7 THINGS YOU SHOULD KNOW ABOUT... CLOUD COMPUTING

Scenario

William is the CIO at a medium-sized liberal arts college. Like the rest of the institution, the IT department is a relatively lean operation, with a modest budget that in large part is devoted to covering operational costs. When the time comes to replace an aging e-mail system, the college conducts a careful evaluation of several external providers of e-mail services and pilots one of the options. Despite his concerns about issues including security and privacy, in the end William supports sourcing student e-mail from "the cloud," knowing that the new service will be operational quickly and that the support and reliability that the provider offers exceed what his budget would allow for a system developed—or at least maintained—in-house.

When the physics department requests a suite of expensive, complex software, William knows he needs to investigate his options. The costs are considerable, and William does not have the expertise on his staff to adequately maintain the software, which requires specialized knowledge and frequent updates. A large university in another state is a recognized leader in the subfield for which this application is used, and William negotiates an arrangement in which that university hosts and maintains the software, which is accessed over the Internet. William's college only pays for actual usage, saving costs overall and allowing William to accurately track IT budget dollars and the IT staff to focus on activities that better match their skills.

For the spring semester, the chair of the economics department organizes an international summit, which will bring hundreds of attendees to the campus for four days of high-profile meetings. For conference sessions, the presenters need reliable connectivity and access to remote resources, and most of the event will be webcast for those unable to attend. The summit's IT needs exceed the college's capacity, and William understands that the consequences of an IT failure in such a public venue would be considerable, for the faculty member who organized it and for the college as well. In the weeks leading up to the event, William and his staff purchase IT infrastructure from the cloud. The arrangement calls for specified levels of service, even through the spikes and troughs of demand during the summit. Without having to invest scarce capital dollars in campus IT services, William is able to provide robust, reliable IT functions for the event, and after the summit ends, the college reduces its capacity for IT services to a more typical level.

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1 What is it?

In its broadest usage, the term *cloud computing* refers to the delivery of scalable IT resources over the Internet, as opposed to hosting and operating those resources locally, such as on a college or university network. Those resources can include applications and services, as well as the infrastructure on which they operate. By deploying IT infrastructure and services over the network, an organization can purchase these resources on an as-needed basis and avoid the capital costs of software and hardware. With cloud computing, IT capacity can be adjusted quickly and easily to accommodate changes in demand. While remotely hosted, managed services have long been a part of the IT landscape, a heightened interest in cloud computing is being fueled by ubiquitous networks, maturing standards, the rise of hardware and software virtualization, and the push to make IT costs variable and transparent.

2 Who's doing it?

Cloud and cloud-like solutions appear to be widespread and growing in higher education, though in relatively focused areas, such as student e-mail. E-mail notwithstanding, higher education institutions are more likely to obtain *new* services from the cloud than to transition established services that have long been operated by the campus. Many colleges and universities see pockets of cloud service usage in other areas, often led by individual faculty or students looking for the added flexibility and convenience that the cloud can provide. Among the drivers that are encouraging more institutions to contemplate cloud services are budget pressures, calls for increased reliability of and access to IT systems, and the need for institutions to provide timely access to the latest IT functionality.

3 How does it work?

In traditional enterprise computing, IT departments forecast demand for applications and capacity and invest time and money to develop those resources in-house or purchase them from others and operate them in-house. With cloud computing, institutions procure IT services from remote providers, and campus constituents access these resources over the Internet. E-mail, for example, long considered a staple of an institution's IT operations, can be obtained from a range of sources, and a growing number of campuses contract with outside suppliers for this function. Software is hosted by the provider and does not need to be installed—or maintained—on individual computers around campus. In some cases, a large university or a consortium might become a provider of cloud services. Storage and processing needs can also be met by the cloud. Institutions pay only for the resources used, and users can access the applications and files they need from virtually any Internet-

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connected computer. In a mature cloud computing environment, institutions would be able to add new IT services or respond to changes in capacity on the fly, saving capital costs that can be redirected to programs of strategic value to the institution.

4 Why is it significant?

Cloud computing presents IT organizations with a fundamentally different model of operation, one that takes advantage of the maturity of web applications and networks and the rising interoperability of computing systems to provide IT services. Cloud providers specialize in particular applications and services, and this expertise allows them to efficiently manage upgrades and maintenance, backups, disaster recovery, and failover functions. As a result, consumers of cloud services may see increased reliability, even as costs decline due to economies of scale and other production factors. With cloud computing, organizations can monitor current needs and make on-the-fly adjustments to increase or decrease capacity, accommodating spikes in demand without paying for unused capacity during slower times. Aside from the potential to lower costs, colleges and universities gain the flexibility of being able to respond quickly to requests for new services by purchasing them from the cloud. Cloud computing encourages IT organizations and providers to increase standardization of protocols and processes so that the many pieces of the cloud computing model can interoperate properly and efficiently. Cloud computing's scalability is another key benefit to higher education, particularly for research projects that require vast amounts of storage or processing capacity for a limited time. Some companies have built data centers near sources of renewable energy, such as wind farms and hydroelectric facilities, and cloud computing affords access to these providers of "green IT." Finally, cloud computing allows college and university IT providers to make IT costs transparent and thus match consumption of IT services to those who pay for such services.

5 What are the downsides?

Cloud computing introduces significant concerns about privacy, security, data integrity, intellectual property management, audit trails, and other issues. Because higher education is subject not only to institutional policies but also to a broad range of state and federal regulations, these issues are complex and become even more difficult in the context of inter-institutional cloud initiatives. Because of the control that consumers of cloud services cede to providers, successful initiatives rely on a high degree of trust between a college or university and a supplier, including confidence in the provider's long-term viability.

6 Where is it going?

The emergence of cloud computing as a viable option for a growing number of IT services speaks to a level of Internet penetration and infrastructure maturity that did not exist just a few years ago. Analysts expect cloud computing to see mainstream adoption in 2–5 years, and some higher education IT leaders believe that cloud computing programs on campus will increase considerably in the coming years. To the extent that these efforts are successful, confidence in the model and trust in providers will grow, and institutions will be more amenable to transferring a larger number of services to the cloud. Conversely, a breach of trust by a cloud provider would likely leave institutions uneasy about cloud services.

Although the benefits of cloud computing are becoming more tangible, significant policy and technology issues must still be sorted out for it to reach its potential. Even as "public" clouds are being developed, a new class of "private" clouds is taking shape. Whereas public cloud providers offer relatively undifferentiated services, private clouds pursue similar economies of scale but do so while preserving the ability to customize applications and services for consumers. Large organizations, such as statewide offices for higher education, for instance, might invest in cloud services for all the institutions in the system. As greater numbers of campuses consider cloud computing, services that have institutional identification or integration needs are less likely to be sourced from the cloud, and a heterogeneous mix of services—some from the public cloud, others from private clouds, still others developed in-house or purchased and customized—is likely to characterize most institutional IT portfolios.

7 What are the implications for higher education?

Colleges and universities are expected to provide a wide and growing array of technology services, some of which are highly specialized or idiosyncratic to individual campuses, whereas others simply need to be available. By offering commodity services over the Internet, cloud computing offers one way for institutions to increase operational efficiency and focus scarce resources on services that are institutional differentiators. Operating in a cloud environment requires IT leaders and staff to develop different skills, such as managing contracts, overseeing integration between in-house and outsourced services, and mastering a different model of IT budgets. Cloud services might facilitate inter-institutional collaboration because they are more easily accessed by students and faculty at disparate institutions. In addition, despite the potential security risks posed by cloud services, some would argue that cloud services offer *more* security than on-campus solutions, given the complexity of mounting an effective IT security effort at the institutional level.

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