



Best practices for modernizing vintage data centers

Part 2: Learn the key steps and benefits to upgrading data centers

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Executive summary

As more efficient use of IT assets becomes a clear and pressing priority for IT organizations, the need to align the data center's facilities and IT processes becomes greater to maintain uptime, coordinate complex integrated systems and deploy shared resources reliably. Most companies hope to get as much as 20 years of dependable service from their data centers. Unfortunately, there are many obstacles to achieving that length of service. In particular, some of the key mechanical, electrical and plumbing (MEP) components data centers rely on are not designed to last that long. In addition, rapidly changing data processing requirements demand that data centers remain flexible and support greater rack densities.

Organizations with a data center 10 years of age or older have several options: building a new data center, putting applications in the public cloud, leasing space in a colocation facility or modernizing the existing data center. Many companies continue to cycle through a gradual transition away from distributed data center architectures to even more centralized sites—and, in some cases, those that are gradually more localized. In part, this means IT strategies are moving out beyond consolidation plans to focus instead on improving and updating facilities where assets have already been centralized.

Modernization efforts go a long way in supporting the needs of mission-critical IT assets as the risk of downtime becomes more stringently unthinkable. Many companies looking to make the most of previous investments also choose to modernize their existing facilities, as it can often be done more cost-effectively than the other options and usually yields significant improvements in reliability, efficiency and operational effectiveness. Retrofitting can also help provide powerful new layers of security, intelligence and automation.

This white paper discusses the benefits and challenges of upgrading the data center's MEP infrastructure components and outlines best practices for successfully planning, implementing and testing those renovations. Tips are included to help companies build more performance-optimized data centers that maximize the investment, economics and design of existing data center facilities.

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Powering Business Worldwide

Create value with upgrades that integrate IT and operations

While good IT managers optimize the use of existing infrastructure and facilities, good facilities managers assure uptime and recoverability. Both would likely prefer to focus on their primary responsibilities. But with the needs of IT and operations converging around the data center, there are now distinct opportunities to work together to better support growth, adapt to change, and increase cost-efficiency.

IT asset utilization joins the interests of IT and facilities and should be a top priority in all data center projects. Similarly, projects that combine multiple systems into a single hardware stack—such as heavily integrated systems—are a good means of finding common interests and savings through upgrade or retrofit projects. Through joint efforts to modernize the data center, IT and operations can demonstrate wise spending, agility, efficiency, and reliability.

Currently, most IT departments do not pay the data center power bill, which can be a significant obstacle to building a business case to replace existing equipment in the data center. A trend toward mixed tier data centers and a general move to Tier 2 reflects stronger focus and weighting on total cost of ownership (TCO) with respect to efficiency. By working together, IT and facilities can better design data centers to meet specific uptime needs.

Data centers exist in variable sizes and dimensions, so there may be several different areas that present viable opportunities to optimize. All mission-critical areas should be reviewed with an eye toward efficiency; upgrades need not be limited to one primary site or equipment area. **Table 1** summarizes usage lifespans for critical MEP infrastructure equipment that might be explored as part of a vintage data center's modernization efforts. Additional upgrade recommendations that facilitate cost, resource and performance-based optimization efforts have been described in the white paper, [“Top reasons why vintage data centers need to upgrade.”](#)

Table 1. Usage lifespans for critical MEP infrastructure equipment

Equipment	Lifetime (years) ①
Rack PDU	8 to 12 years
Power cable (individual cables)	8 to 20 years
Power busway (copper bus bar, plug modules in to tap power)	8 to 20 years
UPS—central enterprise 3000+ kVA	15 to 20 years
UPS—rackmount	4 to 8 years
Batteries	5 to 10 years, depending on type
Remote power panel (RPP)	8 to 12 years
Computer room PDU	8 to 12 years
Electrical switchgear and transformers	20+ years
Generators	20+ years

① These lifetimes assume the equipment is properly maintained and used in an appropriate application and environment.

Benefits of upgrading a vintage data center's MEP infrastructure

Modernizing a vintage data center's MEP infrastructure can enhance availability, raise power and cooling capacity, lower operational expenses and reduce greenhouse gas emissions. It can also yield these additional and perhaps less obvious advantages:

Optimal reliability

The top priority of any data center is assuring the availability of resources. Avoiding service interruptions and downtime is critical. As terabytes of information flow daily, application availability and resilience are mission-critical. Modernized data centers are much better equipped to minimize downtime. They can also facilitate lower-tier data center designs to account for redundancy in a network of data centers; ensure better quality of products and services; and more easily partner with highly skilled, responsive global service organizations.

Improved serviceability

Retrofitting a vintage data center's MEP systems usually improves their redundancy, making it easier for administrators to repair power equipment or perform necessary maintenance tasks without lowering availability.

Enhanced customer perception

Multi-tenant data centers (MTDCs) such as colocation or managed hosting sites often use their facilities as a marketing tool to prospective customers. Presenting a modern state-of-the-art appearance in areas such as system design and aesthetics can help organizations differentiate their data center or validate the price of their services.

Greater agility

By increasing the reliability and agility that comes with IT, data centers can achieve a fresh start without having to build anew. These small changes can have significant impact on operating expenses. A financial perspective on power agility is vitally important given the increasing pressures on shared energy resources and the daunting task many data centers face to do more with less. Power costs directly drive data center facility location decisions today. “Price of power” is also an emerging and important theme. As data center managers plan for future costs, how can power pricing be accurately estimated? The easier it is to go in at any time to make changes and respond to unknown future needs, the easier it will be to calculate cost and quantify impact on the IT capability and availability at all times.

Enhanced flexibility and functionality

A modernized data center is better positioned to accommodate a wider range of recent technologies, such as cloud computing. It's also more capable of supporting the innovations of the future. Flexibility eases growth and responsiveness to change.

Greater scalability

Increasing a vintage data center's power and cooling capacity enables companies to maximize their use of virtualization and blade servers, technologies that increase scalability by freeing up floor space for future expansion. Scalable solutions can better flex with variable utilization needs while adding the potential to align cost with revenue.

Improved safety levels

Implementing upgrades to power distribution equipment yields improved arc safety and ease of maintenance, as well as opportunities to take advantage of remote operating equipment. Upgrading fire detection and suppression systems can remove water from the data center and replace it with alternate technologies.

Penalty avoidance

Sometimes upgrades are not just good opportunities for enhancement; modernization may be necessary to comply with governmental regulations and building codes. The authority having jurisdiction (AHJ)—regional or local—has significant clout in assessing whether or not a facility meets compliance. If seeking certification, it's always better to take the necessary precautions ahead of time.

Enhanced stakeholder relations

Obligations to report to stakeholders on data center efficiency metrics, sustainability efforts and other MEP best practices are likely to increase going forward. The National Resources Defense Council (NRDC) is now advocating for the adoption of a simple server utilization metric that can be published to report on underutilization of servers. It also recommends that, “Industry leaders in data center efficiency should voluntarily disclose in their corporate and social responsibility reports a broad range of information and metrics on their entire data center operations, including fleet-wide utilization levels and ways in which they address split incentive issues internally and externally.”

Proactive notification and predictability

Modern data centers are more capable of meeting the speed of innovation with ease. The options to leverage timely information and automation based on changing business demands can lend competitive advantage.

Challenges of upgrading vintage data center infrastructure

Despite their many benefits, data center upgrades also pose a variety of significant planning and operational challenges, including the following:

Funding the project

Before data center managers can update a vintage computing facility, they must first persuade senior executives to authorize and fund such a project. That means building a detailed and persuasive business model complete with concrete ROI calculations that counter false perceptions and build awareness. Without prior experience, assembling such facts and figures can be difficult. It may be just as hard to obtain approval on retrofit projects as it is to confirm that new build investments will not be wasted. Some ideas, such as the idea that it is always cheaper to colocate instead of investing in a current site, may be difficult to disprove upfront.

Open-ended timelines

Many data center managers face uncertain timelines for validating gains from their current data centers and payback can never be realized.

Out-of-date documentation

Retrofitting an older data center's electrical systems haphazardly can result in overloads and other dangerous conditions. To prevent such problems, facilities managers need access to complete and accurate blueprints of the data center's existing electrical infrastructure. Unfortunately, many companies neglect to keep those documents up-to-date.

Code compliance

Data center operators must verify that any changes they make to a vintage facility's electrical systems comply with current arc flash safety requirements. Conducting thorough arc flash studies without jeopardizing critical workloads takes specific engineering knowledge and skills.

Risk of downtime during construction

Few companies can afford to take a vintage data center offline for months at a time during upgrades. Yet, replacing electrical and mechanical systems in a live, production environment without affecting availability can be a demanding task and requires careful planning.

Change management and impact on overall business process

Some banking companies are finding that many adjustments to standard business procedures are necessary to begin to leverage newer data center infrastructures (especially in the case of those built on the Open Compute model). But even in more incremental upgrades, modernizing the data center can result in wide-scale changes that cut across the company and its culture.



Cooling



Battery room



Raised flooring



Key steps in an optimal vintage data center upgrade

Renovating a vintage data center's MEP infrastructure is a complex undertaking that defies easy summarization. Here, however, is an introductory overview of the most critical stages in that process:

- 1 Assemble the right project team.** As the amount and importance of big data and the cloud grow, companies of all sizes are finding they increasingly need to quickly and efficiently deploy new solutions (including prefabricated assemblies) to support their business-critical applications with an improved time to market by leveraging experienced project management; achieving faster time to operation; and benefiting from predictable time to production (planning, design, installation, commissioning).

The project team for a data center upgrade should include all relevant stakeholders from within the organization as well as a complete set of appropriate vendor partners. Internal stakeholders should be in agreement with respect to goals and objectives for the project, and there should be no organizational silos between the IT and facilities departments.

The data center is the backbone of a business and requires innovative, mission-critical power and thermal-management solutions that will drive efficiency, quickly scale to meet needs, and ensure optimization of IT assets. These solutions need to be easy to deploy and resilient enough to accommodate reduced facility infrastructure redundancies while supporting the quality of service offered. Critical to business success is finding a partner that delivers the engineering skill, service expertise and interoperability that lowers cost, reduces risk and provides a safer environment across the data center lifecycle. When engaging in any data center retrofit project, consider the use of design service experts who are available to help determine the best power methods and solutions to ensure efficiency, cost and safety. Make sure vendor partners under consideration have documented proof of having successfully completed similar projects under similar circumstances.

- 2 Assess and plan.** There is a critical need for action. The NRDC finds that smaller server rooms and closets are responsible for about half of U.S. server electricity consumption, with much of that waste due to lack of awareness and inducements for efficiency. Before commencing a data center upgrade, organizations should create a complete list of their facility's limitations and identify multiple options for overcoming them. There are numerous possible solutions to any given data center problem, and evaluating all of them is the best way to ensure you select the best approach available for your specific needs. A vendor with expertise in data center modernization can help identify appropriate options to study.

Numerous tools and resources are available to help quantify savings and energy potential. Look at several energy usage metrics and compare the total cost of ownership in the current facility to the potential gains from modern power infrastructure. Eaton provides a handy online tool for exploring gains from UPS equipment at <http://pqcalc.eaton.com/>.

- 3 Establish the business case.** Once potential options are identified, businesses must weigh the costs and benefits and then decide which ones make the most sense to pursue. Based on that analysis, managers can then prepare a business case for securing adequate funding.

Many utilities, governments and regulatory bodies offer financial incentives to data centers that significantly improve their energy efficiency. Though no comprehensive catalog of such programs currently exists, an experienced vendor can help businesses determine which offers are applicable to their initiative. Be advised that many programs require organizations to apply for and receive the incentive before any construction work commences.

Energy utility incentive programs help reduce waste in the massive amounts of electricity used by data centers of all sizes. For this reason, many opportunities to partner directly with utility companies exist. For a full overview of this topic, see the (forthcoming) white paper: *"Improving data center efficiency with the help of utility incentives."*

Note that while cost savings and ROI are likely to figure prominently in the business case for a data center modernization project, non-fiscal considerations are often important as well. For example, sometimes the strongest justification for a data center upgrade is that accomplishing your organization's long-term strategic goals will be impossible without it.

4 Create a project plan. The next step is preparing a thorough plan of action, including a realistic schedule. After receiving funding approval, data center managers should create a list of goals and success criteria for their upgrade effort that clearly specify not only which infrastructure changes are within the project's scope but which are not as well. A well-written project plan should:

- Indicate precise steps for minimizing disruption to production workloads during upgrades, assuming the data center must remain operational throughout that process
- List potential issues that could arise while work is underway and define contingency measures for addressing them. What will you do if an electrician accidentally severs the building's main circuit, for example, or your entire facility temporarily loses Internet connectivity? Finding solutions to such problems before they arise can save precious time later.

5 Perform an arc flash hazard analysis. If a data center retrofit includes electrical changes, it is critical to check the revised infrastructure for compliance with current arc flash safety codes. An arc flash hazard analysis can help businesses spot arc flash risks and identify appropriate mitigation strategies. Data centers should always conduct hazard studies in partnership with a qualified power systems engineer.

6 Execute the project plan. To ensure quality results, businesses should work only with contractors that have exceptional project management abilities and a demonstrated history of completing similarly ambitious efforts on time and under budget. It is also important to make certain the project manager holds meetings at frequent and regular intervals to ensure the project is following the agreed upon schedule and any issues are addressed promptly.

Though a largely administrative step in the retrofit process, updating the data center's blueprints is an important best practice that will make life significantly easier for future IT and facilities managers. To ensure revised drawings are as accurate as possible, organizations should hire an engineer or draftsman to assist them.

7 Conduct tests. The commissioning process for an upgraded data center should include careful testing of any system that has been changed, added or replaced. Such tests should assess modified components individually and collectively. For example, if an organization updated its UPS hardware, deployed new PDUs and installed aisle or rack containment cooling, it should confirm that each of those systems functions properly on its own and then verify they also work correctly together by subjecting them to various simulated workloads.

8 Validate results and refine operational methods. Before putting an upgraded data center into production, companies should return to the financial and energy savings goals and objectives defined earlier and validate that all of them have been achieved. This should be a rigorous and objective evaluation of the modernized facility's real-world performance and capabilities, executed with the assistance of a knowledgeable vendor consultant.

Remember to continually update the methods of operation in the data center. Modernization gives data centers the ability to improve the method of operations for both IT and facilities. Oftentimes, there are rich opportunities that exist where documentation and process requirements are not currently available.

Helpful resources

Inspirational tip sheets:

- 12 Ways to Save Energy in the Data Center: www.energystar.gov/index.cfm?c=power_mgt.datacenter_efficiency
- 12 Ways to Improve Efficiency in the Data Center: www.energystar.gov/ia/products/power_mgt/downloads/DataCenter-Top12-Brochure-Final.pdf?7798-0158

Search tools for researching energy incentive programs:

- Tax Incentives Assistance Project (TIAP): energytaxincentives.org
- Database of State Incentives for Renewables and Efficiency (DSIRE): www.dsireusa.org

Organizations in support of energy efficiency efforts:

- ENERGY STAR: www.energystar.gov
- National Resources Defense Council (NRDC): www.nrdc.org/energy/data-center-efficiency-assessment.asp
- The Green Grid: www.thegreengrid.org
- The Uptime Institute: www.uptimeinstitute.org
- U.S. Green Building Council LEED: www.usgbc.org

Conclusion

The world of technology has seen plenty of change in recent years. To keep up with it, organizations with data centers that are 10 years of age or older should seriously consider modernizing those facilities. Upgrading a vintage data center's mechanical and electrical infrastructure can boost reliability, efficiency, flexibility and scalability while reducing operational spending. It can also save companies the considerable expense of building entirely new facilities.

Though upgrading a vintage data center isn't simple, careful planning and skilled execution can dramatically streamline the process and strengthen ROI. Above all, organizations contemplating a retrofit of an older data center's MEP infrastructure should seek assistance from a skilled vendor with deep and relevant experience.

About Eaton

Eaton's electrical business is a global leader with expertise in power distribution and circuit protection; backup power protection; control and automation; lighting and security; structural solutions and wiring devices; solutions for harsh and hazardous environments; and engineering services. Eaton is positioned through its global solutions to answer today's most critical electrical power management challenges.

Eaton is a power management company with 2015 sales of \$20.9 billion. Eaton provides energy-efficient solutions that help our customers effectively manage electrical, hydraulic and mechanical power more efficiently, safely and sustainably. Eaton has approximately 100,000 employees and sells products to customers in more than 175 countries. For more information, visit Eaton.com.

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John Collins is a product line manager for large data center solutions at Eaton. He has more than 24 years of experience in the data center industry. At Eaton, he is focused on ensuring Eaton's data center products and solution offerings evolve with the market. He is involved in many industry groups including The Green Grid, 7x24 Exchange, and AFCOM. John received his Bachelor of Science in Electrical Engineering from the University of Rhode Island and an MBA from NC State University.

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