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TECHNOLOGY

What Every CEO Needs to Know About the Cloud

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In 2010 an IBM survey of more than 1,500 CEOs worldwide revealed a troubling gap: Close to 80% of them believed their environment would grow much more complex in the coming years, but fewer than half thought their companies were well equipped to deal with this shift. The survey team called it “the largest leadership challenge identified in eight years of research.”

Unfortunately, the information technology infrastructure at many large companies only makes this challenge more difficult. Their technology environments actually impede their ability to sense change and respond quickly. While there is no simple fix for this problem, help is at hand in the form of cloud computing, a new suite of digital tools and approaches.

Cloud computing is a sharp departure from the status quo. Today most companies own their software and hardware and keep them "on premise" in data centers and other specialized facilities. With cloud computing, in contrast, companies lease their digital assets, and their employees don't know the location of the computers, data centers, applications, and databases that they're using. These resources are just "in the cloud" somewhere.

To advocates of cloud computing, that's the whole point. Customers don't have to concern themselves with details; they just rent what they need from the cloud. (For a more detailed explanation, see the sidebar "What Is the Cloud?")

What Is the Cloud?

The cloud computing industry is growing and evolving rapidly—and also generating lots of jargon. As a result it can be difficult to understand exactly what the cloud is and how its offerings differ.

To oversimplify just a bit, those offerings can be divided into three categories: raw computing capacity, computers that are ready for software, and software itself.

The first of these, called **Infrastructure-as-a-Service (IaaS),** is the most basic; it's a server or servers out there in the cloud, or a bunch of storage capacity or bandwidth. IaaS customers, which are often tech companies, typically have a lot of IT expertise; they want access to computing power but don't want to be responsible for installing or maintaining it.

How important is cloud computing? I would argue that it's a sea change—a deep and permanent shift in how computing power is generated and consumed. It's as inevitable and irreversible as the shift from steam to electric power in manufacturing, which was gaining momentum in America about a century ago. And just as that transition brought many benefits and opened up new possibilities to factory owners, so too will the cloud confer advantages on its adopters.

At present, there's a lot of uncertainty and skepticism around the cloud, particularly among technology professionals who have deep expertise with, or attachment to, on-

The second tier is called **Platform-as-a-Service (PaaS).** This is a cloud-based platform that companies can use to develop their custom applications or write software that integrates with existing applications. PaaS environments come equipped with software development technologies like Java,.NET, Python, and Ruby on Rails and allow customers to start writing code quickly. Once the code is ready, the vendor hosts it and makes it widely available. PaaS is currently the smallest segment of the cloud computing market and is often used by established companies looking to outsource a piece of their infrastructure.

Software-as-a-Service (SAAS), the third category, is the largest and most mature part of the cloud. It's an application or suite of applications that resides in the cloud instead of on a user's hard drive or in a data center. One of the earliest SaaS successes was Salesforce.com's customer relationship management software, which provided an alternative to on-premise CRM systems when it was launched, in 2000. More recently, productivity and collaboration software—spreadsheets, word processing programs, and so on—has moved into the cloud with Google Apps, Microsoft Office 365, and other similar offerings.

Cloud offerings share a few similarities across these three categories. First, customers rent them instead of buying them, shifting IT from a capital expense to an operating expense. Second, vendors are responsible for everything "beneath the hood"—all the maintenance, administration, capacity planning, troubleshooting, and backups. And finally, it's usually fast and easy to get more from the cloud—more storage from an IaaS

premise computing. Companies shouldn't give such people too much influence over plans to move into the cloud; that would be like putting the crew that ran the boiler and steam turbine in charge of electrifying a factory. The CEO and other senior business executives need to take responsibility for bringing their organizations into the era of cloud computing.

When I talk to executives about the cloud, three questions always come up: Why will the cloud be a big deal beyond the IT department? What are the main concerns and areas of skepticism, and how valid are they? And how should we get started? In this article I'll address those questions. I'll explain the cloud and its benefits, highlight how perceived barriers and other concerns will keep many companies from taking full advantage of it, discuss the implications of various responses, and recommend actions.

The Benefits of the Cloud

Some people maintain that there's nothing magic about the cloud—that anything it can do, on-premise approaches can also accomplish. That argument is correct in theory, at least for large companies that can afford comprehensive enterprise software and top IT talent. Such companies can buy or build software for collaboration or analytics—or

vendor, the ability to handle more PaaS projects, or more seats for users of a SaaS application.

Some large organizations are planning to build "private clouds" that they will own and maintain. These are essentially data centers that use many of the cloud's technologies. Private clouds hold the promise of offering all the advantages of the public cloud while addressing security and regulatory concerns. However, I'm skeptical. The scale economies of public cloud companies lead to great cost decreases over time, and because their environments are intensely competitive, those decreases will surely be reflected in their prices. I doubt that most private clouds will be able to keep up.

anything else—and install it in their own data centers. They can enable these applications for different devices—desktops, laptops, tablets, and smartphones—and make them accessible to employees at home and on the road via web browsers. They can also open this infrastructure to people outside the organization, such as contractors, suppliers, and joint venture partners.

They can—but they rarely do. This is not because their IT departments are incompetent. It's because they're stretched, and doing all the things listed above is surprisingly difficult, expensive, and time-consuming, especially if a company is trying to repurpose older legacy technology for the modern age.

On average, only 11% of a company's IT budget is spent on developing new applications, according to Microsoft; the rest goes to maintenance and infrastructure. Much of that 11% is devoted to big "strategic" efforts like purchasing and deploying a core enterprise system. That leaves very few resources for, say, ensuring that employees have access to all the documents they need no matter where they are, what device they are using, and whom they're working with.

Making individuals more productive.

For global contractor Balfour Beatty, that kind of access is a critical capability. The company's design and construction professionals spend much of their time on job sites overseas, where they need instant and reliable access to cost estimates, photos, blueprints, and other large files. For 10 years, Balfour had been managing uploads and downloads of all those documents with an internal FTP server maintained by the IT department, which was difficult to use and constantly running out of capacity.

So the company turned to Box, a provider of cloud-based content management and file sharing. As is often the case with cloud offerings, resources stored on Box can be accessed via a web browser or applications developed for computers, tablets, and smartphones. As long as Balfour employees have an internet-connected device, they have access to all their files when on the road.

Though the company had implemented Box to get easier access to its information, it soon noticed other advantages. With the FTP server, the IT department had to sign up each new user and create a unique folder for him or her. If a user wanted to invite a collaborator into that folder, the request also had to be routed through IT. With the new cloud-based solution, in contrast, users could administer their own accounts and digital properties, saving valuable time. Director of IT operations Rick Roman explains: “One of the comments we were continually getting from our end users was that they wanted an up-to-date solution that was powerful and flexible enough to fit the way they work. With Box, not only did we find a solution that met the requirements that our employees were asking for, but it gave us a useful suite of collaboration features that has improved productivity tremendously.”

Balfour’s experience illustrates a common pattern in the introduction of novel technologies: The unanticipated benefits often outweigh the intended ones. On each job, Balfour employees need to share documents with an ever-shifting mix of customers, contractors, inspectors, and so on. This is easy to do when they can administer their own accounts, and hard to do in the pre-cloud world. Cloud-based file management was initiated to make individuals more productive but ended up delivering group-level benefits as well.

Facilitating collaboration.

In fact, some of cloud computing’s greatest successes to date have come from allowing groups and communities to work together in ways that were not previously possible. To improve the way knowledge was captured and shared among its 90,000 people, the consulting firm CSC turned to Jive, a maker of cloud-based collaboration software. The first step was an experiment to see if people would be receptive to working with the software. Jive was made available to all employees, an approach that would have been prohibitively expensive if CSC

had needed to buy all the hardware and software licenses itself. People could use the platform to, among other things, pose a question to the whole company, visit and contribute to digital forums like “Where Have We Done This Before?” and “Excel Power Tips,” and set up new communities on the fly.

During the initial 20-week experiment, more than 25,000 people registered for the new cloud-based resource, called C3. They created more than 2,100 groups and logged as many as 150,000 activities per month. Those results persuaded the company to make C3 permanent. “C3 has been simply stunning,” Lem Lasher, the company’s president and chief innovation officer, told the audience at an Enterprise 2.0 conference in 2010. “It is the de facto standard for how we collaborate. It’s the language of the company.”

Mining insights from data.

Analytics has been one of the other areas of greatest activity in the cloud. Companies today gather a massive amount of data, and cloud providers are supplying the hardware and algorithms to help businesses generate advantages from it. Many of these efforts have focused on understanding, predicting, and influencing customer behavior both online and offline. But Radiant Systems, which supplies the Aloha point-of-sale system to thousands of restaurants and keeps their data, is using cloud analytics in a different way—to help its clients control their operations more tightly.

Shrinkage, a polite term for employee theft, is a serious problem in the food service industry, but it’s hard for restaurant owners to closely monitor servers and bartenders in their busy work environments. Radiant realized that the huge amounts of low-level transaction data it kept for each customer could be analyzed for suspicious patterns, such as a volume of large tips far above average for bartenders on a Friday night. When this occurs, it’s likely that the bartender is not charging people for drinks in hopes of getting a big tip.

Using data from all its customers, Radiant developed a set of algorithms to detect many types of shrinkage and bundled them into an offering called Aloha Restaurant Guard (ARG), which generates a weekly set of reports on suspicious activity by site and by employee. These are

sent to restaurant owners and managers, who use them to take corrective action. The results can be surprising and dramatic. According to the company, one casual dining restaurant in Marina del Rey, California, saw a profit increase of $20,000 to $40,000 a year after using ARG to detect employee theft. To acquire this capability from the cloud, the restaurant owner didn't have to buy or install any new software, hire technologists or analysts, or alter his technology infrastructure in any way. He simply had to request ARG from Radiant.

Developing and hosting applications.

Before the cloud, software developers typically had to buy, configure, and maintain their own servers. Those activities are often perceived as a hassle and a distraction from the core work of writing good code.

That was a problem 3M hoped to avoid as it developed its Visual Attention Service, a set of software tools that indicate where people will focus their attention when looking at an image. The company wanted to make these tools available to graphic designers and others via a web-based application but was unsure how much demand there would be for the offering. "To play it safe, we would have had to invest in significant server capacity, especially since our service is so computationally intensive," says 3M business manager Bill Smyth. 3M therefore turned to the Windows Azure cloud platform from Microsoft to host the application. According to Smyth, "The cloud gave us the ability to add capacity quickly and easily, and with no capital."

In addition to hosting applications, cloud providers are making their own powerful software available to customers. Google Earth Builder, for example, is a set of digital tools for geospatial data visualization and analysis that allows organizations to upload their own data and layer them onto popular resources like Google Earth, Google Chart Tools, and Google Maps. Ergon Energy, the electricity supplier for Queensland, Australia, plans to fly a customized airplane over its 150,000 kilometers of power lines, gather data about them, and transfer the data to Google Earth Builder. Ergon CEO Ian McLeod says that the company will use the data-rich maps and pictures that result to "understand the environmental status of the network and its associated risks. With this intelligence we can make better business

decisions around our investments and improve operational response and business performance in key areas such as vegetation management, disaster response, designing customer connections, and augmenting the networks."

As these examples illustrate, the cloud offers benefits at the level of the individual and the group, and of the data and the application. It allows companies to increase the scale and power of their IT and the speed at which it can be accessed and deployed. It eliminates administrative headaches and works across locations, devices, and organizational boundaries. All these advantages will increase as we move deeper into the era of cloud computing.

Recognizing this, forward-looking companies are making aggressive use of the cloud even when they have the technical, financial, and human resources to pursue any computing strategy. The video service Netflix, the social game maker Zynga, and eBay are among the companies that have stated publicly that the cloud is a major part of their computing strategy. They have realized that they don't have to own technology themselves to compete effectively. They see, in fact, that owning all the computing assets they use is actually more likely to hamper their progress than accelerate it.

The Skeptics' Concerns

For all its compelling advantages and leading proponents, the shift to cloud computing has been slow. A 2009 Forrester study found that 37% of large companies were "not interested" in the cloud. Another 39% were interested but had no immediate plans to explore it. A 2011 survey by *InformationWeek* found that only 29% of respondents had analyzed the impact of the cloud on their internet-facing architecture. And the technology research firm Gartner predicts that while cloud computing will grow at an annual rate of 19% through 2015, it will account for less than 5% of total worldwide IT spending that year.

Why so slow? Moving an enterprise's legacy IT into the cloud is difficult because it forces tough decisions about consolidation and standardization. Most organizations that have been around awhile have a hodgepodge of hardware, operating systems, and applications, often

described as “legacy spaghetti.” It can’t simply be transferred to the cloud but must first be untangled and simplified. And though everyone may grouse about legacy spaghetti, few are willing to give up their portion of it just so their company can move to the cloud.

Cost.

The widespread uncertainty about the cloud may be most apparent in debates over its comparative cost.

The findings about cost have been contradictory. For instance, in 2009 a McKinsey case study involving a disguised client concluded that putting the client’s entire data center into the cloud would increase costs by 144%. The following year a report by Microsoft (a company with a stake in cloud computing) concluded that it would be cheaper for all enterprises to put their servers in the cloud. Such sharp differences of opinion make it difficult to follow the advice of a 2011 *Wall Street Journal* article, which recommended, “When considering which systems are candidates for the cloud, companies need to start with the basics: Is this move going to save money?”

The focus on cost is misguided for two reasons. First, most companies don’t spend massive amounts on technology, so even substantial changes in the IT budget won’t make a large difference on the income statement. Gartner estimates that for S&P 500 companies, all IT-related costs accounted for just 3.2 % of revenue, on average, in 2009.

Second, over time the economics of building and running a technology infrastructure will favor the cloud. Cloud providers purchase massive amounts of hardware, bandwidth, and power, and so can get better prices. Because they also buy gear all the time, they can take continual advantage of the computing cost declines predicted by Moore’s Law. These factors will combine to constantly drive down the costs of cloud computing and the charges to customers. Amazon Web Services, for example, has reduced its prices a dozen times in the past three years, even though it does not yet face intense competitive pressure.

Reliability.

Whether or not the cloud is cheaper, many skeptics hold that it's not as reliable as a well-managed on-premise infrastructure. The infrastructure you control, they argue, is more stable than the one you don't.

The cloud's reliability was called into question most sharply in April 2011, when large portions of Amazon's Web Services infrastructure went down for as long as three days. This was a major blow to many companies that used it. But not all of them. Netflix, for example, relied heavily on Amazon, yet remained unaffected by the outage.

How did Netflix escape a crisis? By working hard to build in redundancy so that it could stay running in the event of a huge disruption. Amazon's failure was serious but affected only one of its U.S. data centers. Amazon had also explicitly advised its customers to design their architectures to withstand a service interruption. Netflix took that recommendation to heart, going so far as to build a system called the Chaos Monkey. This digital primate's job is to automatically and randomly shut down major parts of the company's technology environment. Because Netflix learned to handle its own Chaos Monkey, it was prepared to deal with the breakdown caused by Amazon.

Cloud companies are gradually learning this lesson and improving the redundancy and reliability of their offerings. Every outage by a prominent cloud vendor receives a great deal of attention, but overall cloud reliability records are admirable—and would be the envy of most on-premise operations. Google's Gmail service, for example, was available for 99.984% of 2010, or for all but seven minutes of each month. The Radicati Group, a technology market research firm, estimates that this is approximately 32 times more reliable than the average corporate e-mail system. Banks' trading systems might need greater uptime than this, but for most other uses it suffices.

Security.

The security of the cloud is also frequently questioned. It's true that transmissions can be intercepted; firewalls can be breached; viruses, worms, and other forms of malware can invade. Perhaps most unsettling, the people responsible for digital infrastructure can steal

secrets or get sloppy and let thieves in. As the Harvard law professor Jonathan Zittrain wrote, “Before, the bad guys usually needed to get their hands on people’s computers to see their secrets; in today’s cloud all you need is a password.” However, this is true for every computer network, including the ones that companies run themselves.

Like service interruptions, security breaches at cloud computing companies are big news, and the 2011 incidents at the storage provider Dropbox and the e-mail marketer Epsilon were well covered. But it’s worth keeping in mind that 90% of businesses surveyed by the Ponemon Institute, a privacy research firm, had one or more security breaches a year.

The only way to have 100% computer security is to have zero computers. The next best approach is to constantly monitor the threat landscape; buy or build the best technologies to protect devices, networks, and transmissions; and hire and retain top digital security specialists. Cloud computing vendors are better able to do this than all but the very largest and most security-conscious organizations.

For most companies, however, security means more than just keeping the bad guys out. It also means controlling who’s able to do and see what, over time and across changing conditions. The documents and spreadsheets related to a potential merger, for example, should be visible only to the team working on the deal, and when employees leave the company, it should be quick and simple to terminate their access to the company’s digital resources.

Many organizations can exercise this kind of control pretty well with their on-premise computing environments, which include substantial administrative capability. Some cloud offerings, in contrast, can’t. This is because they were originally designed for individuals or small groups of peers, not for hierarchical organizations in which some people have both the right and the responsibility to exercise control over others.

Cloud vendors who are interested in the large enterprise market are working to incorporate administrative functionality into their products; many have already done so. As it matures, this functionality should allay the most serious security concerns.

Regulation.

It's not possible to discuss, or even list, all the legal and regulatory barriers to the cloud here, but many have to do with data access and transport. The U.S. Health Insurance Portability and Accountability Act, for example, puts in place strict access and audit requirements for organizations handling personal health data, and there's been much debate about whether cloud computing providers meet them.

Similarly, the EU prohibits consumers' data from being transferred to countries outside it without prior consent and approval. Companies outside the EU can overcome this restriction by demonstrating that they provide a "safe harbor" for data. Some countries, like Germany, however, have even more-restrictive data export laws, and it's not yet clear if the safe harbor process will satisfy them.

Such considerations mean that it often won't suffice for cloud computing customers or suppliers to blithely say, "The data's in the cloud somewhere; we don't know exactly where." Enterprise cloud vendors are aware of this and are working to modify their offerings so that, for example, they can assure customers and regulators that a specific body of data is being stored in one location and nowhere else.

But for now, current and potential cloud customers need to get as much clarity as possible on the legal and regulatory considerations, if any, that accompany a shift to the cloud. (See the sidebar "How to Start Moving into the Cloud.") It's true that clarity is often difficult here; some regulations are vague, and case law has not yet had time to accumulate. But it's also true that many organizations are taking too conservative an approach to the cloud and that they're able to do far more than they think. For an example of a large organization that despite its many regulatory requirements is moving aggressively into the cloud, look no

farther than the U.S. government. In 2011, Vivek Kundra, who was the government's CIO at the time, announced a strategy calling for $20 billion, or about one quarter, of all federal IT spending to move into the cloud.

How to Start Moving into the Cloud

Most companies are just starting to explore the possibilities of cloud computing. Here are a few guidelines on how to get started.

Identify restrictions and gray areas.

In some industries and geographies, laws and regulations prohibit putting data in the cloud or create confusion about what's permissible. Executives should begin by understanding as clearly as possible the risks and no-gos of the cloud for their companies and should involve their general counsels and compliance departments from the start. They'll have to decide whether to adopt a conservative or aggressive approach in the face of those risks. Because of the cloud's growing importance, I advise boldness for most companies, with possible exceptions including those handling data that involve personal health information and information subject to export restrictions.

Start running experiments with software-as-a-service.

A wide variety of powerful business software is currently available in the cloud. This includes applications for office productivity and collaboration (such as Google Apps, Microsoft Office 365, Jive, Socialtext, Yammer, and Spigit), customer relationship management (Salesforce.com), human resource management (SuccessFactors, Workday), and social media monitoring (HubSpot, Radian6).

If you'll pardon the pun, the near-term forecast for corporate computing is only partly cloudy. Uncertainty about the cloud's benefits and concerns over cost, reliability, security, and regulation will keep many (if not most) companies and their executive teams from making bold moves.

What are the business implications of this uneven adoption of cloud computing? If the cloud's only impact was on companies' IT budgets, the implications would be minor, but as we've seen, this is not the case. Cloud computing offers advantages in, at a minimum, productivity, collaboration, analytics, and application development.

How valuable are these? It's hard to measure, but here's some food for thought: How would you feel if your main competitors started pulling away from you in those areas simply by changing their computing infrastructure? And how much worse would it be if this change created other benefits that are not yet obvious? One common feature of major technological shifts is that their full effects are not visible at first. For example, it was

Pick a couple of apps and experiment with them. Experiments are very different from pilots or trials. Well-designed business experiments have control groups (parts of the company that don't get the cloud software) and data collection (compared with the control group, did total IT support costs go down, employee satisfaction go up, and business results improve?). Results from these experiments will indicate whether use of the cloud should be expanded.

Do your next development project in the cloud.

If you're still buying servers and other gear to create development "sandboxes" for the software you write yourself, stop and ask why. Infrastructure-as-a-service offerings are now quite mature, and platform-as-a-service ones are getting there quickly. They free developers from the headaches of buying, maintaining, and adding gear and let them concentrate on the real work of writing good code.

The cloud also contains powerful software resources that developers can plug into. Google Maps and Chart Tools, for example, can be easily integrated with a company's data to produce a wide range of visualizations. Over time, more and more of the business world's software is going to live in the cloud. You probably want to be part of this trend sooner rather than later.

Talk with your core enterprise software vendors to understand their plans for the cloud.

Many if not most of their offerings are currently available only on-premise. When are they going to release cloud versions of their applications? How are they going to help their current customers migrate to them?

inconceivable at the dawn of factory electrification that a separate motor might one day be placed on every machine in the plant, yet this is exactly what eventually happened.

As the cloud grows and matures, its vendors will continue to innovate and to differentiate their offerings. The results may not be as transformative as those from factory electrification, but I predict that they'll lead to corporate computing environments very different from the ones in place today. The only way to learn about them firsthand is to start moving into the cloud.

Delegating the move to the cloud to traditional IT people is like putting the crew running the boiler and steam turbine in charge of electrifying a factory.

Over time the economics of building and running a technology infrastructure will

As you take steps into the cloud, you'll very likely be working with your company's IT department and CIO. Their attitudes toward cloud computing will be critical and highly revealing. In my view, a CIO's lack of enthusiasm about the cloud these days is about as red a flag as a factory manager's disinterest in electrification would have been a century ago.

favor the cloud over on-premise computing.

In 2011 the CIO of the United States called for moving $20 billion, or one quarter, of all federal IT spending into the cloud.

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