Britt Technology Impact Series

AHEAD IN THE CLOUD:

THE IMPACT OF ON DEMAND SOFTWARE, STORAGE AND SERVICES

AN OVERVIEW 2011–12

TUCK SCHOOL OF BUSINESS AT DARTMOUTH
GLASSMEYER/MCNAMEE CENTER FOR DIGITAL STRATEGIES


TUCK
TECH@TUCK
CENTER FOR DIGITAL STRATEGIES

The Britt Technology Impact Series is made possible by a generous donation from Tuck and Dartmouth alumnus Glenn Britt, CEO and Chairman of Time Warner Cable. In giving the gift, Glenn stated: "The role of business people is to understand the possibilities created by new technologies, recognize unmet consumer or business needs they could fulfill, and determine if the new technology and the customer needs can be put together in a business model that makes sense." The Center for Digital Strategies structures the Britt Series so it highlights relevant aspects of a set of technologies, examines business models and illustrates how consumer and corporate needs are being met.

The Britt Series focused on cloud computing for the 2011-12 academic year because the concept is reshaping how consumers and enterprises access and use information. This summary highlights the unique perspectives offered by Britt Series speakers who are at the forefront of working with cloud technology and, in turn, the future of computing.

CLOUDS IN THE FORECAST

By one measure, cloud computing will have achieved success when harnessing the power of computer networks becomes as simple as plugging in a toaster. The idea behind cloud is to turn software and data storage into services that are delivered through the internet. Consumers and enterprises would call upon these services as needed, much like a utility. Vast amounts of information and computing power would be nebulous and "floating" all around us so they could be available anywhere, anytime, on any device. At is simplest, cloud computing untethers the engine from the vehicle so phones, tablets and laptops become smarter, stronger and more nimble.

Cloud computing has backers, detractors and lots of buzz. Many consumers and enterprise users are eager to trade ordinary computers and servers for newer cloud services. Indeed, the flexibility, ease-of-use and cost-savings promise to make cloud a compelling new world. But the Britt Series made clear the cloud itself is not the biggest story. More important is what the technology can unleash: Cloud has the potential to enable a range of new services for consumers and enterprises.

For consumers, on-premises storage will drop to 64% by 2016 from 93% in 2011 as more people begin saving photos, videos and other files directly to the cloud.

—Gartner

Peter DeSantis D'98 said the simplicity of cloud is an important part of its appeal. DeSantis is general manager of Amazon EC2, the company's elastic cloud computing business. The "elastic" label refers to cloud's signature flexibility to scale as demand warrants. "Today you have to think about infrastructure," DeSantis said. "You have to buy racks, provision bandwidth, rent data center space, hire people to write code — all sorts of different things. But you don't do that for electricity, right?" The universality of the electrical grid means its existence is taken for granted by most of those who use it. DeSantis compared using the ideal cloud service to using a simple kitchen appliance: "The vast, vast majority of the time, the toaster just works."

More than one Britt Series speaker underscored cloud's transformative power by forecasting the term itself is likely to disappear. Cloud could join other technological innovations such as digital music that enjoy such broad adoption they no longer require designation. They become the default. Many consumers already check email stored remotely through providers like Google and Microsoft. Others keep tabs on their social lives through platforms like Facebook that rely on pulling information from far-flung servers. Some maintain the equivalent of digital lockers through storage services including Dropbox, Apple's iCloud and Google Drive. Still more consumers draw information from the cloud to feed data-hungry apps. Using

Bill McDermott, co-CEO of business-software provider SAP AG (left), notes the on-demand responsiveness of cloud systems can give business leaders deeper insights into operations.

these services is so routine many consumers likely do not realize they are relying on cloud computing. Simplicity for the user is instrumental in the growth of cloud technology. Gartner predicts consumers will store 36 percent of their digital content in the cloud by 2016, up from 7 percent in 2011. The research firm said growth will come from consumers' desire to share and access content from multiple devices.

For the enterprise, the cloud presents an opportunity to reduce costs, increase flexibility and free IT staff from maintaining networks so they can focus on other parts of the business.

"The cloud is absolutely the biggest change in IT in the last 30 years without a doubt," said Enrique Salem, president and CEO of Symantec Corp. "It really is just a new way of delivering IT services or computing services."

Cloud services total nearly $75 billion a year around the world, according to Gartner. Demand is expected to grow at 20 percent annually in the coming years. Concerns about security, privacy and reliability will remain high but are not likely to derail widespread adoption, Britt Series speakers agreed. Consumers and enterprises will have to embrace the cloud in part to manage the growing crush of data generated by a computerized world. IBM projects global data volumes will multiply 29 times in the next 10 years to 35 zettabytes. (A zettabyte is a 1 followed by 21 zeros!)

Bill McDermott, co-CEO of business-software provider SAP AG, illustrated the blistering pace at which information is amassing: "If you stacked books from the planet Earth to Pluto 30 times — that's how much data got created in 2011 alone."

Cloud tools make it far easier to manage the data from social tools, for example. "I can't imagine the world without the cloud," said Kate Taneyhill Jhaveri T'03, who oversees global platform marketing at Facebook. "The social world does not work without the cloud because of all the data."

PEERING INTO THE CLOUDS

{Defining new technology}

The cloud can be viewed as a sort of back-to-the-future moment for computing. It is, in some ways, a return to the days of robust mainframes and simple terminals. The smartphones, laptops, and tablets that are today's "terminals" are anything but unsophisticated though they are able to do more by drawing upon resources from the cloud.

Peter Vosshall D'92, VP & distinguished engineer at Amazon, points to the ease of cloud as allowing consumers and enterprises to "outsource all the muck" of IT.

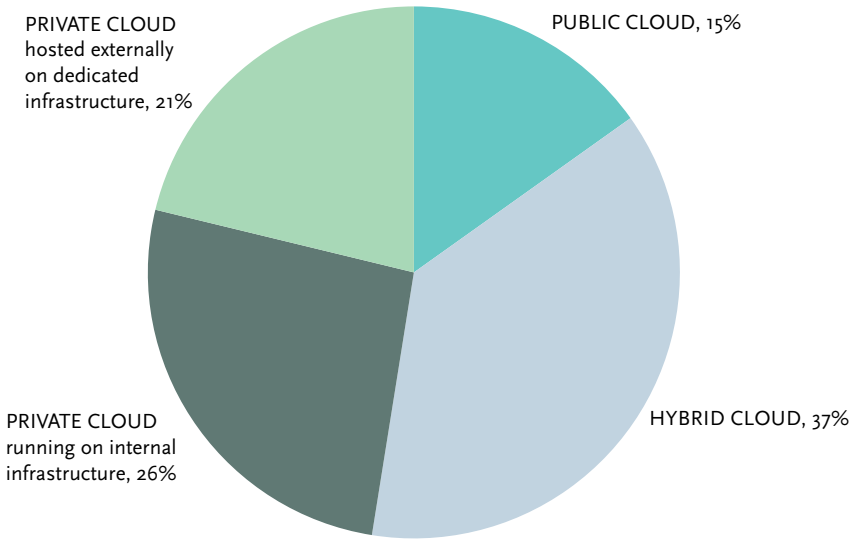
Geir Ramleth, CIO at the engineering and construction firm Bechtel, warns against applying strict parameters to describe cloud technology.

The mainframe model could bring increased simplicity for users. "We have all of the infrastructure now and the technology where that's a realistic model again, where it simplifies both the consumer's life and a technologist's life to be able to outsource all the muck," said Amazon Distinguished Engineer Peter Vosshall D'92.

"Cloud gets kinds of confusing because it means three different things. But at the end of the day it's simplifying technology, cutting the cost, letting the experts take care of managing [IT] so that as a business or as a consumer, you can go on with your life," Vosshall said.

Geir Ramleth, CIO at the engineering and construction firm Bechtel, warned against applying strict parameters to describe cloud technology. "It's extremely dangerous to put any definition on that because I don't think we know what it is yet," he said. "A definition this early in the game can actually limit us." Ramleth contends keeping cloud largely undefined will prevent artificial constraints from limiting cloud's evolution. "Not knowing where we're going is maybe the stronger case. If you go back 30 years, when people started kind of playing with the internet, there was no definition," he said. "You see where that brought us — it brought us very, very far."

Interest in hybrid cloud reflects the need for broad, unified management



SOURCE: Forrester Consulting survey of 327 cloud computing IT leaders

Clouds can be described, if not fully defined, by whether they are "private" or "public." Private clouds are used by a single enterprise whereas public clouds involve shared infrastructure. In addition to Amazon, Google's Cloud Platform, Microsoft's Windows Azure and Rackspace Cloud are among the chief public cloud providers for the enterprise.

Olivier Gouin, CIO at the food giant Nestlé, said there is confusion about where the cloud exists. "The tendency of today's world is to look at the cloud as something outside of the enterprise and I think it's just a wrong perception. It's not just that. It can also be inside the enterprise," he said. "Today, for the large company, the private [cloud] is more important than the external cloud. For the small and medium companies — probably the reverse. So we have to understand different point of view from that area."

Gouin said many enterprises hope to establish private clouds to replicate what is available in public spheres. "What we want to do is to be able to take an application running on the cloud outside and put that inside our company," he said. "We'd be able to control it. Now, this is more of a short-term discussion for the next few years, until we feel it's more secure."

Olivier Gouin, group CIO at Nestlé, says the cloud often is outside the enterprise but also can be located internally in the form of a private cloud.

Enterprises will, in time, embrace more public cloud applications, Gouin predicted. He noted Nestlé runs its global IT systems through three major data centers that will remain in place even as use of cloud expands. "We basically have a billion units going out to the supply chain every single day so you cannot run that on the cloud today." Gouin ventured that some companies could wait years before putting major systems like enterprise resource planning in the cloud.

The public cloud offers speed and simplicity but the customization made possible by a private cloud can provide "functional richness," according to Martin Petry, CIO at the construction tools and technology company Hilti. IT leaders try to gauge the expected server load when determining what cloud model might work, he said. "It's typically driven by a strong data demand, or overall demand on performance, or very strong peak characteristic versus a constant load. And then you need to look into these public cloud offerings, which are then very effective and efficient for us."

More than 143 million consumers used free or low-cost applications that reside in the cloud in 2009. The number will grow to more than 160 million by the end of 2015.
—ABI Research

Petry contends cloud technology is pushing large enterprises "a little bit further" on the technology side but that many internal IT systems do not meet the definition of a private cloud. "When I talk cloud computing — or true cloud computing as I would call it now — that is really the public cloud and not the internal stuff. I think internal stuff, to a degree, that's a little bit of label optimization because ... we have run the data centers with consolidated services for a very long time," he said. "I think now we put the label cloud computing on it because it sounds a little bit more up to snuff. But at the end of the day, true cloud computing for me is really that I actually purchase complete IT services from somebody providing that in an elastic, scalable manner."

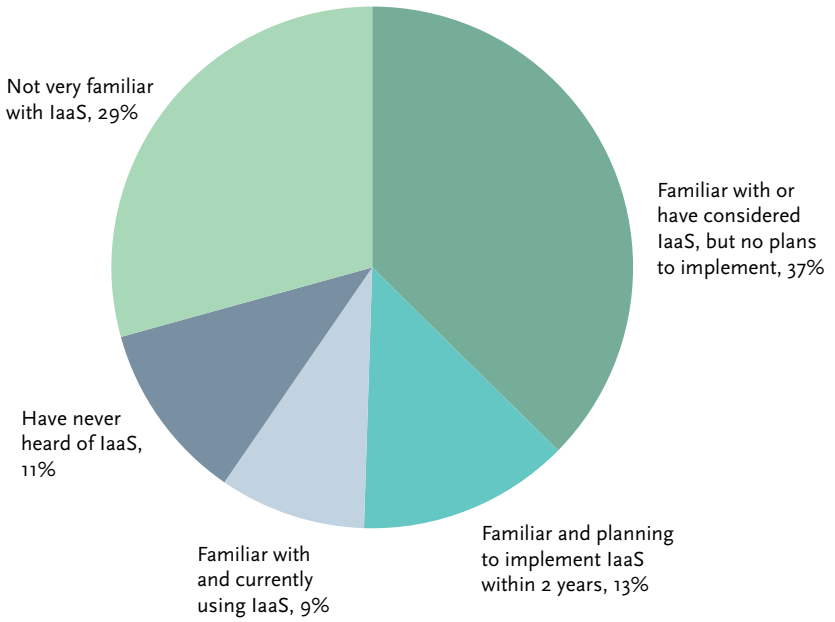
Late-adopters will go from generating 10% of cloud spending in 2011 to 40% in 2013.
—Bain Cloud Computing Survey

SAP's McDermott said small and midsize companies are more likely to move their entire computing systems to the cloud because these enterprises are not dealing with the level of complexity of a large multinational corporation. "If you're a $200 million startup or a midsized company, well why not put your whole business in the cloud if you can? And is it true that someday big companies may put their entire company in the cloud? Sure. It's absolutely true. But right now we see it's a hybrid world that we're playing in," McDermott said. He noted under the hybrid model a company might retain critical pieces like supply-chain information or finance systems in existing data centers and move other parts of the business to a public cloud.

Olivier Gouin, group CIO at Nestlé (left); Martin Petry, CIO at Hilti; Geir Ramleth, CIO at Bechtel; and moderator Hans Brechbühl, executive director at the Center for Digital Strategies, discuss the benefits and challenges cloud tools are presenting for the enterprise.

A Frost & Sullivan survey of IT decision-makers revealed 37 percent were familiar with Infrastructure-as-a-Service, or IaaS, but did not plan to start using these services. IaaS involves an enterprise outsourcing its technological needs including hardware and servers. With IaaS and other cloud services, billing often is on a pay-as-you-go basis rather than through more traditional licensing fees. Frost & Sullivan predicts growth in use of IaaS will surge more than 54 percent through 2015.

Familiarity and Adoption of IaaS



SOURCE: Frost & Sullivan

Clearly defining the cloud

The National Institute of Standards and Technology, a division of the U.S. Commerce Department, defines cloud as having the following five key characteristics:

1. **On-demand self-service.** A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.

2. **Broad network access.** Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops and workstations).

3. **Resource pooling.** The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory and network bandwidth.

4. **Rapid elasticity.** Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.

5. **Measured service.** Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service.

MAKING A SOFT LANDING IN THE CLOUD

{Aiding productivity}

Most Britt Series speakers acknowledged the possible reduced costs and increased simplicity touted by proponents of cloud technology. But much of the focus was on less-apparent advantages such as speeding product introductions and giving consumers and workers more power.

Tom Mills, Global Director of Enterprise Education at Google, asserts that cloud technology can boost efficiency by giving IT workers more time to understand needs of other divisions within the enterprise.

Tom Mills, global director of enterprise education at Google, said a more nimble and responsive IT department can better align its efforts with other parts of the business. There might be, he noted, a way to automate a repetitive task. "It frees people and resources up to go do other things. And I think that's where it becomes really interesting," he said. "If you don't have to spend your time memorizing X amount of facts you can then say, 'OK, now that I have that as an asset I can then build on top of it without having to put the same amount of time and effort into it.'"

"I think the innovation is really starting to pick up now," Mills said. He then offered an example relevant to Dartmouth: Mills noted schools could use mobile apps to make it easier for students to add and drop classes. "Can you imagine the load during that two-week period at the beginning of every semester? And if you have to build the infrastructure to be able to handle peak capacity of that on your own, there's no way that would ever happen." With cloud technology, however, the flexibility to ramp up with demand would make such an app possible.

Mills also highlighted the gains made by one entrepreneur who had four staff members managing IT infrastructure. Cloud services allowed the CEO to cut that to one person. "He put the rest of the people out working with his users because he found users have no idea what technology does and the IT [staff] had no idea what users do," Mills said. "If you put them together some cool stuff can happen like 'Oh, you spend an hour a day doing that. How about I make it a button?'"

Giving workers time to pursue something new is critical for SAP and its nearly 200,000 enterprise customers, McDermott said. "My vision for the company is very simple: If we don't

innovate we go away." Another concern is freeing resources to fund new ideas. "Today, 85 cents on the dollar is spent on hardware and services. We need to kill that hardware. Atoms need to turn to bits," McDermott said.

Kent Parker T'90, COO at cloud computing provider Ariba, stated many processes involved in areas like commerce and customer-relationship management could be made more efficient with cloud tools. He noted 85 percent of invoices are processed by mail or fax machine. "Every business process ... is going to be radically changed by cloud and cloud technology in the next 10 years. And companies or industries or business sectors that don't believe that ... are really destined for some serious failures," he said.

Mac Dougherty T'09, CEO & co-founder of Cognitive Electronics, leads a discussion about how cloud tools can lead to innovation and allow workers to do more.

Mac Dougherty T'09, CEO & co-founder of Cognitive Electronics, compared the recent rise of cloud technology to the late 1990s when the expansion of the internet gave individuals a cheap and easy way to publish. "There was a fundamental shift, particularly in media, because it no longer was important to own a printing press," he said. Cloud technology removes similar barriers by making available storage and processing power that once might have been unaffordable.

Nestlé's Gouin said cloud tools can reduce what enterprises spend to be ready for periods of high demand on servers. He noted traffic at an e-commerce site might spike tenfold when a company introduces a promotion to consumers. Cloud systems would allow an enterprise to temporarily bolster its server capacity without paying to maintain this level of readiness at all times.

Cloud technology also can help enterprises learn from the huge amounts of information they draw, according to Google's Mills. "One of the biggest benefits of the cloud is the scale that you can achieve," he said. "It used to be we bring focus groups of 10 customers to say, 'Hey, what do you think of this feature or this feature?' With Gmail, we have hundreds of millions of users and we can say, 'Oh, 80 percent didn't click on this button.' [It's] probably a good bet that that button does not need to be there."

"You can get some really impactful data at an empirical level across all these types of users," Mills added.

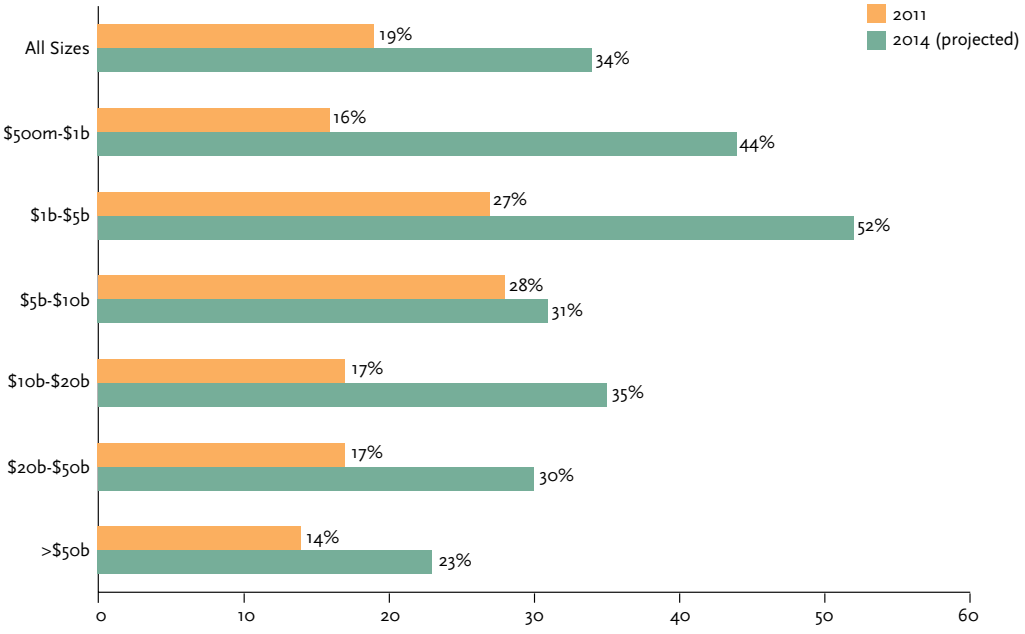
SAP's McDermott said the on-demand responsiveness of cloud systems can give business leaders deeper insights into operations. "It goes back to this personalization, or this consumerization, of IT because now if you're the chief marketing officer and you want brand

Cloud-based servers can reduce operating and maintenance costs 40 percent or more compared with traditional on-site servers.
—Accenture

data or instantaneous information on a market, you can access that," he said. "If you're in HR and you want to manage talent you can get that on-the-run from a talent management provider who's got a public cloud."

Steven Caniano, vice president, hosting & cloud services at AT&T Business Solutions, referred to this flexibility as "business agility." He said cost is always a factor but so, increasingly, is speed. "You've got the ability to move at a pace you never could before. You don't need to size up the architecture perhaps that you might have in the past or deploy equipment that might take you 60 days, 90 days, longer than that," Caniano said. "In order to be competitive, that becomes a differentiator."

Plans For Cloud Adoption, By % of Corporate Applications (U.S. Companies)



SOURCE: Tata Consultancy Services Ltd.

WHEN MONEY FALLS FROM THE SKY

{Pricing}

Questions arose throughout the Britt Series on whether competition for cloud offerings would push these services to become commoditized, low-margin businesses. Many experts predicted prices for cloud services would continue to fall. Indeed, by early 2012 Amazon had cut prices on its cloud services 19 times in six years. Some Britt Series speakers asserted these types of price drops would be acceptable for cloud providers that adjusted their business models.

Caniano said wrapping compelling professional services around cloud offerings would help prevent a ruinous drop in prices. Such offerings go beyond computing and storage on demand. He pointed to AT&T's cloud services for medical imaging. "That pulls along a lot of infrastructure. There is probably nothing that uses more storage than X-rays and MRIs. But we don't sell that as infrastructure. We sell that as a solution to our health care customers," he said. "It differentiates the service such that you're not having a commodity infrastructure discussion; you're having a solution discussion."

The data center market, which exceeds 130 million square feet in the U.S., will grow at nearly 10 percent a year through 2015.

—Frost & Sullivan

Google also looks for ways to neutralize concerns about commoditization. One student asked whether making it difficult for customers to extract their data from cloud services would create so-called stickiness and help providers resist pricing pressure. Mills responded by saying efforts to lock in customers were short-sighted. Cloud providers should instead focus on crafting services that are valuable to businesses and consumers. He noted Google has a division called the Data Liberation Front. This unit is charged with ensuring customers have little trouble withdrawing data from the company's applications. The group's function is to give existing and potential customers reassurance they will not become forever wedded to Google's services. "Larry Page pushes for that because, at the same time, he's basically pushing the product managers to improve their products so that people don't want to take their data out of it," Mills said, referring to the Google CEO. "Vendor lock-in is not necessarily something I would want to aspire for."

Mills said the creation of the Data Liberation Front forged trust with Google's customers because the group made the company more open about problems such as outages. He said customers appreciated the company saying "We understand. This is your data. You deserve to know these types of things." That stance does not mean Google gives customers every piece of information, however. "I would say it might be a little bit different than some of the private clouds. We don't tell exactly what's going on within the data centers all the time," Mills said.

LANDING ON CLOUD NINE

{Finding success in the enterprise}

So what benefit does building a private cloud network bring? What does an enterprise get when it signs on with a public cloud provider? Britt Series speakers addressed these questions by highlighting examples of how the cloud can solve problems.

Yancey L. Spruill T'97, CFO at satellite imagery company DigitalGlobe, explains how the company uses cloud tools to distribute its images and broaden its customer base.

For some enterprises, cloud technology can broaden the customer base. Yancey L. Spruill T'97, CFO at satellite imagery company DigitalGlobe, said distributing its products through the cloud broadened the company's customer base and brought in millions of dollars in revenue in just a few years. "If we didn't have that capability ... we would be limited in terms of who we could sell the imagery to because it's just such a hard IT problem," Spruill said.

DigitalGlobe has satellites circumventing the earth at 15,000 miles per hour. They capture high-resolution imagery used by governments, businesses and, ultimately, even consumers. The amount of data in the image files can be massive. DigitalGlobe began to invest in cloud infrastructure after its imagery overwhelmed the IT system of a major mobile handset maker. To prevent that from recurring, the company set up a private cloud for its image library. Customers now access the DigitalGlobe archive, which grows by thousands of images every day, without having to manage petabytes of complex data. (There are a million gigabytes in a petabyte.) "You have to have a lot of infrastructure. So what the cloud does is we'll host it, we'll manage the infrastructure — you just get the information you want," Spruill said. The move to cloud "really lowers the barriers to consumption for our customers."

DigitalGlobe relies on its cloud technology to feed information to the proper officials in the aftermath of disasters. The company's satellites, which orbit 200 to 500 miles above the earth, snapped images of Japan's Fukushima Daiichi nuclear plant following the March 2011 earthquake and resulting tsunami. DigitalGlobe captured an image of the plant about 30 seconds before an explosion and then about 30 seconds after. "We were able to get that information to the Japanese military and other agency officials within an hour or so. And they were able to use that to help with rescue and recovery efforts," Spruill said.

The cloud lets the company take a similar approach to that of Apple. "Digital media is becoming much more complex," he said. "People can't manage it." He noted it would be

Students and vendors attending Tech@Tuck discuss some of the cloud tools enterprises are introducing. Axis Communications offers cloud-based video monitoring systems.

impossible for many consumers to store their movie and music libraries, for example, on an iPad. "So what Apple will say is 'I'll host it, and you just call it when you want.' And that's what we're doing."

Other enterprises have found the cloud can be ideal for handling technology deployments. Hilti's Petry said the company's use of cloud-based customer-relationship management tools like Salesforce.com makes it faster and easier for Hilti to distribute mobile apps to some of its smaller sales teams. Outfitting workers takes days instead of months and doesn't require an IT worker to travel to wherever the sales team is based. An off-the-shelf product might not be as customized as one Hilti would build on its own but the implementation costs drop by at least a factor of 10. "You don't need to start calculating. I mean, that is a completely different level of deployment, a completely different level of cost," Petry said.

Nestlé relies on the cloud to help monitor what goes on at the retail level. "With the number of consumers that we have it's a huge amount of data. And you don't want to bring that into the company … you summarize it and you work at it from outside," Gouin said. "You only bring the data you need to basically do the analytics with your own data that you have stored internally." The à la carte approach makes it easier for the company to grapple with vast amounts of information about consumers from merchants as well as from sources like social networks.

Nestlé also buys a software-as-a-service, or SaaS, cloud tool for handling HR tasks ranging from employee guidelines to performance evaluations. Gouin estimated the company had about 200,000 employees using the HR tool. The challenge is most employees tap into the system at once. "Two periods during the year you need to allow people to get into the system for a period of … an hour. And they are basically all working at the same time," he said. The ability of the cloud service to handle spikes in volume is critical.

THE FOG OF WAR

{Security and other obstacles}

The Britt Series speakers did not shy from highlighting the many obstacles that must be addressed to allow wider adoption of cloud technology. The No. 1 concern remains security. This is in part because an enterprise relying on a third-party cloud provider still would be responsible if confidential information were to be revealed. As security threats grow more sophisticated, so too must the security measures. Symantec and its predecessor companies once updated their security software once per quarter. Then it progressed to monthly, weekly, hourly and several times an hour. "None of those were good enough," Salem said. "Today 75 percent of attacks hit less than 50 machines. And so we had to invent new things."

Amazon's DeSantis acknowledged concerns about security in the cloud. "You remove a bunch of threat factors by moving stuff in the cloud but we also introduce them," he said. DeSantis also asserted, however, that enterprises running their own servers can feel a false sense of security. He compared the traditional security setup to an egg. "It's a hardened exterior with a mushy interior," DeSantis said. "If you're an attacker, and you get inside that data center, typically you can walk around and find all sorts of stuff." Amazon's use of so-called virtual private clouds is helping reassure some customers, he said. An enterprise using this technology can cordon off its own section of a public cloud. The enterprise can then outfit its allotted space with additional layers of security. "It's pretty easy for customers to put additional segregations inside their environment so if they do find that they're compromised in some way they can provide more blast-radius control."

Consulting firm Accenture predicted a mix of public clouds and private services would become the primary model most enterprises use. This is in part because of concerns about security and reliability. In April 2011, an outage among Amazon servers left thousands of websites inoperable. The problems knocked out some sites for more than two days. DeSantis said the company learned from the failure. "Internally, we've made some adjustments in terms of resourcing to make sure that we double down and fix those." The experience helped the company consider other risks. "It's not like … oh, I stub my toe on the bed but rather, you know, where else in my house might I have stubbed my toe?"

Peter DeSantis D'98, general manager of Amazon EC2, compares using the ideal cloud service to using a simple kitchen appliance: "The vast, vast majority of the time, the toaster just works."

Following a path into the clouds

How to better induce the adoption of cloud services is a concern of nearly all cloud providers and a roadblock many outsiders see for the industry. Assuming that providers can convince customers their basic needs such as security and reliability will be met, in what ways can cloud providers hope to gain traction in adoption? I hoped to answer this question and others with my research into how cloud computing was disrupting traditional software companies' business models. In addition to adoption, my research addressed other concerns in the industry such as investment return and the continued commoditization of cloud services.

Through my research, I found CIOs often were in the dark regarding the level of adoption of cloud services in their company because employees often paid for services using personal credit cards. This trend of adoption suggested an optimal sales strategy for cloud providers is one that contrasts with that of traditional enterprise software sales. For cloud, it is best to focus on the bottom-up approach. Providers hoping to grab share should focus on making it as easy as possible for the ultimate user to sign up and use the product. This eventually will cause enterprise-wide adoption through a democratic majority of users. This is different than the past when the successful sales strategy was to win big accounts by focusing on top decision-makers in the organization. One could liken this strategy to what Apple is doing with the iPad. The company is trying to gain a foothold in the enterprise via users bringing in their own technology to the workplace.

In addition to adoption concerns, cloud providers also must contend with a revenue curve that is drastically different than the traditional software model. Instead of funding development costs upfront and having a large influx of revenue upon product launch, cloud providers must still make large infrastructure investments early on but not see any return on these investments until their user base ramps up. This is why adoption is so important. I found there were ways companies could try to mitigate this. One way is by overbooking their servers (similar to airlines overselling flights) with the hopes that customer demand will be varied enough to handle demand at any given time. Another method to mitigate this investment risk is by encouraging subscriptions. We already are seeing the industry switch to a model where customers pay upfront for a certain level of compute resource and storage that supplies a steady revenue stream to cloud providers.

Pricing power in the cloud space has been eroding as companies with similar products have tried to differentiate on price. For example, Amazon has reduced prices 19 times for its cloud services since its launch just six years ago. As companies struggle to differentiate themselves, I believe we will see companies move farther and farther up the cloud stack. That is, they will move from providing just infrastructure-as-a-service, or IaaS, to software-as-a-service, or SaaS. This would occur as they hope to entice customers with their unique advantages. This attempt at differentiation most likely will increase the cost of business, however. This suggests margins could degrade in the space. So how can companies keep pricing power? One possibility could be through the bundling of cloud with additional on-premises product and support to avoid pure-play price competition. Regardless of the strategy, this commoditization will no doubt be one of the major (if not biggest) concerns of players in the future.

-Geoffrey Mattei T'12, MBA Fellow, Center for Digital Strategies

The disruption was a rare event for Amazon but received widespread attention because of the number of enterprises whose systems were disabled. The ramifications extended beyond corporations. Amazon's cloud business, for example, includes 187 government agencies, according to the *New York Times*. The company announced numerous changes following the disruption. Gartner predicted by 2015, eight in 10 enterprises that rely on cloud computing services will insist on independent certification that a provider can get operations and data up and running after a disruption.

Several Britt Series speakers stated the "down time" was less with cloud than with traditional computer networks run by the enterprise. The comparison looks more favorable for cloud tools when including the type of planned outages necessary for system upgrades.

The eroding line between people's personal and work lives adds to the challenge. "One of the biggest concerns I have as consumers start using more cloud-based services is, what information are they putting out? Every major corporation will tell you if you put out intellectual property about the corporation they will fire you. But they can't keep you from putting out information about yourself, and so that creates a certain specific risk," Symantec's Salem said. "I'm confident we can secure public-cloud based services. I'm not confident we can change user behavior."

By 2015, eight in 10 enterprises that rely on cloud computing services will insist on independent certification that a provider can get operations and data up and running after a disruption.

—Gartner

The essence of cloud technology involves beaming data from one place to another so providing security can be a daunting task. Salem prescribed setting up a robust system of accountability. "What really matters is not this device or that device," he said. It is critical to know who owns what information and where it is stored as well as how it is being used. "Ultimately, if we're going to make cloud computing secure, it requires an information-centric approach. Why do I say that? Because you just need to know what information you're going to put in somebody else's data center."

Deciding what information might be too critical to trust to any outside player is important. Salem told of a CIO at a large company who was concerned with guarding the formula for a key product. "She said 'Enrique, it's 1 percent of our data. That's not getting out of my control. I'm going to have a very locked-down environment and I'm going to control that 1 percent. The other 20 or 30 percent that I need to keep confidential I can put that in a cloud-based service. And the rest of it, it's public anyway. So it's OK.'"

Close tracking of information can make it easier for enterprises to team up on projects with those outside the enterprise. Bechtel, for example, often will take part in joint ventures with competitors. In the past, the company would invite partners on a project into the company's

William Tworek, senior technical staff member & executive IT architect, office of the IBM CIO (second from left), warns security breaches can arise if workers deploy cloud tools without informing IT departments.

network. "They actually came in and they got an account with us, and they used our tools for the stuff. And I tell you, it doesn't make for good night's sleep ... when you have your competitors actually sitting inside your network," Ramleth said. With cloud tools, the company can keep partners outside Bechtel's data center.

"The old IT world was like a European medieval castle with a moat around it and big walls — and you have a drawbridge that's called a firewall," he said. Under the cloud model, the company will grant access to certain information.

For consumers, the concerns about security often involve the idea that someone else is in control of their data. Google's Mills pointed out consumers already turn much of their most sensitive personal information over to enterprises. "How do you do your 401(k)?" he asked. "They have all your money. They have your social security number. They have your bank information." Mills said gaining comfort with the notion of putting information on far-off servers rather than a home computer requires consumers to think through their concerns and realize they might not be any more secure with information housed locally on a computer.

Hilti's Petry said legal concerns present another challenge. He asserted the legal framework, especially in Europe, was outmoded for handling and storage of data. "That puts clear limits on the utilization of cloud today," he said. He believes updating laws to account for how information is stored with today's technology is critical.

Legal difficulties also can arise when users try to end cloud-service agreements. Several Britt Series speakers said it often is far easier to put data in the cloud than to remove it. Gouin described the difficulty Nestlé once faced with a provider of cloud services. The vendor sought

to charge a fee to Nestlé to withdraw the company's own data. "This company says, 'Yeah, well, you have to pay for it.' Well, wait a moment, it's my data. 'Yeah, but we're going to process it, so you have to pay for it.'" Gouin said the dispute ended amicably but it provided a lesson. Nestlé enhanced its legal agreements to avoid future disputes. "We have to learn how to kind of accept a very different risk, an operational risk that we didn't have before."

William Tworek, senior technical staff member & executive IT architect, office of the IBM CIO, noted the agility of the cloud can be dangerous if it allows workers within an enterprise to bypass the technology experts. This so-called "shadow IT" is a problem because IT departments cannot maintain proper security without knowing what other departments are doing. People without appropriate knowledge, for example, can disable security measures that appear cumbersome.

Symantec's Salem cited the example of one enterprise customer whose marketing department put a large set of customer data into a public cloud service. The marketing team bypassed IT in making the decision. Vulnerability in the cloud provider's security then exposed the customer data. "Shadow IT brings with it a number of concerns because you're not using the state-of-the-art or the latest techniques used by your internal organization."

In some instances, workers using unauthorized cloud tools might still have access to information once they leave the company. "The challenge with cloud computing is, I think, largely an educational one," Tworek said. He predicted IT departments will have to give up more control because of the spread of cloud tools. He added that IT leaders will have to increase efforts at making other parts of the enterprise understand the risks and benefits. "Their role is to educate in the consumerization of IT versus control and govern. And that shift from control and governance to education is very difficult."

At Bechtel, the IT department discovered how much the proliferation of consumer devices was infiltrating the office. The company issued an app for use by the 1,000 employees to whom the company had given iPhones. The number of downloads of the app, however, approached 3,000. "We said that's great … people use their own iPhone in the cloud to do their transactions," Ramleth said. "And then we started thinking, 'Hey, wait a moment. What kind of information requirements are those people using it under? What about the data that sits on that device? It sits on a private device with no licensing, no legal obligation.'" In response, the company revamped the information agreement it has with employees.

It can seem counterintuitive but the cloud can be more, not less, secure for enterprises and consumers, several Britt Series speakers noted. The safety comes in part from the ability of cloud service providers to deploy security measures in a quick and uniform way. Amazon's DeSantis predicted improvements in cloud technology would ease worries about safeguarding information. "As that innovation increases … I think we're going to end up with a more secure computing environment." That forecast is welcome news for small enterprises that might lack the resources to focus on security in an environment in which there are several million attacks a day.

"I absolutely and fundamentally believe there is nothing inherently insecure about the cloud. It's more a matter of what vendors, what companies you work with," Symantec's Salem said. "Done right, it can be more secure."

There are other obstacles for cloud adoption. The switch to pricing based on consumption can be difficult for enterprises and consumers alike. IBM's Tworek noted internal financial systems with many enterprises can be inflexible. "A lot of big enterprise financial systems are set up to have consistent monthly charges ... so we deal with people who say 'Yeah, I know that's really cool that the cloud will charge me different rates each month. Can we just charge me $1,000 every month because that's in my budget?'"

Service outages at Amazon, Google and Microsoft cost each of these cloud providers an estimated $200,000 per hour.

—International Working Group on Cloud Computing Resiliency

Amazon's Vosshall asserted the benefit to turning fixed costs into variable costs is worth re-engineering financial systems. He noted many enterprises run servers that use only a sliver of their capacity on a typical day. "CPU load across your servers are just embarrassingly low numbers — single digits, maybe 10 percent. That means you've got four-fifths of your capital just sitting there doing nothing," he said. With cloud "you can just scale up as you need it and scale down when you're done with your capacity then you don't have those costs anymore."

PINNING DOWN RISKS AND REWARDS

{Deciding what goes in the cloud}

The Britt Series speakers made clear enterprises are looking to cloud to expand what is feasible. Amazon's Vosshall offered the example of a photo-sharing service that compiled users' photos into slideshows accompanied by music. The service languished until the company made it easy for users to share their newly complete videos through social channels like Facebook. The popularity exploded and the increased demand meant the Amazon customer consumed vastly more computing power. Demand for servers — known as "compute instances" in Amazon's cloud service — surged. "They went from running I think maybe 50 compute instances to over 4,000 within a 24-hour period," Vosshall said. He noted the cost of setting up that many servers when the company was established would have been prohibitive. The ability to expand as needed was critical to allowing the customer to meet demand without disruption.

Hilti's Petry said the company has relied on the cloud to do heavy lifting for data-intensive tasks like video messaging. Petry said the cost of taking up a gigabyte of data on the company's existing servers made it less expensive and easier to put video in a public cloud. "No way on earth that I put that in my data centers. So, up in the cloud," he said. "There are strong [companies] that provide this type of specialized service at very reasonable cost proposition. And that's exactly how we use public cloud."

Spending on public cloud IT services in 2011 was estimated at $28 billion compared with more than $1.7 trillion in spending on all IT products and services
—IDC

"I don't have the elasticity, in terms of value for the performance required, in order to provide it. And that is where, for me, currently, the true cloud computing makes the most sense. And that is also the No. 1 filter," Petry said.

Hilti does "quite a bit" of cloud computing, though Petry said it was for "peripheral" items the company does not have to run on its network. "I still have my data centers," Petry said. "That will not change in the next few months. It might change over the next 10 or 15 years, very likely, in different steps. But that's not reality today."

Kendall Collins, SVP and GM, Chatter at Salesforce.com, noted some of the biggest demand will come not from traditional areas like traffic to websites and instead from the continued rise of social platforms. “The web growth is really not there,” he said. “The entire consumer web is being re-architected around people and we see this now happening in the enterprise. We see businesses saying, you know, ‘We need to re-architect around our people. That is our most important asset.’” That growth is likely to drive cloud.

McDermott said small or midsize companies purchasing SAP’s enterprise resource planning suite can use it through a public or private cloud. This speeds up deployment. “Instead of implementing that through consultants and taking three to six months, maybe even a year, which small companies can’t afford anymore, we’ll do rapid deployment solution and we’ll have you running in 30 days.”

Some of the easiest operations to bring to the cloud are those necessary-but-routine functions that support rather than drive a business. This “business process-as-a-service” for functions such as human resources accounts for 80 percent of cloud revenue, according to Gartner.

Amazon’s DeSantis said cloud use will increase in part because it lets enterprises avoid having racks of servers sit idle. “Where there’s waste, there’s probably opportunity,” he said. Beyond demand, the simplicity cloud brings will be too compelling to ignore, DeSantis predicted. “As much as I’m happy with what we built so far … customers are still doing way too much work for themselves.”

Symantec’s Salem cautioned not all systems can be put in place overnight just because the data storage and processing will occur in the cloud. “Building out a cloud-based solution that integrates with your business still requires many of the same approaches you used before. One of the biggest issues is IT organizations are not necessarily prepared,” he said.

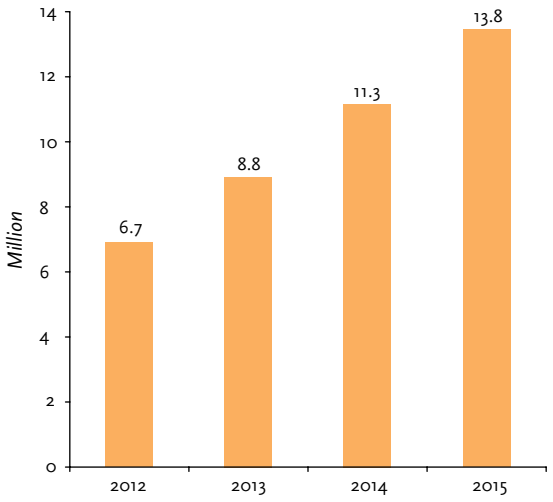
The move toward the cloud will not be instantaneous. "IT will continue to run a very large percentage of the total infrastructure of a corporation for many years to come," Salem said. Even some of the heaviest users of cloud computing still rely on traditional internal networks. Salem shared an exchange he had with Tim Campos, CIO of Facebook. Campos told Salem the social network, with some 900 million users, keeps about 70 percent of its infrastructure in the cloud. The remaining 30 percent remains on-site in traditional servers.

The challenges of any IT setup, including using cloud tools, mean companies are not quick to shed workers. A Computer Sciences Corp. survey found only 14 percent of companies cut IT staff after moving to the cloud. In fact, another 20 percent of enterprises hire additional cloud experts.

Several speakers, including CIOs, predicted IT divisions will prosper, not wither, in a world full of clouds. CIOs might become more like brokers of IT services. They could serve as architects of cloud environments and help other parts of the enterprise procure their processing and storage resources.

AT&T's Caniano said the loss of some control for IT departments might make cloud unpopular at times. "The biggest competitor out there is actually the IT departments and companies that are doing it themselves," he said.

Cloud Computing Impact on Jobs: Total Cumulative Jobs Generated by Cloud Computing Worldwide at Year-End, 2012-2015



SOURCE: IDC, 2012

Caniano stated the challenges of shifting culture to embrace adoption are not unique to cloud. "We've seen this before in business with things like outsourcing," he said. "You need to give up an element of control. If you're going to avail yourself of the benefits of the cloud or of any service or any provider capability, you've got to get comfortable moving from 'I'm going to own this,' a server-hugger type of mentality ... to one where I'm going to be become a manager of service providers, a sourcer, a strategic partner. That's a very different skillset for a lot of businesses to have to adopt. And it's absolutely a cultural shift first and foremost to understand that it makes sense to move into that model."

WHEN CLOUDS ROLL BY

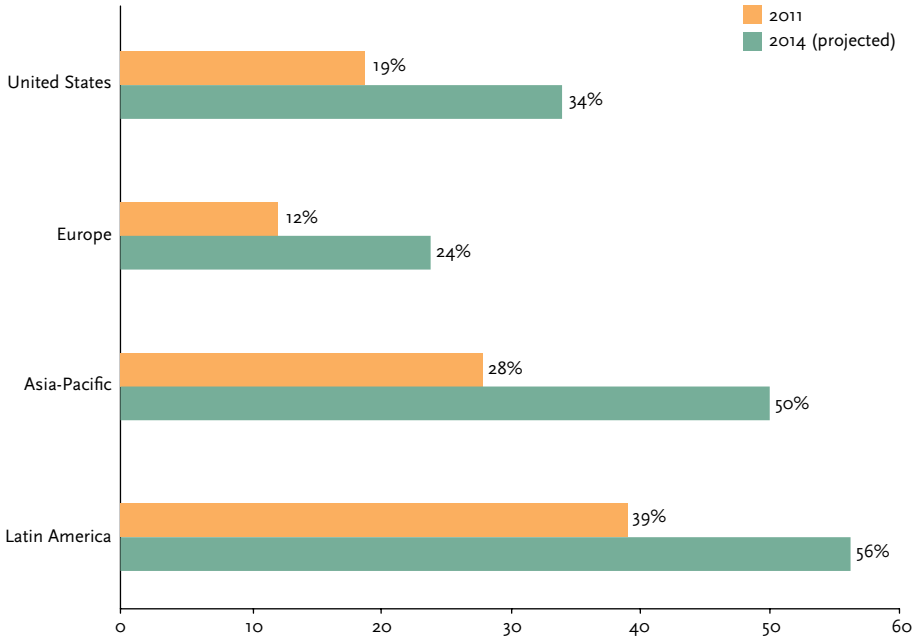
{Mobility}

One of the biggest forces pushing cloud technology into broader use with consumers and enterprises is mobility. The rise of smartphones and tablets depends on instant retrieval of data. Computer Sciences found in its survey of 3,500 enterprise cloud users in eight countries the primary reason for moving to the cloud was to support mobile devices.

Growth in use of Infrastructure-as-a-Service will jump more than 54 percent through 2015.
—Frost & Sullivan

Symantec forecasts by 2015 the number of smartphones will jump to 10 billion from the 2.5-3 billion now in use. The rise of the iPhone illustrates the rapid increase in demand for smart devices. There were 35 million iPhone users in the U.S. by mid-2012, according to comScore. The growth has come not just from new consumers adopting these devices but also from replacement of obsolete technology. Apple has released five versions of the iPhone in the five years since it introduced the device. Almost three out of four iPhone owners carry one of the two most recent models, according to comScore. Only 2 percent of iPhone users still carry the original iPhone. The rapid replacement of outdated technology signals demand for mobile devices will continue to grow from new and existing smartphone users.

Cloud Applications as % of Total Corporate Applications



SOURCE: Tata Consultancy Services Ltd. survey of 270 companies

The self-reinforcing growth of both cloud and mobile will present opportunities not available in the past. Symantec's Salem offered an example of what further innovation could bring. Holding up a smartphone, he said the device's ability to locate itself could bring a powerful security feature that would benefit consumers and enterprises if concerns about privacy are first addressed. "If somebody tried to log in as me today in California they shouldn't be able to because I have my device and I am at the Tuck School of Business in Hanover, New Hampshire. And so somebody logging in as me in California — the system should deny that access using the geolocation technology built into this device. So authentication is a big deal."

SAP's McDermott said the cloud is not just delivering data to mobile devices for consumers but also increasing the expectations for the workplace. Workers are demanding the same powerful tools they use at home become available in the office. "The world is going to punish companies who don't enable people, who don't enable people to get just what they want in the form that they want it right now. If it's not right now, you're toast," McDermott said.

Only 14% of companies downsize their IT departments after adopting cloud, while 20% of organizations hire more cloud experts.
—Computer Sciences Corp.

Google's Mills noted mobile and cloud share a fundamental link: "The way that I would think of the cloud ... is just the way that the world works now with the internet and technology. I mean, if you have your phone, you have everything."

CLOUDS ON THE HORIZON

{What we found}

The Britt Series speakers agreed cloud technology will play a central role in the future of computing. SAP's McDermott summed up the many predictions by calling cloud "an unstoppable force." The simplicity of outsourcing IT functions — of plugging in the toaster and having it work — will remain compelling. So, too, will the ability to access data and computing power anywhere, anytime on any device. Outfitting phones, tablets and laptops with a strong but invisible tether to robust computing power will make these devices more powerful. Making it easier to accomplish more on mobile devices will, in turn, reinforce demand for cloud services. The benefits of simplicity and mobility will draw consumers and enterprises to the cloud even as concerns remain about data security and privacy.

In 2012, for the first time, more adults in the U.S. carried smartphones than more basic phones.
—Pew internet & American Life Project

Ultimately, the cloud will increase what is possible. Google's Mills predicted the vast majority of data eventually will be accessed and stored through public clouds. He and other speakers agreed the use of cloud computing will expand well beyond current levels. "It's definitely the early days," Mills said.

If the cloud does indeed come to underpin much of how enterprises and consumers interact with technology there would be little need to refer to "cloud computing." Such services would become the default. Amazon's DeSantis sees just such a future: "There's no reason why everything that people do with the computer can't ultimately be delivered as a service."

The Center for Digital Strategies at the Tuck School of Business at Dartmouth promotes the development and implementation of digital strategies — the use of technology-enabled processes to harness an organization's unique competencies and support its overall business strategies.

M. Eric Johnson, *Associate Dean for the MBA Program*
Benjamin Ames Kimball Professor of the Science of Administration
Director, Center for Digital Strategies

Hans Brechbühl, *Executive Director, Center for Digital Strategies*

Tim Paradis, *Program Manager / Editor*
Kelli C. Pippin, *Marketing Manager / Copy Editing*
Leslie Tait, *Administrator / Copy Editing*
R.C. Brayshaw & Company, *Graphic Design / Printing*
Mark Washburn, *Photography*
Heather Gere, *Videography*
Daniel Maxell Crosby, *Videography*
Jones Media Center, *Dartmouth College*

2011–12 CDS MBA Fellows

Marco Castillo	Manish Dalwadi
Torlisa Jeffrey	Geoffrey Mattei
Jonathan Mitchell	Vivek Narasimhan
Saurabh Sharma	Joan Shu

The CDS MBA Fellows contributed project research and conducted exclusive interviews with many of the executives which informed this report. To access the interviews or learn more about on the Center for Digital Strategies please visit:
tuck.dartmouth.edu/digitalstrategies

TUCK SCHOOL OF BUSINESS AT DARTMOUTH
GLASSMEYER/MCNAMEE CENTER FOR DIGITAL STRATEGIES

100 Tuck Hall
Hanover, NH 03755-9000 USA
603-646-0899
digital.strategies@dartmouth.edu

CENTER FOR DIGITAL STRATEGIES MOBILE APPS

The Center for Digital Strategies' research, roundtable overviews, case studies, blog entries, Britt Series overviews, press hits and videos are now available on the iPad.

STAY CURRENT WITH OUR IPAD APP:

STAY CONNECTED WITH THE BRITT SERIES THROUGH OUR BTIS APP:

Scan this QR code to download the BTIS Apple mobile app:

Scan this QR code to download the BTIS Android mobile app:

CONTRIBUTING EXECUTIVES

Steven Caniano
VP, Hosting & Cloud Services,
AT&T Business Solutions

Dick Cantwell T'81
Global Vice President, internet
Business Solutions Group,
Cisco Systems

Kendall Collins
SVP & GM, Chatter at Salesforce.com

Peter DeSantis D'98
VP, Amazon Web Services

Mac Dougherty T'09
CEO & Co-Founder,
Cognitive Electronics

Olivier Gouin
Group CIO, Nestlé

Matt Holleran D'89
Venture Partner,
Emergence Capital Partners

David Chemerow D'73, T'75
COO & CFO, Rentrak

Bill McDermott
Co-CEO & Executive Board
Member, SAP AG

Michael G. McGinn D'87, T'92
General Manager, Finance & Strategy,
Rhapsody America, LLC

Tom Mills
Global Director,
Enterprise Education, Google

Kent Parker T'90
Chief Operating Officer, Ariba, Inc.

Martin Petry
CIO, Hilti

Geir Ramleth
CIO, Bechtel

Andy Russell D'88
Global Director, Sales & Customer
Operations, Nike

Enrique Salem
President & CEO, Symantec

Yancey L. Spruill T'97
CFO, DigitalGlobe

Kate Taneyhill Jhaveri T'03
Global Platform Marketing, Facebook

William Tworek
Senior Technical Staff Member &
Executive IT Architect,
Office of the IBM CIO

Peter Vosshall D'92
VP & Distinguished Engineer,
Amazon.com

Nada Wheelock T'95
Manager, Global Services Social
Media Strategy, EMC

Blair Westlake
Corporate VP, Media & Entertainment,
Microsoft

amazon
CARBONITE
facebook
NIKE
CISCO
GLOBAL RELIEF TECHNOLOGIES
Field User Driven Real-Time Data Solutions
RENTRAK
ARIBA
COGNITIVE Electronics
Google
Rhapsody
at&t
DIGITALGLOBE
HILTI
Salesforce.com
IBM
AXIS COMMUNICATIONS
EMC²
Microsoft
SAP
BECHTEL
EMERGENCE CAPITAL PARTNERS
Nestlé
Symantec