INTERACTIVE SESSION: TECHNOLOGY

THE GREENING OF THE DATA CENTER

What's too hot to handle? It might very well be your company's data center, which can easily consume more than 100 times more power than a standard office building. Data-hungry tasks such as video on demand, maintaining Web sites, or analyzing large pools of transactions or social media data require more and more power-hungry machines. Power and cooling costs for data centers have skyrocketed, with cooling a server requiring roughly the same number of kilowatts of energy as running one. All this additional power consumption has a negative impact on the environment as well as corporate operating costs.

Companies are now looking to green computing for solutions. The standard for measuring data center energy efficiency is power usage effectiveness (PUE). This metric is a ratio of the total annual power consumed by a data center divided by how much is used annually by IT equipment. The lower the ratio, the better, with a PUE of 1.0 representing a desirable target. The PUE of traditional data centers has hovered around 2.0. That means the data center is using twice the amount of electricity that's actually needed to do the computing. (The extra power is consumed by lighting, cooling, and other systems.) PUE is influenced by many factors, including hardware efficiency, data center size, the types of servers and their uses, the proficiency of monitoring software, building architecture, and the climate outside the facility. New data center designs with PUEs of 1.5 or better are emerging

Virtualization is a highly effective tool for cost-effective green computing because it reduces the number of servers and storage resources in the firm's IT infrastructure. About five years ago, Acorda, a $210 million-per-year maker of drugs to treat nervous disorders such as multiple sclerosis, found it needed more servers and was outgrowing its data center. The company invested $100,000 in virtual servers running on technology from VMware. Using virtualization, Acorda avoided spending an additional $1.5 million on more physical servers and increasing energy consumption. Moreover, when the company moved to a new building in 2012, it was able to significantly shrink the size of its data center, further lowering cooling costs.

Acorda took additional steps to boost energy efficiency at the new facility. The company installed motion sensors that shut off lights after five minutes if no movement is detected, and it invested in a more intelligent cooling system that automatically changes settings as conditions change. Current plans include replacing all of Acorda's host servers and taking advantage of a VMware feature that moves virtual servers from one cluster to another, thereby reducing the number of clusters that require power at any given time. Acorda is also preparing to test virtualized desktops, which will greatly reduce the power required to run workstations and laptops.

Other tools and techniques are also available to make data centers more energy-efficient. Google and Microsoft have built data centers that take advantage of hydroelectric power. In April 2011 Facebook publicly posted the specifications for the design of its data centers, including motherboards, power supply, server chassis, server rack, and battery cabinets, as well as data center electrical and mechanical construction specifications. Facebook hardware engineers re-thought the electric design, power distribution, and thermal design of its servers to optimize energy efficiency, reducing power usage by 13 percent. The power supply, which converts alternating current into direct current consumed by the motherboard, operates at 94.5 percent efficiency. Instead of using air conditioning or air ducts, the servers are cooled by evaporative cooling and misting machines, which flow air through grill-covered walls. The server racks are taller to provide for bigger heat sinks, and the data center's large fans can move air through the servers more efficiently. Facebook's engineers modified the programming in the servers to work with these larger fans and reduce their reliance on small, individual fans that consume more power. This data center design, which has a 1.07 PUE rating, was implemented at Facebook's Prineville, Oregon data center. All of these changes have reduced Facebook's energy consumption per unit of computing power by 38 percent and operating costs by nearly 25 percent. The Prineville data center reports that its PUE is 1.07, one of the lowest.

By using ambient air cooling techniques and running warmer than average, Google's newest data centers deliver a PUE rating of 1.16. Yahoo's new Lockport, N.Y., data center has a PUE of 1.08. Lockport's cool climate, prevailing winds, and hydropower help cool Yahoo's 120 foot by 60 foot server buildings. FedEx located its energy-efficient Colorado

data center at an elevation of 6,000 feet so that the building can be cooled using outside air instead of internal air conditioning.

In addition to lowering IT costs, using cloud computing services may save energy as well. Cloud computing centers pack in servers that have been optimized for virtualization and for supporting as many different subscribing companies as possible. Cloud vendors are willing to invest heavily in cost-lowering virtualization software and energy-conserving server hardware because those efforts can produce major savings when doing the computing for large numbers of companies. A study by the Carbon Disclosure Project predicted that by 2020, large U.S. companies with revenues of more than $1 billion that used cloud computing would be able to achieve annual energy savings of $12.3 billion and annual carbon reductions equivalent to 200 million barrels of oil—enough to power 5.7 million cars for one year.

Experts note that it's important for companies to measure their energy use and inventory and track their information technology assets both before and after they start their green initiatives. And it isn't always necessary to purchase new technologies to achieve "green" goals. Organizations can achieve sizable efficiencies by better managing the computing resources they already have. Unfortunately, many information systems departments still aren't deploying their existing technology resources efficiently or using green measurement tools.

In 2015 and beyond, electricity demands to power data centers have never been higher, thanks to the continuing shift to the mobile platform. Experts predict there will be 15 billion mobile devices in use by year's end, and other estimates suggest there may be 50 billion by 2030. Meeting this considerable demand will require continued innovation in green computing to minimize environmental impact by any possible means.

Sources: Robert Bryce, "Green Computing Can't Power the Cloud," economics21.org, May 22, 2014; Tony Kontzer, "Energy Management Revamps the Data Center," *Baseline*, January 30, 2013; Charles Babcock, "Facebook's Data Center: Where Likes Live," *Information Week*, March 6 , 2013; Doug Mohney, "The Little Guys: Survival vs. Green," *Green Data Center News*, May 15, 2013; Chris Murphy, "FedEx's Strategic Tech Shift," *Information Week*, May 20, 2013; "How Facebook's Data Center Leads by Example," *CIO Insight*, August 20, 2012; Sam Greengard, "IT Gets Greener," *Baseline*, April 11, 2012; "New Study: Cloud Computing Can Dramatically Reduce Energy Costs and Carbon Emissions," AT&T, July 21, 2011; and Kenneth Miller, "The Data Center Balancing Act," *Information Week*, May 16, 2011.

CASE STUDY QUESTIONS

1. What business and social problems does data center power consumption cause?
2. What solutions are available for these problems? Are they management, organizational, or technology solutions? Explain your answer.
3. What are the business benefits and costs of these solutions?
4. Should all firms move toward green computing? Why or why not?

and services. Historically, at least in large firms, the IT department was responsible for selecting and managing the information technology and applications used by the firm and its employees. It furnished employees with desktops or laptops that were able to access corporate systems securely. The IT department maintained control over the firm's hardware and software to ensure that the business was being protected and that information systems served the purposes of the firm and its management. Today, employees and