A market position paper from the experts in *Data Center Infrastructure Management*

# Data Center Infrastructure Management

## The Promises, Challenges and Imperatives of Data Center Infrastructure Management

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## Managing the Critical Information Gap in the Data Center

Today's data centers are no longer just an enabler to the business; they can often provide corporations with competitive advantages and are the underpinnings to corporate success. Effective data center infrastructure management strategies can propel the efficiency, utilization, and availability of data center assets and services. However, a fundamental rethinking of the relationships between facilities and IT infrastructure components, that provides consistent and predictable levels of efficiency, utilization, and availability to their respective organizations, needs to occur.

While both IT and facilities organizations have invested heavily in technology resources (people, processes, and tools) to manage the data center infrastructure, they have failed to achieve the promise and potential due to critical gaps between their data center facilities and IT infrastructure components.

"What is even more concerning is not change itself, but the rapid rate of change faced by today's data center managers. It comes from all directions: business, economic, technological, and compliance related. The one constant is change."

A new perspective on managing the critical infrastructure gaps is emerging that recognizes:

- The importance of real-time data to understand the true capacity of available infrastructure
- The criticality of interdependencies between logical and physical layers
- The need for holistic management capabilities and visibility of IT and facilities infrastructures
- The need for more powerful management tools that offer a rich, visual view of the infrastructure and can guide design and change management

This forward-looking perspective will be the guiding force behind new data center infrastructure management (DCIM) solutions from industry leaders such as Emerson Network Power®.

## The Impact of Change on the Evolution of Data Centers and the Relationship Between IT and Facilities

Over the previous decade, new advances in IT technologies have placed new and additional pressures on the traditional methods of facilities planning and management. Demands driven by economic and market conditions, as well as new initiatives that are energy efficient or "green," have necessitated building and IT management tool adoption. However, with the advent of technologies such as virtualization and the move to high density or cloud computing strategies, new challenges emerged, broadening the "information gap" between logical and physical infrastructures and masking critical interdependencies.

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Virtualization is one of the most significant drivers of both potential benefits and risks. Advanced, automated provisioning capabilities enabled in virtualized environments, whether they are server, storage, network, or desktop, bring inherent management challenges and impacts to the infrastructure.

In the past, data center design required significant over provisioning of capacity to allow for anticipated growth. Additionally, the push for higher densities has created challenges in terms of power and cooling capacity and its allocation across the data center. Higher densities, and the increase in overall compute capacity they have enabled, are also largely responsible for the rise in data center energy consumption, which has caused both financial and environmental concerns. Those concerns have driven fundamental changes in data center cooling strategies and were one of the primary drivers behind the rapid adoption of server virtualization.

Maximum availability, utilization, and efficiencies in the face of economic and business pressures create a burden on both facilities and IT managers to continuously optimize. This requires each organization fully understand its combined operational objectives to achieve these goals.

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### Evolution's Impact on Data Center Infrastructure Optimization

Data center managers have been challenged to maintain or increase availability, utilization, and efficiency in the face of rising costs and demands. Despite the large investments in today's data centers, significant inefficiencies still exist.

The collision of static infrastructure with dynamic IT operations has hindered progress. This has been compounded by the inability to achieve end-to-end visibility of true performance, let alone lend to predictive performance. Accounting for data center costs is often split across multiple organizations, forcing a compartmentalized decision-making process without consideration of upstream or downstream ramifications, increasing risks of data center and business application failures.

These decisions often jeopardize the very goals they have striven to support, as impacts at the physical infrastructure levels can have far more devastating impacts to a virtualized environment, server, or rack, than impacting availability of applications at an exponential rate. As IT adapted to more dynamic operations, new issues emerged in managing the overall data center as the information gap between logical and physical infrastructures masked critical challenges such as:

- Common performance and utilization data accessible by skilled IT and facilities practitioners is difficult and expensive to collect
- Inconsistency of data with little to no insightful information has left data center managers without "actionable and contextual" information to guide optimization decisions
- Managing complexity and volatility has proved extremely challenging to current staff and processes

As the necessity to drive further optimization continues, there is an apparent lack of tools and processes to synchronize the virtualization automation with the physical infrastructure without significant service engagements. This strategy limits optimization in design, necessitating a stronger synergy between the physical and IT infrastructures and the growing need for them to have a more dynamic relationship between the facility and IT infrastructures.

# The Promises, Challenges and Imperatives of Data Center Infrastructure Management

**The Data Center's Contribution to Organizational Health**

Maintaining that value to the business comes amid rising costs of infrastructure, power, and cooling, and the mantra of doing more with less. In a 2008 report, McKinsey & Company states, "Today's data centers account for approximately 25% of the total corporate IT budget, when you take in account facilities, servers, storage and the labor to manage them."(McKinsey & Company, 2008) Figure 1 illustrates typical enterprise costs.

**Figure 1: Breakdown of average IT cash costs at a typical company**

Source: McKinsey & Company

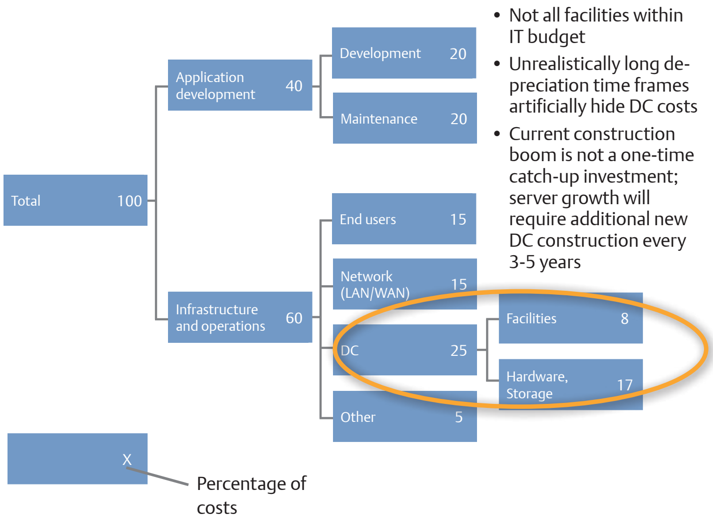
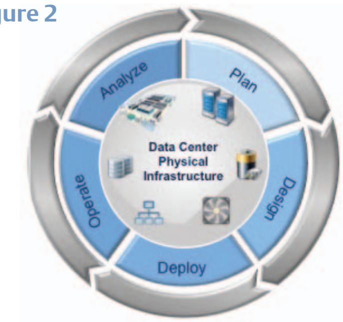



Figure 1: Despite the high costs, companies have been unable to move towards a holistic management of the physical infrastructure due to the lack of solutions. An approach that enables continuous improvement process and holistic management such as those shown in Figure 2 must address the following issues:

- Decoupling of applications/services from the physical infrastructure (virtualization) extends the life of existing data centers
- Maximizing utilization and improving the ability to consolidate current facilities into fewer, more efficient data centers
- Optimizing physical infrastructure to increase energy efficiency and enable higher densities
- Reducing complexity, increasing agility, driving continuous analysis, and planning and management improvements

**Figure 2**




**Achieving Peak Utilization**

In a 2009 report, Gartner states the following key findings:

- Most data centers do not populate server racks beyond 40% to 60%, on average.
- For x86 servers, typical utilization rates are between 7% and 15% in a non-virtualized environment (still the majority at the moment).
- Energy use in low-performance servers can reach 60% to 70% of their nameplate rating. (Gartner, 2009)

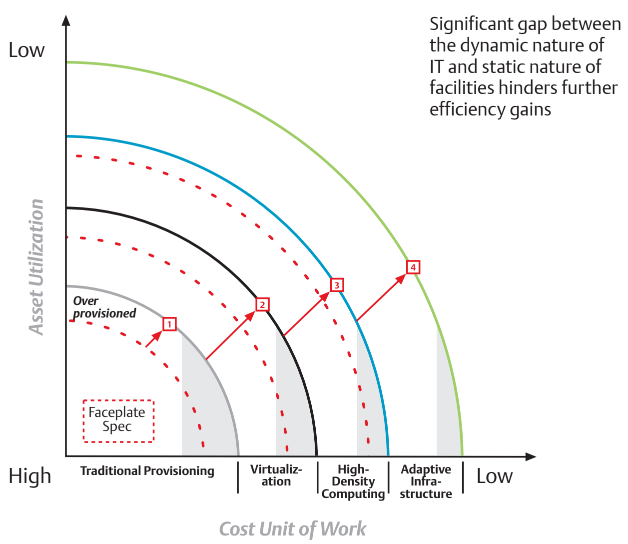
Holistic, real-time infrastructure monitoring, measurement, and management allow for the effective realization of utilization and allocation of resources across the data center. For example, a Web server with a faceplate power value of 450 Watts may only draw 150 Watts or less under lower utilized usage. Conversely, there is typically a gap between stated faceplates and actual peak, further ballooning the "cushion" of true peak performance by as much as (+/-) 10-20%.

Conceptually, virtualization has been tied to servers with the end goal to increase physical resource utilization. Virtualization technologies have focused on managing virtualization technologies to achieve their goals, not to manage the infrastructure needed to support them. Prior to the introduction of server virtualization, average consumption of physical server resources was at 15-20% of the asset's full capacity. Increasing the usage of the physical resource by increasing the consumption of the asset from 15% to upwards of 85% redefined how the data center would be managed. Although the advent of virtualization and high-density computing has extended the horizon of utilization, the gaps caused by the lack of insights into actual or absolute peak have hindered maximum utilization of assets as shown in Figure 3.

These strategies and methods of maximizing the usage of the asset increased the power consumption as well as the environmental aspects. With the utilization watermark of the asset increasing, existing power and cooling systems had to keep pace. Consolidation of physical resources allows for higher utilization; however, a larger emphasis would be put on the physical resources due to the importance of keeping the resources online and highly available. It is common today to find a server with upwards of 20 applications, making the risk of losing a server or rack of servers at this application density exponential over traditional one-application-to-one-server designs.

The concept of virtualization and the new focus on cloud computing become a pivot point to the Recovery Time Objective (RTO) and ROI of the business. In addition, with a truly virtualized environment, resource pools can be leveraged; therefore, a dedicated resource would no longer be as critical. However, the overall data center and facilities become increasingly important to the successful operation of the business.

**Figure 3: Utilization Efficiency Horizon**




**Efficiency Without Compromise**

In the data center, efficiency has traditionally been used to refer to energy. But in reality, energy is just one of the resources consumed by a data center. And energy efficiency, while important, is just one chapter in the larger data center lifecycle story. For example, is a system that offers excellent operating efficiency but can't accommodate growth or change really that efficient? How about a system that offers small energy efficiency gains but exposes critical IT systems to greater risk?

That's why a data center efficiency equation should involve design, management, and operation. Of course, data center output is the other side of this formula. A data center that can double its capacity without increasing operating or management costs has been just as successful at improving efficiency as one that cuts costs by half.

Taking advantage of the opportunities outlined in this paper enables IT organizations to more efficiently deploy and use all their resources throughout the life of the data center—including physical space, capital equipment dollars, design and management time, service costs, and, yes, energy.

***Areas of Opportunity***

**Density Creates Efficiency:**

Industry estimates put the cost of building a data center (the building shell and raised floor) at $200-$400 per square foot. By building a data center with 2,500 square feet of raised floor space operating at 20kW per rack versus a data center with 10,000 square feet of raised floor space at 5 kW per rack, the capital savings could reach $1-$3 million. Operational savings are also impressive—about 35% of the cost of cooling the data center is eliminated by the high-density cooling infrastructure.

High-density cooling: High-density cooling brings cooling closer to the source of heat through high-efficiency cooling units located near the rack to complement the base room air conditioning. These systems can reduce cooling power consumption by as much as 32% compared to traditional room-only designs. Pumped refrigerant solutions remove heat from the data center more efficiently than air-cooled systems and provide incremental energy savings between 25% and 48% based on kW of cooling capacity per kW of heat load.

Intelligent aisle containment: The well-established practice of hot/cold aisle alignments sets up another movement—containment. Aisle containment prevents the mixing of hot and cold air to improve cooling efficiency and enable higher densities.

High-density power distribution: Power distribution has evolved from single-stage to two-stage designs to enable increased density, reduced cabling, and more effective use of data center space.

**Availability:**

In the race to achieve improved energy efficiency—and, ultimately, cut costs—businesses cannot lose sight of the importance of maintaining—or improving–availability.

*Uninterruptible power supply (UPS):* Data center managers should consider the power topology and the availability requirements when selecting a UPS. Enterprise data centers should select double conversion UPS technology for its ability to completely condition power and isolate connected equipment from the power source.

The extra protection that a double conversion UPS affords does come with a small price in terms of efficiency; however, most organizations believe the small amount of energy lost during the conversion is well worth the added protection this process delivers. In addition, newer UPS systems are now available with energy optimization controls that enable users to open and close different components of the UPS based on organizational priorities and operating conditions.

Intelligent paralleling improves the efficiency of redundant UPS systems by deactivating UPS modules that are not required to support the load. In N + 1 UPS configurations, the load is typically evenly distributed across all modules. If a failure occurs, or a module is taken off line for service, the load is redistributed across the remaining modules.

This feature is particularly useful for data centers that experience extended periods of low demand, such as a corporate data center that is operating at low capacity on weekends and holidays. In this case, it ensures the UPS systems supporting the load are not operating at loads at which they cannot deliver optimum efficiency.

*Economization:* Economizers, which use outside air to reduce work required by the cooling system, can be an effective approach to lowering energy consumption if they are properly applied.

*Service:* Professional services to ensure you are reaching the promise of improved, continuous operational performance, accelerate return on your data center investments and assets, while reducing the cost, risk, and complexity of change.

**Simply Manage Your Physical Infrastructure**

What sets successful IT operations apart from the rest is how they manage assets in an agile environment, bringing control to the chaos. Access, control, and management of literally hundreds or thousands of heterogeneous devices in the physical infrastructure spread across multiple locations and geographies are a daunting task.

"What sets successful IT operations apart from the rest is how they manage assets in an agile environment, bringing control to the chaos."

Implementing data center best practices and taking a holistic perspective to your data center infrastructure operations is imperative to an organization's ability to meet its business goals. A critical component is the availability of data.

Access to the mountains of data is not enough. Once available, a management system based on contextual, actionable data allows the transformation of data into true insight. Actionable insight into how your equipment is being utilized, what capacity is available, where it's residing, how much power it's using, and the ability to test scenarios prior to change can optimize performance and reduce risk associated with managing high-density infrastructures, no matter how complex the environment.

## Emerson's Solutions for Data Center Infrastructure Optimization

When Emerson, a $20 billion global manufacturing and technology company, decided to build a new data center to support a major consolidation project, the team responsible for overseeing the design of that facility had two advantages that most organizations don't enjoy: a forward-thinking executive team and deep experience.

The strategy was to design the next-generation data center for Emerson, taking advantage of a true "green-field" opportunity supported by an executive team who clearly understood the strategic value of information technology to the success of the company.

The second advantage was Emerson's depth and breadth of knowledge, experience, and solutions. Emerson Network Power, a business unit of Emerson, had industry-leading solutions and deep experience in providing equipment, appliances, and management of the data center infrastructure along with a full range of infrastructure technologies that extend from "grid to chip." The team had access to the latest in transfer switches, UPS, precision cooling, power distribution and data center management software–and the engineers who designed those products.

As a leader in data center infrastructure, Emerson Network Power also developed a groundbreaking approach to data center energy efficiency called Energy Logic. Energy Logic takes a more holistic approach to examining all aspects of power, cooling, and IT performance. This approach brought new clarity to discussions around data center efficiency and introduced the concept of the cascade effect. This effect illustrates the cascading impact of efficiency improvements at the IT device level, which then cascades and generates the greatest savings because they reduce the energy requirements of all supporting systems.

When the new 35,000-square-foot Emerson data center opened in St. Louis, MO in 2009, it clearly accomplished the objective the team had been working for–create an efficient, highly reliable data center with the flexibility to support the future growth of the business. The facility was awarded LEED Gold Certification and today uses 30% less energy than a traditionally designed data center without compromising the availability required to support the global organization.

Yet, despite that success, the project management team came away from the experience knowing that this facility, which they had full control over from the beginning and which used the latest technologies, was not truly integrated and optimized. The technology needed for true integrated, optimized operations was just not available.

### Emerson Network Power Will Lead the Next Generation in Data Center Infrastructure Management and Optimization Solutions

The insights Emerson gained in developing the Emerson Data Centers helped shape Emerson's perspective on how DCIM must change in the future to deliver increased utilization of available capacity, optimize efficiency, and provide greater staff productivity.

Realizing the tremendous advantages companies can gain through innovations in DCIM, made possible by Emerson's depth and breadth of expertise, Emerson Network Power has embarked on an aggressive path to solve these challenges. Emerson Network Power is part of a $20 billion dollar global organization that, in 2009, invested more than $1 billion in the Avocent® acquisition—the largest in Emerson's history—to strengthen its position in this space. This is in addition to the investment made in 2008 to acquire Aperture®, a leader in enterprise data center management software.

Emerson has appointed the former CIO of the business, Steve Hassell, to lead the newly acquired and formed Avocent product division and DCIM portfolio for Emerson Network Power. Mr. Hassell's firsthand knowledge and experience as a CIO brings a deep, personal understanding of the challenges data center managers face to the development of the Emerson strategy.

Today, Emerson Network Power delivers the most comprehensive range of data center infrastructure technologies in the market.

- Number one in data center power with solutions that extend from the switches that handle power at the facility input to the power supplies inside IT equipment—and everything in-between.
- The world's largest provider of data center cooling technologies with a full range of room, row, and rack and cooling systems.
- Market leadership in hardware has, by necessity, allowed Emerson to build its software development capabilities. Emerson ranked 76th on Software Magazine's 2009 list of the world's largest software and services providers prior to the Avocent acquisition.

The Emerson Network Power software-based data center solutions include the Liebert® SiteScan® monitoring system, the Aperture data center management suite and, now, Avocent data center access and control, power management, data center planning, and branch and government solutions.

Emerson Network Power is the only organization that has both the depth and breadth of solutions in asset, power, and cooling design and management solutions, as well as embedded server firmware and management capabilities on millions of data center appliances worldwide. This combination or resources, experience and technologies makes Emerson Network Power uniquely positioned to help customers bridge the gap between the data center and IT infrastructure layers and enable intelligent optimization and management of the data center infrastructure.

## Works Cited

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