IDC Server Tracker refers to these nodes as “units.”
2. We consider blade systems running hypervisors or “mainframes” as converged at both a physical level and a logical level — a converged part of the infrastructure.
3. Percent of nodes with networked storage equals percent of nodes attached to a storage subsystem such as a storage area network (SAN) or network-attached storage (NAS).
4. Percent of nodes with networked storage that use thin provisioning on virtual volumes. Virtualized storage with thin provisioning allocates storage requested by the node as virtual storage. It preserves actual physical disk capacity and adds more only as needed. The system manages physical disks as a single disk pool and allocates physical disk capacity according to the amount of data written to the virtual volumes, avoiding overprovisioning.

Source: IDC, 2011
What "work" or throughput the data center pushes through. We can consider a data center's network capacity (ports, aggregate bandwidth, effective throughput) for data flow to/from the data center as a proxy for the data center's throughput or "work."

How "converged" the data center has become. We can assess this value by measuring the percent of the data center resources (e.g., storage, memory, server nodes, network I/O, virtual OS images) that administrators can deploy from a pooled collection versus the percent of resources dedicated to a specific domain (e.g., a technology island or a separate application or organizational silo).

The cost or expense to run the data center. We can determine this cost by the annual budget for equipment hardware, infrastructure software (OS, middleware, administration, and DBMS, but not applications), and IT infrastructure administration staff (versus application development and support). We also include as cost the effects of unexpected downtime, including work stoppage, revenue loss, and/or wasted labor due to downtime or delayed application response time.

**Measuring the Impact**

To achieve the benefits of a converged IT infrastructure, organizations have to start from wherever their infrastructure is today. Most large organizations have serious sprawl and incompatibility issues created by years of meeting their immediate needs using a project-by-project approach. As part of our research, we assessed each company's maturity across a set of best practices. Table 2 highlights some important findings on key measures and the best practice indicators for organizations at different levels of converged IT infrastructure:

- Traditional and Compartmentalized (Level 1) organizations have only begun to initiate convergence.
- Standardized and Optimized (Levels 2 and 3) organizations have implemented many of the best practices but are just realizing benefits such as lower infrastructure costs and IT productivity improvements.
- Automated and Adaptively Sourced (Levels 4 and 5) organizations have optimized IT infrastructure as far as possible given currently available technology and are technically capable of offering cloud services.
### TABLE 2

**Leading Indicators of Convergence Best Practices**

<table>
<thead>
<tr>
<th></th>
<th>Traditional/Compartmentalized</th>
<th>Standardized/Optimized</th>
<th>Automated/Adaptively Sourced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of servers running hypervisor</td>
<td>20</td>
<td>45</td>
<td>84</td>
</tr>
<tr>
<td>Number of virtual images per server</td>
<td>1.3</td>
<td>8.8</td>
<td>22.7</td>
</tr>
<tr>
<td>Converged 10GbE fabric deployment (%)</td>
<td>0</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Automated provisioning (%)</td>
<td>9</td>
<td>48</td>
<td>100</td>
</tr>
<tr>
<td>Utilize a centralized asset configuration database (%)</td>
<td>0</td>
<td>67</td>
<td>100</td>
</tr>
<tr>
<td>Number of separately governed IT/data centers</td>
<td>52</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Percent of total processing at data center</td>
<td>61</td>
<td>79</td>
<td>100</td>
</tr>
<tr>
<td>Number of consoles used to manage the infrastructure</td>
<td>17</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Use of industry-standard process models, such as ITIL, ITSM, CobiT (Respondents rated their use of the models on a scale from 1 to 5, where 1 = do not use and 5 = have already implemented.)</td>
<td>1</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Tendency to purchase IT assets in a bundle (%)</td>
<td>7</td>
<td>57</td>
<td>87</td>
</tr>
</tbody>
</table>

Note: These scores represent average values for the respondents falling into each category.

Source: IDC, 2011

### Results

As discussed, the research team requested not only information about each company's throughput and level of convergence but also information about its data center total cost, IT labor cost, speed of deployment, and uptime characteristics. The results indicated a marked correlation between higher levels of convergence and reduced IT costs per unit of workload, faster deployment, and reduced downtime. Figure 2 shows how all of these factors play out for organizations at each of the convergence levels.
Effect of Increased Convergence Levels on IT Costs, Uptime, and Speed of Deployment

Note: IDC assigned companies to different convergence maturity levels based on a composite ratio that included percent of nodes using virtualized storage, percent of storage linked via virtualized I/O, percent of OS images configured/provisioned automatically, and other measures of standardization and best practices.

Source: IDC, 2011

As shown in Figure 2, companies at higher levels of convergence benefited from lower costs per unit of IT workload. For example, organizations at Level 4 convergence reported costs per unit of IT workload almost 60% lower than those of organizations ranked at Level 3.

HP’S CONVERGED INFRASTRUCTURE SOLUTIONS

HP is a global supplier of network, storage, and server hardware as well as data management software products for large and medium-sized businesses. It also provides a broad range of IT implementation and support services for its customers through its
partners and its own global services organization. Leveraging all of these assets, HP was an early champion/advocate of converged IT infrastructure in virtualized environments.

HP Converged Systems are preintegrated, tested, and supported solutions optimized for cloud, virtualization, and next-generation applications. HP intends for these systems to reduce the resources and the time (by months or even years) required for planning, procurement, and deployment so that customers can accelerate their time to application value. HP provides customers with several options:

- HP VirtualSystem simplifies and extends converged infrastructure into optimized, turnkey solutions for server and desktop virtualization. HP designed it to deliver a high-performance virtualized environment with pretuned server, storage, networking, management, and hypervisor resources. The HP VirtualSystem is targeted for use cases including hosting one or multiple applications — including mission-critical applications — and provides the foundation for the next level of system, the HP CloudSystem.

- HP CloudSystem is an integrated system for building and managing services across public, private, and hybrid clouds. It combines Converged Infrastructure with HP Cloud Service Automation software, providing a cloud platform that aims to increase agility for enterprises and drive revenue growth for service providers.

- HP AppSystems is a portfolio of integrated systems optimized for dedicated workloads such as data management, business reporting/analytics, and collaboration. HP designed and tuned it for these specific applications to achieve fast time to value, high application performance, and service-level requirements.

**Convergence Has to Be About More than Products**

HP provides its customers a systematic approach that brings together server, storage, and networking resources in a common pool. This approach also brings together management tools, policies, and processes so that resources and applications are managed in a holistic, integrated manner. In addition, it brings together security and power and cooling management capabilities so that systems and facilities work together to extend the life of the data center.

HP and its partners then work with HP customers to transition to a Converged Infrastructure Data Center design in which resources can be dynamically provisioned and shared by many applications and/or managed as a service as business needs change. This effort intends to help the IT organization rapidly replicate applications, generate economies of scale, and optimize its environment for energy efficiency, high availability, and increased utilization.

By meeting these objectives, a converged infrastructure solution can also become the ideal foundation for private clouds if customers intend to move in that direction. HP customers can deploy at their own pace through a transformational or project-based approach that matches the organization's preferred delivery model: on premises, outsourced, or via the cloud — or a hybrid of all three.
As customers move to a converged IT data center, HP Technology Services can help them balance IT efficiency, innovation, and modernization priorities and identify the best convergence approach. The HP Strategic IT Advisory Services (SITAS) portfolio of capabilities strives to help CIOs achieve several vital goals, such as delivering a better ROI by reducing costs and improving processes, producing faster response to changing business needs, and enabling business innovation.

Using a converged infrastructure maturity model assessment, HP helps organizations determine the current state and the desired future state of their data center by providing an action-oriented, high-level road map for reaching objectives. HP also brings knowledge, deployment methodologies, comprehensive financing options, and global resources to help optimize a customer's current IT environment while striving to minimize the risks of lost investment or extensive retooling as the organization moves forward.

**Challenges and Opportunities for HP**

Most organizations are at the beginning of the journey toward converged infrastructure data centers, which will take several years to complete. Today, rethinking the data center and how it's run is a top priority, which is driving current discussions about converged infrastructure systems and/or private clouds.

HP, as a leading provider of many of the core elements in current data centers (e.g., servers, storage, networks, facilities, power and cooling), must play a role in helping companies make the transition as painless and flexible as possible. Part of achieving this goal requires HP to stay focused on rolling out some key technical enhancements to existing product lines. These enhancements include:

- Extending support for 10GbE across all of its storage products (including support for both block and file access options)
- Continuing to enhance the automated data movement services on its disk storage systems and extend those services to remote data centers
- Expanding the portfolio of application-specific converged systems while ensuring consistent data management and connectivity options across general and application-optimized systems

HP must also continue to extend the scope of unified orchestration services across multiple converged systems and across multiple data centers. Extending enterprisewide support further in other elements (e.g., server provisioning, performance monitoring, and resource management) will also be critical.

A converged infrastructure data center approach presents technology challenges, but more important, it poses a significant number of challenges for IT organizations in terms of product evaluation, budgeting, and IT operations management. These organizations will ask HP what it is doing in terms of services, application development, and financing to help them navigate the transition in the areas of technology standards, facilities design, and IT staff retraining. HP and its business partners must educate HP customers about the broad set of professional services offerings available to help them navigate the change.
WHAT CONVERGENCE MEANS FOR DATA CENTER EXECUTIVES

The transition to a converged infrastructure–based data center will play a vital role in helping IT teams meet the fast-evolving business needs of their organization. It will also be critical in efforts to reduce both the capital costs and the operational costs of running data centers and the applications/information residing in them. To meet these objectives, IT suppliers (such as HP) need to deliver solutions that more tightly integrate the hardware elements, provide an open operating environment, and support full orchestration of resources across the entire data center.

Delivery of more capable solutions, however, is not sufficient. IT organizations must adjust existing product selection and management practices to fully take advantage of converged IT infrastructure. When speaking with IT executives considering broader use of this approach, IDC has three major recommendations:

- Embrace standardization of hardware and software components as much as possible because this can simplify management and interoperability challenges (however, be sure that the approach also provides an interoperability and transition path for mission-critical applications on installed systems and SANs)
- Implement a mature, centralized, and automated approach to management operations with added investment in performance monitoring and analytics as well as installing a chargeback system
- Revamp the IT organization structure to move away from device-specific (e.g., server, storage, and network) administration and move toward an IT resource–oriented (e.g., database, collaboration, and archiving) structure

In addition, the IT executive team should meet with the finance department because a shift to a converged IT infrastructure is also likely to mean a complete rethinking of IT budgeting and cost allocation. Don't let organizational/institutional barriers stand in the way of this important data center effort.