SearchDataCenter.com E-Guide

Best Practices for Data Center Design and Maintenance

Many of today's businesses face a variety of data center challenges – from power and cooling limitations to continuous operations and maintenance difficulties. To combat this issue, many companies are now considering renovating or re-building their data center facilities, but do not know where to begin. In this expert E-Guide, brought to you by SearchDataCenter.com and Dell, you will gain insight into best practices for data center design and maintenance in today's down economy. Explore expert tips for determining where and how to build your next data center and discover how to construct a data center that will scale for 10 years of growth. Learn why it is necessary that all aspects of the data center facility's operations and maintenance are considered early in the development of the site requirements.

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Where and how to build your next data center in a down economy

Richard Jones, Contributor

I've talked to an increasing number of IT organizations that have determined they need to vacate their current data center and build a new one. The reasons have been varied, with insufficient power and cooling density topping the list. Other reasons included moving to a region with less natural disaster risk or lower tax rates, electrical rates, and labor costs; needing greater floor weight loading capacity; and building a more efficient cooling design. Whatever the reason you have for vacating a dilapidated, underpowered, overpriced, should-be-condemned facility, the questions that you must answer are "Where is the best place?" and "How should it be built?"

Keep in mind that building a new data center assumes you've done the due diligence with regards to outsourcing or retrofitting, and your business needs and economics have ruled those options out. Last year, I wrote a tech tip on determining whether to outsource, partner or manage your disaster recovery plan in-house. This tip offers some ideas on deciding your approach. Now, on to where and how to build a new data center.

Where to build a new data center

This question demands answers to the questions of cost and natural disaster risk. Let's first look at cost. The biggest cost over time is usually electrical utilities. Utility rates can vary as much as three times across the nation. Typically, areas away from large metropolitan centers have less expensive power. Within North America, the northern Midwest and most of Canada offer lower power costs. Additionally, states and provinces in these areas are willing to offer tax breaks and real estate prices are often reasonable. The gating factor that must be researched in these regions is the availability of ample Internet bandwidth. Just a few years ago, this was a big problem, but with infrastructure for cellular service being deployed virtually everywhere, the problem is rapidly disappearing. However, if your site selection requires redundant Internet connectivity, it may restrict possible locations.

For an idea of why companies are moving to newer facilities, I talked to a number of IT organizations along the U.S. Pacific coast that have recently moved or are in the process of moving to newer data center facilities in Nevada, Colorado and Iowa. I've seen some common themes between them.

- Vacated facilities didn't meet seismic and power requirements.
- New location offered power rates between one-half and one-third of vacated facilities.
- New data centers are operated by remote control.

I'd like to point out that remote management technology has improved so much that there's no longer any reason to put system administrators in the physical data center. In these cases, the network operations center is still located at the company headquarters. Minimal staffing is used at the data center location except for security, maintenance and remote hands when needed to replace a bad disk drive, power supply, etc.

There are occasionally reasons to keep a data center located near or at the corporate headquarters. Examples I have seen are state governments that, for legislative and political reasons, must keep the data center in their state. Heavy manufacturing often requires that the data center controlling the manufacturing process is colocated with the factory. However, in the latter case, the recovery or archive site is located thousands of miles away.

There are other factors that must be considered when choosing a location: regional building codes; municipal taxes and tax incentives; availability of ample inexpensive water and power; risk of natural disasters, including flood plains, accessibility, political unrest, seasonal temperatures (cooler climates offer cooling savings through air economizers); and workforce availability. Once all has been considered and a location chosen, then how to build comes into question.

How to build a new data center

The general design of the structure will be done by an architect who has experience building data centers. Data centers have unique loading, cooling and power requirements that not just any architecture firm should be trusted with. The same goes for general contractors. You will want to choose a general contractor that has built a number of data centers already and will understand the need for power, cooling and cleanliness in the equipment rooms. That being said, there still are some factors that should be considered when building your next data center:

- **High ceiling.** For improved airflow and efficient cooling management, you need ample overhead space for ducting. You'll want to take advantage of buoyancy principles -- cool air sinks and hot air rises. Let the hot air rise above the equipment and create a blanket of cool air that the equipment sits within.

- **Rethink raised floors.** Raised floors are costly and in many ways can be regarded as only an aesthetics feature. They are actually troublesome to airflow in the data center. Most new remotely managed data centers do not have raised tile floors, equipment placed right on the concrete and cabling in overhead trays. This design is not aesthetically pleasing, but it's practical and efficient. It is much easier to pull wires through an overhead cable tray than to lift tiles and slide them underneath.

- **Cooling plant.** Location of the cooling plant should also take into account the ability to use air economizers in cooler climates.

- **Plan for cell or pod designs.** If you expect to expand over the life of the data center, plan for modular growth so that power and cooling equipment can be added in stages.

- **Power.** The days of 5 kW per rack are now long gone. Expect densities to increase. I've talked to a number IT organizations that are now feeding and using 25 kW per rack in their data centers. Plan for 30 kW per rack. Not all racks will need that much, so planning with cell or pod designs allows you to create sections in the data center that offer high power and cooling per rack and others that offer traditional levels near 5 kW of power and associated cooling.

- **Rethink the building.** Containerized data centers have been around for some time as backup or mobile units (used by government militaries for a number of years) and are just starting to gain traction in the commercial market. Most people I talk to have to spend some time warming up to the idea. I suggest that you do carefully consider the option of containerized data centers. They are not for everyone, but you may

find economic value for most of your IT computing needs. Coupled with the ideas cell/pod design and excluding raised floors, you may find economic value in building a shell that can house traditional data center equipment and containerized equipment side by side.

A number of other efficient data center ideas are also floating around the Internet. As with all cases, do an economic study on each, but remember that there may be financial incentives available that can offset the costs of going green to make it economically viable.

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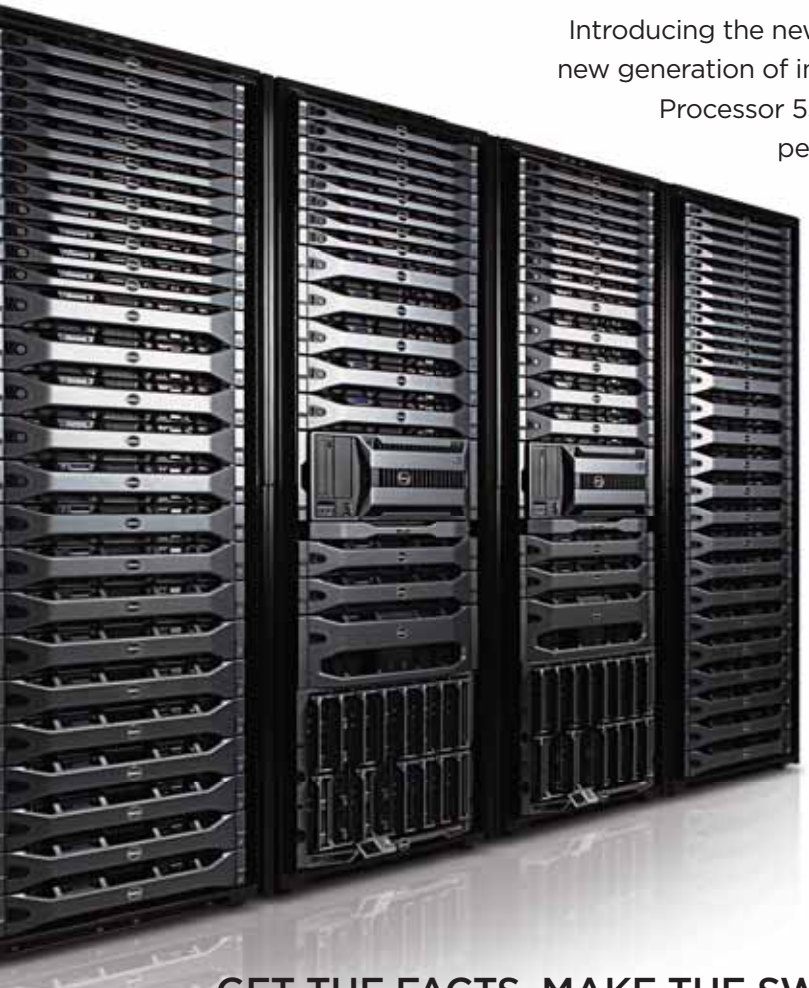

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Data center operations and maintenance best practices for critical facilities

By John Collins and Terry Rodgers, Syska Hennessy Group

Operations and maintenance (O&M) of today's critical facilities is being recognized as equally important as the engineering and design phases of these complex sites.

As the robustness and associated complexity of critical infrastructures has increased to allow for improved fault tolerance and concurrent maintenance capabilities, the importance of establishing equally robust O&M practices to manage these facilities has become apparent. Studies show that 60% or more of "impact events" where critical missions have been compromised are associated with human activity. This activity includes routine switching and reconfiguration of critical systems, maintenance tasks and, of course, human error.

The requisite staff and processes necessary to support continuous operations must be in place on the first day that the site goes live and must continue through to the final day that critical operations occur. This requires that efforts toward establishing these processes begin well before the facility begins operations, and ideally will begin during the site programming and requirements definition stage.

Data center design considerations

High availability for critical facilities typically necessitates complex redundancy schemes such as 2N, 2(N+1) or even 2(N+1)/3 configurations. The expectation is that even if critical equipment or systems fail, there is sufficient redundancy available to support uninterrupted operations.

But if the affected infrastructure doesn't include adequate means to isolate the failed equipment, and subsequently cannot access, repair or replace the equipment during sustained operations, outages are still incurred. This means that the requirements for sustaining critical operations over the life of a facility must be included in the design and construction before operations begin. This is called designing for maintainability.

Construction, startup and commissioning

The best engineered and designed facility is no better than the implementation of the design during construction. The need to provide strict oversight and quality control of the construction process requires frequent field progress inspections during construction. In addition, comprehensive startup and testing by qualified technicians is necessary to prepare for formal acceptance testing before the facility can be certified as ready to commence critical operations. This process is called commissioning, and it also includes ensuring that the project is appropriately staffed and that workers are provided site-specific training and have accurate as-built documentation on hand on Day One.

Formal commissioning starts during the design phase (if not earlier) to provide reviews for constructability, maintainability and to ensure the design intent (captured in the basis-of-design document) is compliant with the owner's requirements and expectations for the facility's performance. Commissioning also includes various levels of testing and verification, including factory acceptance tests, shipping and receiving requirements, field progress inspections, pre-functional and functional performance tests, and, finally, integrated systems tests.

The site O&M staff should participate in the commissioning process throughout the construction, startup and acceptance testing of the site. This provides valuable and sometimes unique opportunities for the O&M staff to participate in activities where they can learn and prepare for future tasks they will be responsible for during critical operations. There is no better opportunity for hands-on training and developing a deep understanding of site-specific nuances than at this time.

Operations and maintenance staff and organization

The staff assigned to operate and maintain a critical facility deserves as much foresight, consideration and attention as any other aspect of the process. The O&M staff should be identified, organized and trained before the site goes live. Some important considerations are which skills are required to operate and maintain the site. Whom should this department report to? What will the permanent staff be responsible for and what will be outsourced, including service-level agreements?

One of the first questions should be, "Will the O&M organization differentiate between staff assigned to provide O&M services to the critical infrastructure or will one organization cover all critical and noncritical O&M activities?" Ideally, a dedicated staff is assigned responsibility for the critical infrastructure and a separate staff for noncritical infrastructure. Continuous operations require constant vigilance and focus on the critical, 7/24/forever systems. As urgent as a leaking window may be, especially when it is in a highly visible location, it can be a distraction for staff that should be totally focused on critical operations. Likewise, critical O&M budgets should not compete for scarce resources that may include furniture, landscaping and other necessary expenditures.

Operations & Maintenance Processes

Operations and maintenance of critical facilities is not just a set of procedures. It is a strategy that should include clear goals and objectives, well-defined roles and responsibilities, an organization that focuses on continuous operations, and sufficient resources to accomplish the goals.

When is the site most vulnerable and deserving of the best staffing? Nights and weekends, when contractors, vendors and parts are hardest to come by? Or during the]business day, when outages can have the most impact? Obviously, the answer is connected to the mission of the site. If the site does support business activities that are more valuable during normal business hours, you may get one answer. If, on the other hand, the site has a true 24/7/forever mission in which 9 a.m. Monday is no more important than 9 p.m. Saturday, you may get another answer.

The answer to these questions can generate even more questions. For instance, where will you store critical spare parts? Will they require environmental conditioning or routine maintenance (like rotating equipment to preserve lubrication and preclude "bowing" of shafts)? Will the site require in-house expertise for administration of complex monitoring and control systems or just what's necessary to operate the systems?

Which spare parts will be considered critical and maintained on-site? What tools, equipment and inventory will be necessary? Will a Computerized Maintenance Management System be employed, and if so, who will build and configure it?

There are also significant variations in maintenance programs for facilities in general, with critical facilities tending more toward the high-end. Most facilities have some level of planned maintenance. Routine tasks based on time intervals, or frequency, are referred to as preventive maintenance. For instance, on a particular piece of equipment, inspections may occur monthly, belts checked and adjusted quarterly, filters replaced every six months, and internal cleaning, alignment checks, and sensors calibrated yearly. The shortcoming here is that the tasks occur regardless of actual operating condition. These programs can be improved when based on actual equipment runtime, but still do not take actual operating condition into consideration.

An improvement is to implement condition-based monitoring technologies that allow maintenance to occur based on actual operating conditions. A simple example is using a differential pressure sensor to monitor filter condition. When the filter loads up, the delta-P increases and the filter is replaced when appropriate.

When these condition-monitoring technologies are used and the data trended, you can predict in advance when maintenance will be required. This is called predictive maintenance. Thresholds can be assigned for alerts and alarm conditions, and by analyzing the trends, you can predict when the thresholds will be exceeded and even predict failures.

Some examples of operating condition monitoring technologies include vibration analysis, tribology (lubrication analysis) and infrared thermal scans. These technologies can reveal incredible insights into the operational condition of equipment while the equipment is online, without requiring shutdowns or maintenance outages.

Conclusions

It is necessary that all aspects of the facility's operations and maintenance are considered early in the development of the site requirements. Otherwise, opportunities may be lost to embed the requisite O&M requirements into the facility's design and construction. It should be intuitively obvious that with the extremely large capital investment required to design, construct and bring online critical facilities today, and considering the importance of the missions associated with these facilities, that equal consideration is given to the staff, programs and resources that will be entrusted to operate and maintain the site over its intended lifespan.

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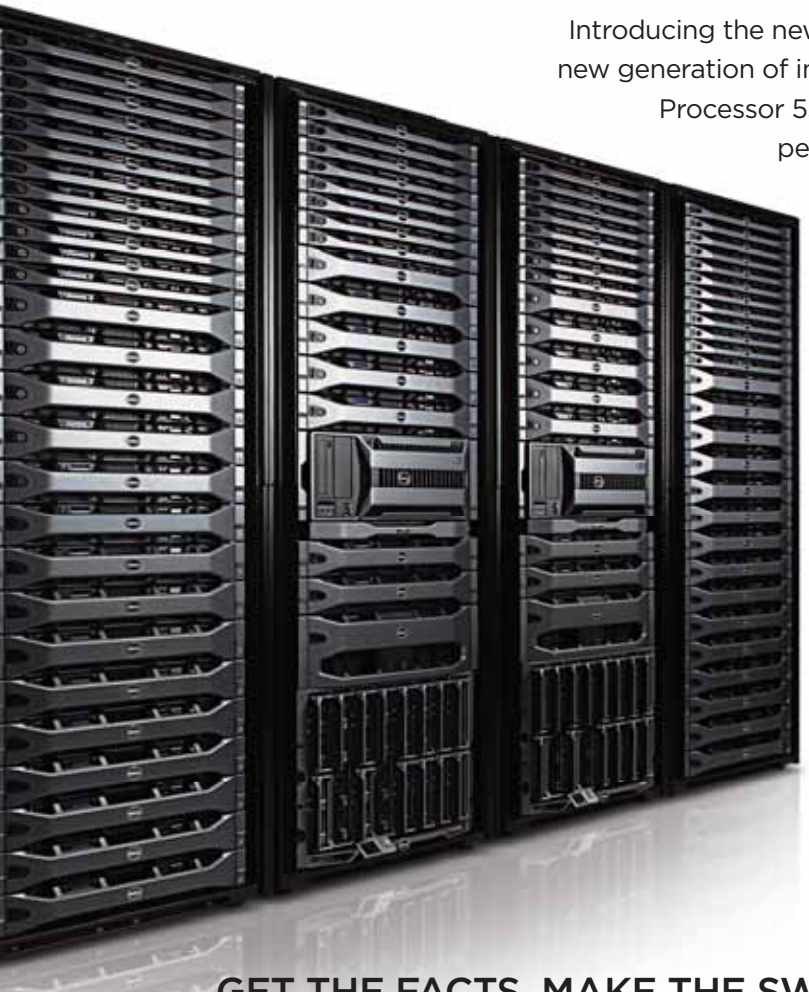

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How do I design a data center that will scale for 10 years of growth?

Robert Macfarlane, Contributor

So much is heavily dependent on the individual business that a rule of thumb for a scalable data center design is both unknowable and untrustworthy. Furthermore, different companies, in even the same business sector, can have very different histories and very different expectations.

With this in mind, think about where your IT tends to operate on the "technology continuum." In other words: How often do you turn over hardware? How aggressive are you in acquiring the newest technology? How flexible are you in appropriating funds and staff to go along with the new business or technology as it occurs?

Consider all this information in the context of your knowledge of how the industry is moving. And work up actual layouts to determine the amount of space that will be realistically required over the projected time period, both for technology and for infrastructure. Considering this is not a simple task, given how hardware is getting smaller, but at the same time proliferating, and the move many companies are making toward server consolidation and virtual computing.

But no matter how confident you are with your analysis and projections, always look to locate the data center so there is opportunity for future expansion into "soft space." Soft space being area that can be taken over without having to move a department with difficult or expensive amenities and with nothing on the separating wall that would make its removal problematic, such as power panels or the communications demark. In many cases, this area is even equipped with raised floor, piping and power feeds in order to get heavy construction done at the least expense and with minimal later disruption.

The one "rule of thumb" we can provide is that it is generally accepted today that, for a major data center meeting the Uptime Institute's Tier 3 or Tier 4 standards, you should plan on the mechanical/electrical support space being at least another 50% (and probably closer to 100%) of the technology room space. In other words, whatever space you predict will be needed for cabinets and other technical hardware, double it.

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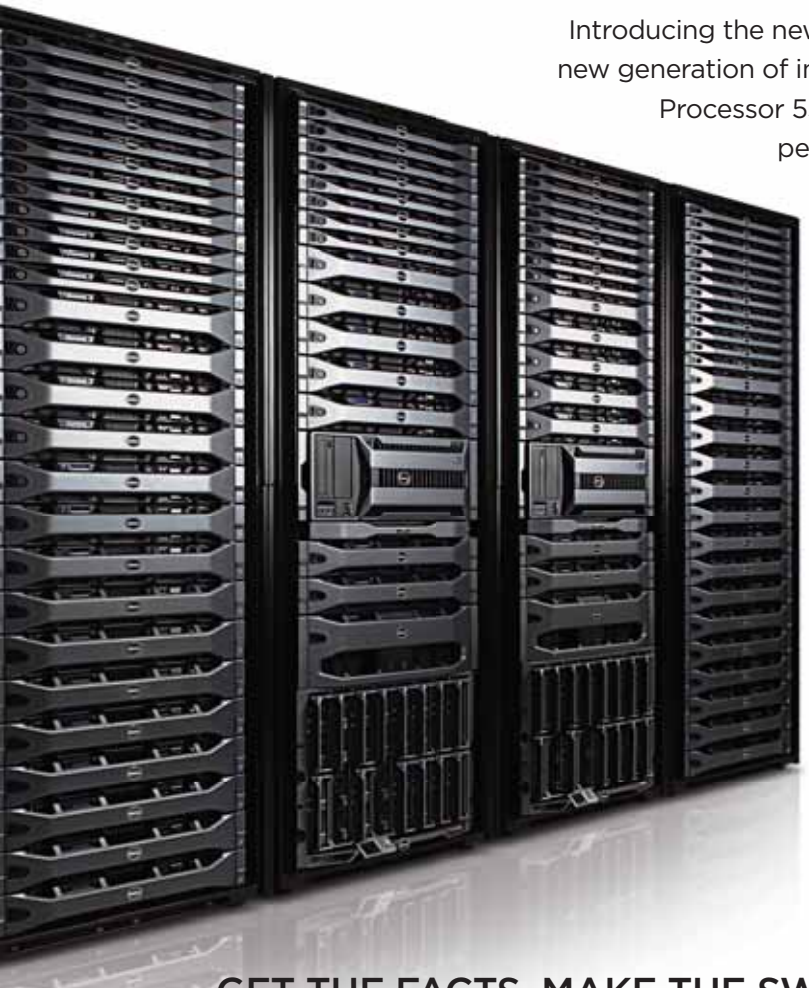

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