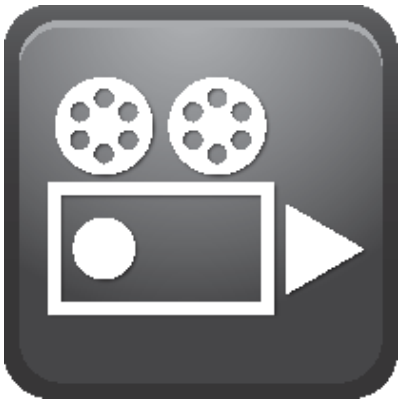
CHAPTER 1 BUSINESS INFORMATION SYSTEMS IN YOUR CAREER

CASE 1

Business in the Cloud: Facebook, Google, and eBay Data Centers



(a) Facebook Data Center

URL https://www.youtube.com/watch?v=_r97qdyQtlk; L=8:20

(b) Google Data Center Efficiency Best Practices: Power Efficiency

URL http://www.youtube.com/watch?v=voOK-1DLr00; L=10:00

(c) A More Detailed Look at "Triton"

URL https://www.youtube.com/watch?v=pNUv3ekSDOU; L=4:21

SUMMARY Businesses today run on the Internet, and the Internet runs on data centers. Today, data centers might be more accurately called business centers. Data centers drive nearly every aspect of many businesses, especially ones with a significant online presence like Facebook, Google, and eBay. But data centers are significant users of expensive electricity to cool their servers, and they make a significant contribution to pollution and global warming. Cloud data center operators are using a variety of new techniques to become more efficient in their use of electricity.

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CASE Consumers of technology constantly demand devices that are smaller, more efficient, and more powerful than the ones they have. But most consumers don't understand the massive back-end infrastructure that powers their "front end" devices, like mobile phones, smartphones, tablets, and desktop computers.

Take, for example, smartphones and tablet computers. iPhones, Androids, BlackBerrys, iPads, and other tablets represent a trend in all forms of mobile technology towards smaller devices that perform an increasingly large number of functions. But every time a smartphone or tablet user connects to the Internet, places a call, or sends an instant message, it uses power not only on their phone, but at every step of the infrastructure used to perform that function. More often than not, data centers are intimately involved in any Internet-based communication.

In 2017, there are approximately 3 million data centers in the United States and another 6 million data centers of all sizes worldwide. The number of data centers is growing at around 15% a year. IDC estimates that the number of data centers will decline beginning in 2018 due to the growth of very large cloud mega-data centers. Currently US data centers consume about 100 billion kilowatt hours of electricity, about 2% of all electricity generated in the United States. Because most data centers use air conditioning of one sort or another to keep operating temperatures of microprocessor chips within a safe range, they are significant contributors to pollution and global warming . Most data centers do not practice energy management, and waste approximately 20 billion kilowatt hours annually. The growth of cloud computing, in particular streaming of music, television, and movies, is expected to accelerate data center power consumption in the next ten years even as the number of data centers decline. Due to these increasing power demands, by 2020, the world's computer servers will match or exceed the carbon emissions of the airline industry.

Data centers are growing not only in number, but also in sheer size. IBM has a data center which covers approximately 40,000 square feet (three football fields) and contains 10,000 servers. The cost of running large data centers is a significant component of the overall IT budget of firms. There are two components to the energy cost of data centers: the cost of running the computers, and the cost of cooling them. For this reason, large-scale data center operators are seeking a variety of new ways to cool their servers.

Of all the Web sites in the world, Google and YouTube may get the most hits per day, but no site can top Facebook as far as raw traffic. Facebook is by far the "stickiest" of the top sites, meaning its users spend more time per visit there, so it's reasonable to argue that no site has a greater need for a robust infrastructure than the social networking giant. Valued at $523 billion and boasting a mind-boggling 1.65 billion monthly active users as of 2017, Facebook faces computing demands that no other company has ever faced. Not only is their site traffic unparalleled, but users are contributing 100 petabytes of photos and videos on Facebook each day, and that data requires storage

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To manage this demand, Facebook has built 300,000 square foot data centers in Oregon, North Carolina, and Iowa, and has announced another in Texas. They are also planning more international data centers to complement their data center in Lulea, Sweden. They also lease server space across the United States and worldwide. Facebook has chosen locations that allow them to use environmental factors (such as cooling water from rivers, and cooler northern climates) to reduce the costs of cooling computers, and to minimize their carbon footprint. Each location consumes roughly 30 megawatts of electricity. To ensure 100 percent uptime of the flagship Facebook site, each site has backup power. For example, the Oregon location has 14 diesel generators capable of 3 megawatts apiece in case of a power generation.

A widely used method for assessing data center efficiency is Power Usage Effectiveness (PUE). PUE measures the ratio of total facility energy divided by IT equipment energy in watts. IT equipment refers to the computers and hard drives used in the facility. Total facility power would include lighting, and cooling the computer equipment, a major cost. PUE measures the energy used to power and cool a data center. In 2012, a typical data center consumed 2 watts of total facility power to support 1 watt of IT equipment. Today the number is much closer to 1.7 because of changes in IT equipment, and changes in facility power management. The ideal is a PUE of 1, in which case all power was being used to simply operate the IT equipment and no other significant support power for cooling is being used.

Other large tech companies like eBay are developing their own techniques and methods to better evaluate the business impact of their power consumption. The auction giant has revamped the way it views its infrastructure efficiency, using the concept of Digital Service Efficiency (DSE). DSE is like a miles-per-gallon metric used to measure how effectively its power consumption is driving its business. Instead of miles, eBay charts revenue (or other business measure), and instead of gallons, eBay charts kilowatt hours. For instance, eBay is able to understand how many kilowatts it takes to process customer transactions, and what is the carbon emission impact of its data centers. eBay managers chart the efficiency of its data center operations using a dashboard:

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Digital Service Efficiency (DSE) helps eBay to see the full cost, business impact, power efficiency (PUE), and environmental impact of customer buy and sell transactions. The dashboard combines PUE with other DSE measures of data center performance. Today, many data centers use both PUE and DSE.

eBay operates one of the largest data center networks in the world, and it has begun to shift from air to water for its data center cooling needs using a new cooling technology from Dell called Triton. In large data centers, temperatures can reach 120 degrees in just two minutes if the cooling system became disabled. At this temperature, processors and hard drives begin to malfunction. The traditional method of using air cooling has become increasingly expensive as data centers continue to grow. eBay has begun reconfiguring its server cooling from air to liquid cooling using water which is a more expensive, but also a far more effective process for removing heat. The company already boasts some of the best power usage effectiveness (PUE) ratings in the industry.

VIDEO CASE QUESTIONS

1. Why does Facebook's data center specialist argue that "The Internet is not a cloud?"
2. What are some of the techniques Facebook uses to cool its data centers?
3. Describe the five methods recommended by Google for reducing power consumption.
4. Based on the Google video, how much of the world's global greenhouse gases are the result of computing?
5. What are some of the benefits of using Dell's Triton water cooling technology?