



A CMI Business Brief White Paper:

Efficient Data Centers Are Built On New Technologies and Strategies

By Tim Cuny, CMI VP of Solutions





New technologies can work wonders, but they cannot magically transform a sprawling, inefficient data center into a paradigm of high-tech high performance. Although virtualization technologies, cloud platforms and new management tools can help companies squeeze more productivity from existing resources, today's solutions may become tomorrow's headaches unless organizations adopt more strategic – and proactive – approaches to optimize data center management, growth and service level agreements.

Because of several converging phenomena – rapid advances in technology, exponential increase in demand for services, and flat or declining IT budgets – data centers that were once touted as models of operational and economic efficiency are now regarded as silicon-lined money pits. In many instances, yesterday's IT solutions have become today's challenges.

Today, the average company spends 70 percent of its IT budget on operations and maintenance, leaving little to invest in innovation. Nearly two-thirds fall behind schedule when deploying new IT capabilities,ⁱ and it can take up to six months to establish hardware and software infrastructure.ⁱⁱ

Until recently, the data center itself was viewed as the main driver of business efficiencies. As IT groups struggled to meet demand for services and data-processing capacity, they understandably placed less emphasis on making the data center more efficient. After all, when a railroad engineer's mission is to haul more freight at faster and faster speeds, the engineer isn't going to obsess over fuel consumption and employee productivity. Over the past few years, however, many IT managers have been asked to do exactly that, thanks to technology-fueled trends that include:

- The growth of “Big Data” – data sets so large that they are impossible to process with existing data center infrastructure and management tools.
- The fusion of mobile and business communications, as well as BYOD (bring your own device). At a minimum, this requires IT groups to achieve greater interoperability between wired and wireless networks.
- Advanced business analytics – complex forecasting programs that run simulations based on historical data to predict future business outcomes.

Beginning in the mainframe era, IT departments responded to the growth in demand by adding processors, storage capacity and operating system upgrades, as needed. Because the focus was on keeping the “train” steaming ahead at full speed, data centers now have a huge appetite for physical space, power and labor – not to mention additional hardware, software, cabling, etc.

Fortunately, new technologies are available to help IT “do more with less.” These technologies can dramatically enhance operational efficiency, lower costs and provide a greater ROI. They can improve infrastructure performance and squeeze more value out of existing resources. However, implementing these solutions requires senior management and IT to develop farsighted strategies, and such strategies have gone



missing at many organizations. Data center strategies must be based on continuous assessment of, and planning for, every infrastructure component. Tactical responses and temporary fixes are things of the past.

This white paper provides an overview of 5 key components for a data-center optimization strategy – those suitable for small- and medium-sized enterprises. We have outlined key benefits and features of: server and storage virtualization technologies; converged infrastructure systems; cloud computing; and data center management software, as well as “green” technologies that can reduce energy costs and reduce an organization’s carbon footprint.

Server Virtualization

By using a software application to divide one physical server into multiple virtual environments, server virtualization effectively creates many servers from one – E Pluribus Unum. Although server virtualization has existed for over 10 years, many small businesses have yet to capitalize on the advantages offered by this “new” technology – benefits that include:

- Faster provisioning of servers. Because server virtualization enables data center administrators to almost instantly replicate virtual machines to add capacity, they can swiftly provision new projects, applications and users. Needless to say, faster provisioning also reduces manpower requirements.
- Lower energy costs. Migrating physical servers to virtual machines helps lower power and cooling costs. In addition, fewer servers = less networking gear = fewer racks, which translates into less data center floor space, an important consideration for companies that don’t own their data center(s).
- Because server virtualization abstracts away the underlying hardware, replacing it with virtual hardware, vendor lock-in is reduced. Data center managers have more flexibility when it comes to the server equipment they choose, and can leverage this newfound flexibility when the time comes to renew or purchase equipment.
- Disaster recovery efforts are improved by eliminating dependency on particular hardware vendors and models. Because data centers no longer need to keep identical hardware on hand, companies can save money by buying cheaper hardware; consolidating servers to fewer physical machines; and (in many cases) automating much of the recovery process.

Learn More About Converged Infrastructure Systems

Cobbled together from different parts from different vendors, today’s enterprise computing model is becoming ever-more unwieldy, complex and inefficient.

In response, IBM recently unveiled its PureSystems converged infrastructure system, which integrates every IT element (physical and virtual) into a single machine that can be easily installed and managed right out of the box.

The rack-based system features a single management interface and a catalogue of smart software “patterns” that enable IT staff to focus on business-critical tasks instead of endless system maintenance, updates and other “scut work.” In short, PureSystems slashes the costs, inefficiencies and complexities associated with managing the modern data center.

For more information on how converged infrastructure systems work and what they can do for your organization, download the CMI white paper: [To Combat Rising Inefficiencies and Costs, IBM Integrates the Data Center into a Single “Box.”](#)



- Server virtualization and consolidation also prepares organizations to move into the cloud.

Storage Virtualization

Many companies respond to growing data volumes through server consolidation and virtualization, but merely add hardware to address the growing need for storage capacity. This has created tremendous inefficiencies. In some cases, 70 percent of storage capacity sits idle, locked behind particular servers or purposes while other servers run out of capacity.

Using storage virtualization, data services are no longer limited by hardware characteristics. Instead of “silos” of storage capacity that cannot be shared, a virtualized storage pool makes unused storage capacity available to any server, user or application accessing the pool. When storage is no longer needed, it becomes part of the pool again, and can be used elsewhere.

Storage virtualization also provides consolidated storage management, eliminating multiple tools and processes for different arrays. By pulling storage management together under one roof, data center managers can increase the reliability of storage environments and reduce opportunities for human error. Storage virtualization also allows system administrators to share high-end features (thin provisioning, snapshots, remote replication, etc.), which are included in the storage system, with arrays that don’t have the features. This can extend the life of storage devices and maximize return on investment. In many cases, it can prevent or delay additional storage purchases.

By replacing a fragmented environment with centralized and flexible storage, virtualization reduces the total cost of ownership. Equipment, management, energy, maintenance and licensing costs are lowered and storage is used more efficiently.ⁱⁱⁱ

Converged Infrastructure Systems

Under the enterprise computing model, it has become increasingly complex and costly to support the full lifecycle of applications and infrastructure. Highly paid professionals must devote their time and expertise to procure, configure, deploy, integrate, tune and scale system components. This leads to longer project timelines and higher costs.

Converged infrastructure systems integrate key IT elements (physical and virtual) into a single machine that’s easy to install, automate, update and manage. Essentially, this integrated system is “a data center in a box.” Using converged

Tivoli Storage Manager Defeats Data Duplication

With more data to back up, data duplication has become harder to combat. Unfortunately, many storage management products produce massive amounts of duplicate data during their periodic full backups. Not only does this increase operational and capital costs, it makes data recovery more difficult and risky.

To control costs and keep the “data footprint” to a minimum, IBM Tivoli Storage Manager (TSM) uses a management model that enables IT administrators to identify, protect, securely move, archive and delete data as appropriate. The methodology used by TSM backs up only new or changed versions of files, which slashes redundancy, network bandwidth requirements and storage pool consumption compared to products that employ periodic full backups. Tivoli Storage Manager data reduction techniques also include sub-file backup, tape reclamation and data compression.

The IBM Tivoli Storage Manager family includes:

- **Storage Manager FastBack:** a near-instant recovery solution that helps mid- and large-sized organizations establish continuous data protection of their business-critical applications in data centers and remote offices.
- **Storage FlashCopy Manager:** This tool helps organizations to perform and manage

CON’T. NEXT PAGE 4



infrastructure system, IT only needs to manage a single integrated system.

A converged infrastructure condenses and virtualizes scattered physical parts while allowing IT to maintain the necessary isolation among operational functions – e.g., HR, Finance, Sales and Marketing. A converged system provides a simplified experience to IT staff and the businesses that use IT resources, since there’s no longer a need to manage a jigsaw puzzle of networked pieces purchased over the years from different hardware and software vendors.

Converged systems automate many processes, reducing the amount of manpower needed. They enable companies to significantly reduce the amount of time required to, install, configure, provision, change or expand the data center infrastructure. More time can be devoted to mission-critical tasks and innovation instead of basic operations and maintenance. What’s more, converged systems allow companies to quickly establish private clouds that can be scaled up and down automatically.

Cloud Computing

A growing number of organizations are migrating selected applications (usually email and other utilitarian functions) to cloud environments run by third parties. The benefits of these external clouds are many, including:

- Reduced risk associated with smaller upfront investments. Because the lion’s share of hardware and software is supplied by the cloud provider, and accessed by employees from anywhere in the world through private or public networks, capital investments are minimized.
- Lower operating costs using the pay-as-you-go model. Cloud providers have exploited efficiencies of scale to keep usage fees low.
- Scalability and Flexibility. You pay only for the services and capacity you need – when you need them.
- Higher productivity. IT personnel spend less time managing the network; more time working on mission-critical functions.
- Leaner and greener data centers. Smaller, virtualized data centers consume far less power and physical space than sprawling behemoths.

While external clouds free up staff and infrastructure for mission-focused work, internal clouds can support a wide range of users and services with easy scalability and rapid provisioning. Many companies are launching internal clouds from converged infrastructure platforms.

Data Center Infrastructure Management Software

Data center infrastructure management (DCIM) was once reserved for large

frequent, near-instant, non-disruptive, application-aware backups and restores.

- Storage Productivity Center: This storage resource management solution let you control your entire storage infrastructure through a single interface, including mixed-vendor storage systems.

Rather than offer the traditional once-a-day backup, Storage Manager FastBack features continuous data protection. This protects data as it’s created, without impacting operations. Tivoli Storage Manager FastBack also eliminates the need to move tapes from a remote office to a central vault by replicating “de-duplicated” copies of your data over the wire to a central Tivoli Storage Manager server for backup consolidation and disaster recovery. As a result, you reduce the risks of data loss from lost or stolen tapes, as well as from errors during manual data protection operations.

Traditional storage management solutions are not intended for environments that feature large databases, virtualized workloads and encrypted files. They are also less suitable for organizations undergoing growth and change, which usually create more data. With traditional solutions, more data means longer backups and missed backup windows. As a result, some data may not be protected at all.

The TSM family offers dramatically increased scalability and performance over traditional products. A single Tivoli Storage Manager

CON’T. NEXT PAGE 5



companies with thousands of square feet of data center floor space and large IT staffs. Today, almost any organization may have significant numbers of physical and virtual machines. The emergence of DCIM software is occurring as organizations look to better manage their data center infrastructures without increasing the number of “warm bodies in cold rooms.”

DCIM software benefits data centers in a number of ways. First, it provides added visibility into the IT infrastructure. Attempting to manually monitor and manage network performance is frequently time consuming and laborious. DCIM software provides visibility into the physical infrastructure so administrators can instantly gauge how the data center environment is configured, which resources are assigned to which servers and how the consumption of the resources fluctuates over time.

In short, DCIM promotes better decision making. When data center administrators are able to continuously monitor and manage resources, they make better decisions.

To successfully run a modern data center, automation is required whenever possible because any time humans become involved, human errors are bound to follow. Using DCIM software, organizations can automate repetitive, error-prone tasks such as data migration, storage reclamation and server and storage utilization monitoring.

DCIM software boosts application availability and operating efficiency by putting more information at management’s fingertips. It lets administrators assign the right applications to the right hardware, ensuring that each application makes efficient use of resources. This translates into higher application availability and lower data center costs.

Sustainability Strategies and Equipment

Traditional data centers were designed to house mainframes and minicomputer operations. Obviously, today’s power distribution, cabling, flooring and lighting requirements are far different. New hardware and network configurations require up-to-date cooling strategies. For example, instead of reducing the temperature of an entire facility to Artic conditions, the latest technologies focus on concentrating cooling where and when it’s needed within the racks and aisles. This can dramatically lower costs and conserve resources.

Historically, data centers have kept “cold aisle” temperatures at

server can manage up to two billion data objects, whether files, databases or images of entire volumes. Additionally, Storage Manager can run a larger number of concurrent operations than ever before. And it dramatically simplifies management by eliminating virtually all data-base administration tasks and unifying the management of Storage Manager, Storage Manager FastBack and iStorage Manager FastBack for Workstations under a single administrative console. Storage Manager can easily transfer work between backup servers to accommodate acquisitions, consolidations and reorganization.

Storage Manager FastBack contributes to storage management simplification through full automation that features a “set it and forget it” policy engine. Its self-managing repository always has a set number of data iterations on hand for easy rollback and fast recovery.

FastBack features integrated support for all Microsoft Windows and Linux-based applications, including Microsoft Exchange, SQL, Oracle and SAP. An optional Storage Manager FastBack for Microsoft Exchange recovers granular e-mail data objects quickly.

Tivoli Storage Productivity Center can help reduce storage complexity with storage reporting across host file systems, data-bases and storage, and it provides correlation between host usage and storage assets, as well as comprehensive reporting on virtualized environments.



approximately 65oF/18oC. According to a recent report by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), however, certain data centers can safely operate at temperatures as high as 104oF/40oC. Though we don't recommend pushing the extremes, it's not uncommon for operating targets to reach 80oF/26oC.

Raising overall temperatures by a few degrees can significantly reduce water consumption by the cooling systems.^{iv} Raising ambient temperatures can be safely achieved by:

- Positioning server racks to create hot and cool aisles; then directing the output of air conditioners into the hot aisles while keeping room temperatures relatively high.
- Creating "tent arrangements," and employing convection coolers and blowers to exchange cool and warm air.
- Concentrating low-wattage lighting where it's needed, and reducing ambient lighting.
- Using variable frequency drives and electronically commutated fans.
- Using recycled water sources.

Most data centers collect hot exhaust air and return water. The water is then chilled and re-circulated. Some facilities use "air-side economization" pump hot internal air out of the building and pipe in cool external air. A similar process, "water-side economization," returns water pumped through an external radiator or cooling tower instead of a chiller. Both methods can radically lower cooling-related water requirements. In addition, studies have shown that they are viable options for at least part of the day – even in warmer climates.

Limiting physical sprawl is one of the most important goals of sustainability. Companies can reduce the amount of floor space occupied by their data centers by deploying compact infrastructure resources. For example, many late-model uninterruptible power systems (UPS) feature footprints 50 percent to 60 percent smaller than previous-generation models. Companies that operate a data center at 400V can eliminate transformer based Power Distribution Unit (PDU) cabinets, reducing the power distribution footprint by 50 to 60 percent. Within the mechanical operations, using commercially packaged air handling units and In Row cooling can eliminate traditional Computer Room Air Conditioners (CRACs), which take up significant amounts of space in the data center.^v

Become a "Strategic Data Center"

A data center is like a high-speed train. IT can't focus solely on tinkering with the locomotive (servers) while ignoring the roadbed (network) and cars (storage), as well as fuel consumption and labor productivity. Data center optimization requires senior management and IT to develop not just incident-management procedures, but also change-management and capacity-planning strategies. Collectively, they must plan new routes, lay additional tracks and acquire "rolling stock" for the coming years.

In a recent study of enterprise data centers, IBM and IDC developed a model of operational efficiency and best practices to assess the capabilities of today's data centers and describe ways that IT groups can achieve data center optimization. The model recognizes four key stages in the evolution of the data center



related to efficiency: Basic, Consolidated, Available and Strategic. Strategic data centers deliver:

- Greater investment on strategic initiatives. Staff spends more than 50 percent of its time on new projects versus maintaining the infrastructure, compared to only 35 percent for Basic data centers. Thirty-nine percent are planning transformational projects to reengineer their IT service delivery, compared to 23 percent in Basic data centers.
- Greater efficiency. Strategic data centers enjoy more than 2.5 times the staffing efficiency of basic data centers, averaging 27 servers per administrator compared to 10 servers per administrator in Basic data centers.
- Greater flexibility. More than half of the Strategic data centers support a high rate of organizational change compared to just six percent in Basic data centers.

Four characteristics distinguish companies that adopt a more strategic approach to the data center:

1. Optimized server, storage, network and facilities assets maximize service capacity and availability.
2. The data centers are designed for flexibility to support changing business needs.
3. Data centers make use of automation tools to improve service levels and availability.
4. Strategic plans are developed to align IT activities with company goals, and these plans are kept current.

Today, about one in five data centers operate at the Strategic, or highest efficiency, level. Companies not yet operating at this level can achieve greater efficiency by emulating the four key behaviors of IT organizations that operate Strategic data centers. For most organizations, getting there will not happen overnight. Typically, it takes an organization several years of planning and strategic investments in each area of the data center to achieve Strategic status. Although North American organizations, and companies with more than 500 employees, had the highest proportion of Strategic data centers, this efficiency is achievable for any company. Strategic data centers are found in all regions of the world and in smaller companies.^{vi}

Most companies, whatever their size, plan on using outside help with the projects that advance efficiency, a realization especially shared by Strategic data centers. To achieve the highest levels of efficiency, data centers must continually re-evaluate their performance, reviewing their investments in tools, technologies and governance, and must have the right level of skills and assistance.

The first step is to develop a proper strategy – a roadmap to direct the enterprise from Point A to Point B and beyond. The roadmap should include data center maturity assessments (both infrastructure and operations), as well as virtualization assessments. Your “Grail Quest” is to develop a service-driven plan that ensures that the data center works closely with the business to provide optimal levels of service at acceptable operating costs.



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- i IBM Market Insights Study, 2011 Business Benchmarking Time-to-Value Study.
 - ii From a commissioned study conducted by Forrester Consulting on behalf of IBM in 2011.
 - iii Mark Peters, "Storage Virtualization for Efficient Operations." The Enterprise Strategy Group, Inc., 2012.
 - iv John Collins, "Implementing Sustainable Data Center Practices," Environmental Leader, July 17, 2012.
 - v Ibid.
 - vi "Data Center Operational Efficiencies Best Practices," IBM Global Technologies Services, April 2012.



Status Check: By Kris Neely, CMI's Chief Technology Officer

Changes in the data center are more rapid and pervasive than at any time I can remember. What was once a relatively staid environment, or as staid as any IT computer room can be, has now evolved into a veritable beehive of activity. Engineers may be working on some or all of these technologies, often at the same time: virtualization, WAN and LAN optimization, new IT operations tooling (installation, upgrade, etc.) cloud, HA/DR, server consolidation – and the list goes on.

In my mind, this puts a premium on organization, documentation, teamwork, and, above all, strategy and architecture. Without a documented (on paper) strategy and associated (and equally well-documented) architecture, costs will rise, rework will increase, mistakes will occur, and the result will be more complex and error prone than it needs to be.

We've been here before (sort of): the old model of all-things-in-one-box (for example, a mainframe environment) was very much akin to "keep all your eggs in one basket." That model got displaced by the pizza-box mode: one server (one "pizza box") equals one application. That model contributed the first round of strategy/architecture issues as applications were parsed to individual platforms and keeping track of the resulting explosion or 'sprawl' was a whole new headache – especially if the strategy and architecture were not documented.

Then the data center was hit with the server consolidation/virtualization wave, which didn't so much explode as implode: 10 pizza box computers became 10 partitions or virtual machines on one physical server. That's a key difference as those 10 VMs were dependent on the one physical box that housed them, on the operations care-and-feeding of said box, etc. And – the architecture the model was based on. Without a documented strategy and architecture to refer to/depend on/reference and cost – things often turned from bad (confusion) to worse (out of control/held-together-with-bailing-wire, too expensive) and so on.

Thus, my take-away from this White Paper is the same as my advice to the CIOs, CFOs, and CEOs reading it: everything in your data center (and your IT Department as a whole, actually) should be based on the Strategy-Architecture-Design-Implementation Plan (SADI) cost model. That's a mantra we recite daily at CMI. Because data center optimization is complex and expensive – but significantly less so with a SADI roadmap to follow.

See You Next Time,
Kris Neely
CTO, Chouinard & Myhre, Inc.



Reality Check: A CFO Reviews this White Paper

As a CFO that has worked in Visual Effects, an industry that pushes the limits of processing and data storage capabilities, I know first-hand what can happen to the cost of a data center when demand outstrips supply. Demand will always outstrip supply, and just adding more hardware is only a stop-gap, and an expensive one at that. You need to consistently look at the overall process and set a strategy to improve efficiency at all levels, or eventually the whole infrastructure will become less efficient and your return on investment will fall at an exponential rate.

I also have worked with an App company that maintained over 100 million users. While their content on an iPhone is a long way from a movie being shown on a 40 foot screen, they face very similar technical and infrastructure problems to a VFX company in managing and maintaining the data created by their users. Exploding data sets is a problem many companies face today..

The obvious benefits of such amazing technologies as mobile devices, cloud services and virtualization are quickly lost if you don't have a strategy for growth. And growth can come in many forms, sheer size of the organization, revenue, number of customers, number of locations or supported devices. Growth and complexity have very similar impacts on a companies' infrastructure and efficiency. In my experience, you have to look at both the systems and the processes. If you ignore one, then you will never solve the problem.

For example, I have heard many CFO's say they are planning to replace Oracle with SAP, or vice-versa. But both of those software systems at their core are very similar, both have strengths and weaknesses, and they need to be set up for your own unique organization. In most cases, replacing one with the other is ignoring the fact that it was not set up or being used efficiently. Or your business has changed and you have not adapted. Just replacing one with the other will bring in new consultants, and the problems may be solved because of that, but it is a very expensive solution to what is usually a process problem in the organization, not just the systems.

In setting your strategy for data center optimization, you also need some benchmarks. It is very difficult for an organization to assess how well it is performing and an IT department is neither inclined nor impartial, nor does it usually have the experience of seeing many other businesses to know how to measure efficiency compared to its peers. All businesses are different, and as I noted earlier, growth and complexity can come in many forms, some which you may never have seen before.

An independent and experienced voice in this fast moving area is important, can help you assess where you stand and also assist in setting a strategy for your future systems and processes. It is essential to recognize that neither the systems nor the processes can be looked at in isolation,



and also that neither can be considered in isolation of the current and future needs of the organization. Developing a service-driven strategy and a culture is the key to long term efficiency.

Best of Luck,

Kevin

Kevin Weston is the former CFO Digital Domain Productions, VP Finance and Operations of LucasArts and CFO/SVP Finance and Operations at Eidos Interactive Inc.