Data Center Improvements for Long-Term Savings

Improve and Maximize Efficiency as You Save Money

White paper

OPTIMIZE

your data center through choice and flexibility

Outmoded data centers are the last vestiges of the evolving information technology (IT) function. As companies mature and grow, all too often their data centers age and grow haphazardly. Typically, data centers become repositories for outdated or underused hardware that consumes floor space while providing little benefit. They house redundant systems, not all of which are needed. And they consume a lot of electricity and manpower.

Table of contents

There are ways to revitalize the data center that can improve functionality, reduce the physical footprint, and save money while better meeting the organization's needs. And all of this can be done while having an important positive impact on the environment. With IT budgets tighter than ever, more and more companies are exploring how making changes to their data centers and computing environments can save them money and also help them address important environmental concerns. This white paper examines some of the latest thinking in technologies that meet today's data center needs.

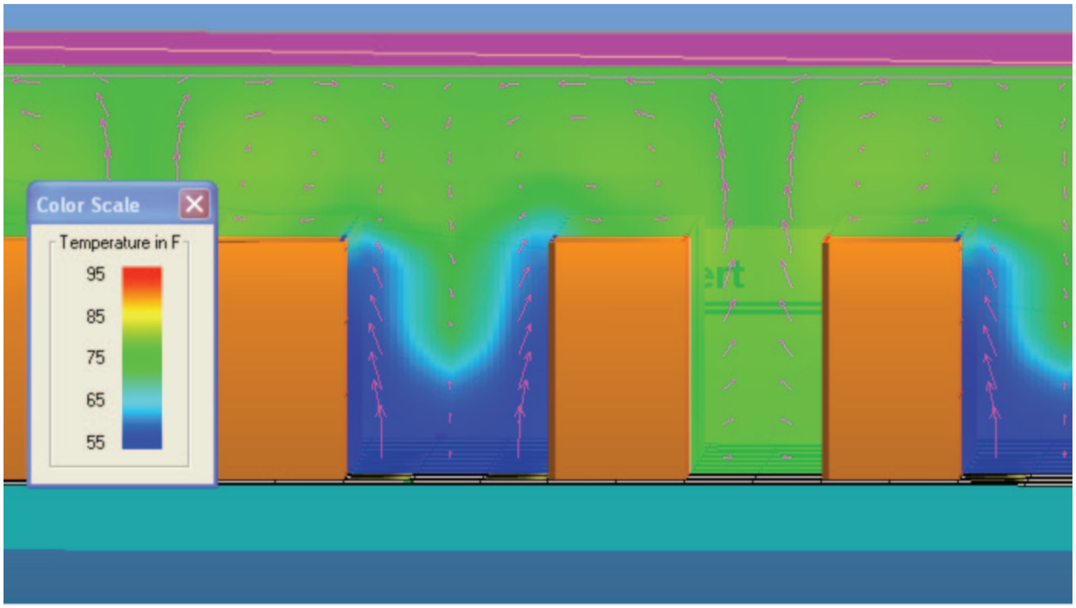
Introduction

There is a tremendous difference between data center improvements and simple space expansions. For true hard-dollar savings, data center improvements must include identifying redundancies so unneeded equipment can be unplugged and eliminated. Updates should include consolidating applications whenever possible, employing energy-efficient technologies, and finding ways to streamline personnel without sacrificing quality.

By making improvements in the data center, companies can save money while improving their IT infrastructures. At the same time, they can reduce their electrical consumption and make an important difference in the volume of carbon emissions they generate. Modernization and moderation are the keys.

With better facility design and management, companies can improve and maximize their overall efficiency, saving hard dollars. This paper looks at some of the methods and benefits.

Figure 1
Sample CFD graph



Designing a better center

Cooling Off
With electricity costs second only to equipment purchases at most data centers, energy-efficient data center design has to be a high priority. Designers should consider power and cooling capacity as a critical element, because as much as 70% of the energy consumed there will likely be spent on keeping hardware cool. Designing for optimal thermodynamic results is important. That includes optimal plenum design and zoning, and placing equipment in such a way that less cooling is required. In addition to using maintainable, reliable, and energy-efficient technologies, companies can better design their centers by employing expertise with regard to computational fluid dynamics (CFD) modeling. A sample CFD graph is shown above.

Proper Maintenance
Regular maintenance may not be glamorous, but it does save companies considerable money. By extending life cycles of infrastructure assets and by replacing or adjusting equipment in a timely fashion—always with an eye toward improving energy efficiency—the result is real dollar savings. Activities in this space include automated calibration of metering and monitoring devices and quality assurance of routine maintenance (for belts, filters, and connections).

Operational efficiencies

There are a variety of ways companies can modernize their operational efficiencies (also see HP's Data Center Environmental Opportunities white paper).

Improved Asset Utilization
Servers are typically sized for peak workload and growth demands. When multiple systems are deployed, there is often extra capacity built into every server configuration. The result is servers running at just 15% to 25% of their capacity.[1] Increased standardization, automation, and virtualization enable firms to dynamically and automatically shift resources such as servers, disks, and networks among applications as required. As an example, this flexibility would enable administrators at financial firms to run applications like Siebel or SAP at 70% or 80% utilization, without risking critical infrastructure failures.

Improving Asset Utilization

- Turning off servers no longer in use after discovering no application owner is identified.
- Continuous monitoring to see if application is active or not
- Slowing internal clock speeds (chip vendors are providing the ability to do so) when the compute load slows; if feasible, implement—it will save energy but perhaps not capital expense (CapEx).
- Reducing power consumption—This reduction is a critical element in virtually every server and PC processor design and product road map, and is helping to enable new classes of mobile computing devices.
- Turning off modules within an application, for example, SAP, to reduce power consumption.

1 A typical x86 server consumes between 30% to 40% of its maximum power when idle (*Power And Cooling Heat Up The Data Center*, Richard Fichera, Forrester, March 8, 2006).

Improved Scalability and Agility
Beyond efficiency for the IT staff, increased standardization, automation, and virtualization will deliver unheard-of agility for business managers. As new applications and solutions are deployed, it is easier and faster to set up new partitions or virtual machines within a single processor rather than sizing an application solution for an additional fully configured server. HP has found productivity gains when installing and configuring a virtual machine in one hour versus installing and configuring a new server in one day.

Total Cost Savings
By combining multiple servers into one, companies can achieve economies of scale by reducing floor space and cutting power and cooling expenses. As a bonus, hardware and software licensing, maintenance, and network connectivity costs go down by combining what were previously separate physical server environments. Finally, fewer workers are required when managing fewer systems. VMware claims that customers estimate average cost savings ranging from 23% to 48% from hardware and systems cost reductions and 40% to 72% in operations cost reductions.

The Specifics
HP has identified four critical areas for cutting costs in the data center:

- Virtualization
- Automation of service delivery
- Applications modernization
- The human element

Virtualization
Virtualization is essentially the dynamic pooling of heterogeneous compute, storage, and network resources. All of these can be virtualized in different ways to accomplish different business objectives. Rather than running a set of dedicated discrete components for every application, clients run applications across a pool of shared computing/capacity, storage, and network/bandwidth resources. The resources are dynamically allocated, provisioned, and ultimately dismantled based on their changing business needs.

The virtualization service delivery model is provided as a utility-like service. The centers reduce costs and more quickly deliver resources/services that enable increased flexibility and responsiveness to ever-changing business needs, with higher levels of service availability.

Many view virtualization as a technology solution—a result of the significant roles hardware and software play in enabling this type of functionality. But in reality, virtualization is a services-based solution that can employ a variety of enabling virtualization technologies in a number of fashions to virtualize various layers of the IT environment. It is the way in which these technologies are implemented and managed on an ongoing basis that delivers the most value to the organization. After all, the technology will inevitably change. But without the appropriate management, support services, and ongoing operational best practices, the technology alone would yield limited results.

There are different approaches and fundamentally different ways of virtualizing IT infrastructure. And virtualizing can be done in various ways at various levels of the environment, including at the network, server, operating system (OS), application, and storage layers.

Benefits of Virtualization

Adopting virtualization technologies enables IT to be responsive to business needs:

- 40% to 80% utilization rates for Intel servers up from today's 5% to 15%.
- Provisioning times for some new applications measured in tens of seconds, not days.
- Response times for change requests measured in minutes.
- Zero-downtime hardware maintenance without waiting for maintenance windows.
- Achieving 99.999% (five nines) availability now becomes highly feasible. Five-nine availability implies a downtime of only slightly more than five minutes per year.

Implementing virtualization technology can help organizations achieve critical IT objectives:

- Dynamic resource allocation, with burstable capacity to accommodate fluctuations in demand
- Rapid provisioning of additional resources beyond the base capacity commitment, with fulfillment of IT resource capacity requirements as needed
- Optimal server utilization, so a single machine can handle increased workloads and multiple applications with limited or no degradation to performance and availability
- Better return on investment with less expenditure related to infrastructure and its management
- Improved cost control and predictability with usage-based pricing to better align spending with actual resource consumption
- Accelerated time to market for new applications by leveraging available partitions of the virtual server—this helps avoid the delays and cost of purchasing additional server hardware when additional computing resources are needed
- Electrical power/cooling reduction, through the ability to move applications from server to server during low usage to reduce data center power and cooling

Virtualized Applications

Application virtualization is the ability to install and use an application on a system while protecting the local operating system and other applications from modifications that could affect stability or security. Apart from reducing maintenance on the server, the actual process of deploying new applications is simpler, and, if there is a problem with the new version, the rollback process is simple.

The following list presents the value of application virtualization-targeted solutions:

- Clustering and high availability—Advanced application virtualization capabilities provide for hot fail-over. This is particularly powerful in cluster environments in order to increase application reliability and availability; however, current virtualization technologies also allow for hot fail-over in nonclustered environments, provided the configuration is set up correctly.
- Fault tolerance—Isolating the application from the server environment creates application mobility. This increases application virtualization fault tolerance significantly by keeping a stateful connection while moving applications between virtual servers or across physical servers. Such a feature would be especially applicable in mission-critical application environments or those environments that have especially long-running processes such as scientific applications.
- Application scale-out and consolidation—Application virtualization provides a consolidation strategy to data centers by enabling multiple applications to be provisioned on a single physical server (which increases server utilization). This can be accomplished by geospatial placement within a data center or across data centers. When performance for a particular application becomes an issue, that application can be relocated to another server. With more advanced application virtualization solutions, the application relocation can be done while maintaining connections, providing real-time scale-out and scale-up capabilities.
- Reduction of service/operating system maintenance downtime—Application relocation enables applications to be moved off servers while maintenance or operating system upgrades are being performed. When the maintenance is completed, the application can be relocated back to its original server. Also, by isolating application environments, an application upgrade can be performed with much less risk to other applications running on that server. (Server virtualization provides this same isolation benefit.)
- Rapid deployment of new services—Applications can be provisioned onto virtual servers more quickly than they can on an unordered physical server. An application moved from a test to a production environment can be provisioned onto an existing server rather than having to order and configure a new physical server. Application relocation provides the benefit of using a smaller server for testing the application in limited production and then relocating the application to a larger server in a full deployment without disconnecting any of the users.
- Composed workload—Application virtualization can address a composed workload scenario on a pool of machines where various applications are interposed based on priority and time of day. For example, many financial services companies run both online transaction processing applications such as trading programs (with peak demand at the start and end of the trading day) but have minimal volume before start and after close of trading. During the times when the trading systems are not utilizing capacity on machines, batch programs and/or processes can be moved onto the infrastructure for capacity use during the nighttime (at lower electricity rates). At the end of the night, the batch processes can be check-pointed and stored to disk so the full computing capacity is available for the online transaction processing applications.

Note: Not all applications are designed for virtualization. This may be because of the way they were designed or because of “hardened” legacy interfaces.

Automation of Service Delivery

The IT industry today faces three major challenges in the service delivery space:

- An increasing need to drive cost curves down through operational efficiency
- A requirement to maintain service delivery excellence
- Compliance with the demands of clients and the marketplace regarding standards associated with frameworks, such as BS15000 and IT Infrastructure Library (ITIL), to be deemed eligible to bid for significant pieces of business

The traditional approach to service delivery involves attacking problems by concentrating on changing the technology and tooling. Those efforts drive cost savings. Although selecting different hardware is easy, it may only result in procurement cost savings. That alone does not necessarily increase asset utilization or address the issue of market-driven standards.

In contrast, automating service delivery creates a fully integrated ITIL service management and ITIL information and communications technology infrastructure management (ICTIM) framework that aligns to best practices as defined by ITIL. Furthermore, automation ensures the design, development, and deployment of tools and processes are tightly integrated.

Greater business agility can be achieved through a globally consistent operating environment across service delivery capabilities by standardizing, automating, and integrating technologies. Here are some of the benefits:

- Reduced complexity through leveraged data center locations, processes, people, and technology
- Correlated real-time events to business impact through database technology
- Integrated composite point solutions and business processes through an enterprise integration framework
- Standardized processes including ITIL, Capability Maturity Model® Integration (CMMI), and Lean Sigma
- Automated manually intensive operations, resulting in predictive management
- Enabled end-to-end visibility from the data center to the client

Virtual Control Center

The virtual control center (VCC), an aspect of automated service delivery, provides process-driven requirements leading to an optimized monitoring and incident management function. A primary business process objective of the VCC is minimizing the time required to recognize issues and restore service. A secondary objective includes weaving in proactive alerts (typically based on service degradation threshold monitoring) to allow for the recognition of impending issues, so they can be addressed before reaching a full-service outage.

Optimizing control center capabilities that will manage diverse hosted services requires consolidation, transformation, and automation. This move toward a utility computing model helps companies meet market demands. By implementing a VCC, companies can better support diverse and changing customer and corporate needs while continuing to improve productivity, customer service, reliability, and accuracy. The VCC provides predictable and reliable monitoring and proactive services regardless of the regional point of delivery and underlying enterprise management system(s). With a single visualization—one console—all the necessary information and systems-level interaction are provided to the control center operator to complete his or her job functions precisely and expeditiously.

Configuration Management Database

Modern firms provide the ITIL-based process framework for service management (service delivery and service support) and security processes and tools used in the agile infrastructure. Common processes enable quality and reduced costs to deliver.

A configuration management database (CMDB), as the ITIL characterizes it, is rapidly growing in importance to IT organizations, as it can provide a core enabling capability to promote more cohesive service management, or IT service management (ITSM).

Automated discovery and mapping of application dependencies on infrastructure components are important to enterprises. IT executives require nonintrusive solutions to help them gain visibility into their application infrastructures for change and configuration management, resource optimization, compliancy, and business continuity controls. In short, the CMDB makes their infrastructure actively self-managing.

Applications Modernization

Reducing the Application Footprint

With old applications retrofitted for today's more complex business infrastructures, many companies find their applications costing them disproportionate amounts of their IT budgets. Untangling the knot of patches, fixes, and add-ons accumulated over the decades requires expertise in older computer languages, as well as time and effort your organization may not have. Outdated systems do not provide the flexibility for companies to remain responsive to a dynamic and highly competitive business environment.

Companies must use their industry and domain expertise, applications knowledge, and strategic planning capabilities to quickly and efficiently move legacy applications to modern platforms that provide more functionality, flexibility, and are more economical. HP professionals can help ensure your applications portfolio and infrastructure align to your business, operations, and budget needs as a major component of your future mission strategy.

The Steps to Modernization

Relearn—Document status of applications' environment and establish a baseline of functionality, business rules, and data flows

Refactor—Stabilize current code base, improving performance and more easily maintaining applications

Rehost—Move existing applications to lower-cost platforms, reducing maintenance and operational costs

Re-interface—Provide new interfaces to unlock functionality, increasing transactions initiated so processes can move faster

Re-architect—Separate systems' components so systems work together

Replace—Replace legacy applications with off-the-shelf solutions or (if necessary) custom-built J2EE applications, or a combination of the two

Retire—Identify redundant systems and target them for de-commissioning; identify systems that should be replaced with a common system and systems that need to be retained

Designed for Run™

Modernizing older systems and data centers can be financially daunting. Most companies expect to pay for modernization by reducing their applications management costs. The savings, they reason, will fund the investment in new development. When bidding on application development projects, they typically look at the cost of the development alone. Yet, the build portion is only a fraction of the total cost structure. In the mainframe world, people "designed for run" because storage, memory, and other elements were expensive. In the client-server world, people solved problems by adding more servers or network capacity. That era added tremendous costs to the IT world because the impact of providing service to all components of the architecture was not considered.

Efficiency—Manageability—Operability—Infrastructure Awareness

HP understands the economics, the performance characteristics, the reliability, and the need for 50% to 60% asset utilization. Often, enterprises build systems with only 10% utilization and consolidate servers on the back end.

Executing Designed for Run requires modernization road maps, industry frameworks, and reference architectures. Other needs include design work with network engineers, infrastructure engineers, database and testing experts. In the end, enterprises need to build a secure, agile environment that is always on—zero outage. Designed for Run is a major part of HP's internal culture and the way the company executes.

The Human Element

Improved Manageability

By increasing standardization and automation, companies can typically get away with fewer IT administrators. Instead, they can rely on integrated performance teams comprising internal stakeholders such as the chief information officer, technologists, and others who monitor automated management software. It is easier to manage a smaller number of centralized systems than it is to control a larger number of distributed systems. The manageability of systems directly affects the cost and availability of the environment.

Work Arrangements

Remote systems management is another way companies are saving real dollars. It refers to the ability to centrally manage remote sites without local resources.

To guarantee service levels across dispersed sites, you need the following:

- Unrestricted tracking and management of software and hardware assets across any network
- Hands-off automated processes that don't require special servers or additional local administrators for any of your computer platforms
- Set-and-forget self-managing systems that continually align themselves with your centrally defined IT policies
- Intelligent systems that prevent the stealing of bandwidth from core business activities
- Seamless integration, with a single set of controls and unified reporting across headquarters and remote sites

Telepresence

Telepresence refers to a user interacting with another live, real place. It is distinct from virtual presence, where the user is given the impression of being in a simulated environment. Telepresence and virtual presence rely on similar user-interface equipment. The user's experience at some point in the process will be transmitted in an abstract (usually digital) representation. The main functional difference is the entity on the other end: a real environment in the case of telepresence versus a computer in the case of virtual reality.

Telecommuting, e-commuting, e-work and …

Telecommuting, e-commuting, e-work, telework, working at home (WAH), or working from home (WFH) are work arrangements in which employees enjoy some flexibility in working location and hours. Typically, the daily commute to a central place of work is replaced by telecommunication links. Long-distance telework is facilitated by virtual private networks, video-conferencing, and Voice over Internet Protocol (VoIP). It can be efficient and useful for companies, as it enables staff and workers to communicate over a large distance, saving significant amounts of travel time and cost. As broadband Internet connections become more commonplace, more and more workers have enough bandwidth at home to use these tools to link their home office to their corporate intranet and internal phone networks.

Conclusion

IT dollars are harder and harder to come by, leaving more companies exploring ways of changing their data centers and computing environments to save money and cut energy costs. Whether revitalizing an aging data center or building new ones, careful planning, smart thinking, and energy consciousness are some of the most important requirements for moving forward.

HP is working on a variety of ways to make data center operations more functional, cost-effective, and capable of providing environmentally conscious benefits. Our consultants can show you how modernizing operations and applications, reducing the physical footprint, and using the work force better can cut costs and provide significant savings—both hard and soft.

About the authors

René J. Aerdts

René J. Aerdts is the chief technologist and leader of the Information Technology Outsourcing/Business Process Outsourcing (ITO/BPO) Chief Technology Office with HP. In this role, he leads a team of architects to drive vision and strategy by using technology and innovation as a competitive advantage. As an HP Fellow, Aerdts helps develop enterprise-wide initiatives that shape the future of HP. He leads HP Fellows Program activities for clients in the communications industry.

Aerdts joined EDS' Systems Engineering Development Program in the Netherlands in 1986. After transferring to Plano, Texas, he was project leader for the Primary Integrated Platform Environment (PIPE®) and a major contributor to the patent for the PIPE process. He has completed temporary assignments in the United States, Argentina, Australia, Belgium, Brazil, Denmark, Germany, Hong Kong, Italy, Malaysia, New Zealand, Singapore, Sweden and the United Kingdom.

Before joining EDS (now HP), Aerdts spent almost five years as a scientific assistant at the State University of Utrecht in the Netherlands, teaching, performing research, and publishing articles.

René Aerdts earned his doctorate in mathematics with a minor in physics from the State University of Utrecht in the Netherlands.

Alex Cameron

Alex Cameron, an HP Fellow, has more than 25 years experience in the IT industry as a strategist, technical leader, innovator, and product developer within government, defense, and transport industries. His present work and interests are focused on enterprise agility and the core strategies of business planning and modeling along with activities such as enterprise architecture planning and modernization that support the business initiatives.

Cameron's career began at EDS (now HP) in 1998 as a senior technical leader and architect developing client solutions. He then went on to provide regional technical leadership in Service Delivery as the regional chief technologist in Asia Pacific.

Cameron joined EDS (now HP) from Australia's largest telecommunications company, which was awarded one of the largest contracts by the Department of Defence to design and develop an operational over-the-horizon radar system. As the lead IT architect for the system, Cameron was appointed as the divisional leader to take on the responsibility for developing and delivering this major component.

Before that appointment, Cameron performed roles in business development, consulting, engineering management, research engineering, and was a weapons and electrical officer in the Royal Australian Navy for 15 years.

Alex Cameron received a bachelor of engineering (communications) degree in from the Royal Melbourne Institute of Technology and a master of engineering science degree from the University of New South Wales in 1981. He enjoys publishing papers and is a sought-after public speaker.

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