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DIGITAL LIFE



15 WAYS THE CLOUD WILL CHANGE OUR LIVES

By Joe Mullich

“Cloud computing has the potential to generate a series of disruptions that will ripple out from the tech industry and ultimately transform many industries around the world,” says John Hagel, co-chairman of the Deloitte Center for the Edge, Deloitte’s Silicon Valley-based research center. Here are some of the ways the cloud’s ability to access, analyze, store and share information could change our business and personal lives:

Everyone will become a gamer. Gaming is called the “killer app” of cloud computing, and gamers have salivated over demos with complex 3-D graphics delivered to mobile devices through the cloud. While some technical wrinkles remain, players can now enjoy breathtaking gaming experiences anywhere because of the cloud’s power to provide higher speed without interruption. The same gaming principles are now being extended to many other areas. “You can deliver information to a patient about using a drug in a way that is as compelling to use as any game or app,” says Lynette Ferrara, a partner at the IT consultancy CSC. The new generation of wellness and chronic disease management programs use gaming techniques to educate and coach patients in real time. “We expect that information will be available at our fingertips, and the cloud will change the nature of the kind of information we can access.” Ferrara adds, “In essence, we will all become gamers, with this functionality being used for everything from product development to personalized medication and disease management programs.”

Fixing stuff will be easier. Thanks to the cloud, you can expect to get earlier notice when things around your house or office are about to go on the fritz. For example, a cloud-based app alerts drivers of electric cars when their batteries will run out of juice, letting them get to a charging station without needing to call a tow truck. A major medical equipment company developed a cloud-based application that feeds information to field system engineers who need to maintain health equipment, helping them head off problems. And when stuff needs to be fixed, the cloud will make that easier, too. Daniel Burrus, author of *Flash Foresight*, says tablet PCs using cloud-based applications will give field technicians immediate access to training modules if they need to, say, figure out how to repair a certain type of furnace. “There will be a wave of just-in-time training,” Burrus says.

Computers will become invisible. When people use search engines, they usually don’t realize they

are accessing billion-dollar computer networks. As the power of the cloud spreads, one effect will be to make software and computing more invisible, says Dan Reed, vice president of Microsoft’s eXtreme Computing Group. Your interaction with computers will be more hands free — such as the recent introduction of the Kinect, which allows gamers to eschew controllers and just use gestures and movements that are interpreted by a 3-D camera and infrared detection system. Expect to see more of this type of computer intuition because of the cloud. “You will be able to walk in a room and there could be hundreds of sensors in it that could respond,” Reed says.

You’ll actually find what you want in stores. Surveys show a large number of consumers are dissatisfied with the growing practice of web-to-store — where they shop for products on the Internet and then go to a store to purchase them — because too often the store doesn’t have the product on hand as its website promised. With the cloud, inventory records will be much more visible and reliable. Connected shoppers, who browse brick-and-mortar aisles with web browser in hand, are beginning to exercise their leverage, such as asking the store to match a price found on a competitor’s website. Retailers’ brand value will be dramatically affected by how they satisfy these mobile-savvy shoppers.

Everyone will want to give you advice. In an age of information overload and unlimited choice, companies in all industries will want to become your trusted advisor — which is also a key way retailers will fight against commoditization. “Companies will be less interested in the immediate sale than in providing advice in order to develop a relationship,” Hagel says. The need for guidance will spawn new companies that leverage the insights from the many footprints we leave online. Now, for example, shopping sites might offer suggestions of movies or videos based on previous purchases. “The next level will be companies that make those suggestions based on not just your activity on one specific

site, but across a range of places — what you watch on web TV, on YouTube and other sites,” Hagel says. “If a company can capture all my online activity, as it occurs in real time, it can have an integrated view of me as an individual and suggest things I didn’t even know I wanted to look at.”

You’ll be able to make smarter decisions. Having just-in-time training won’t be the only way the cloud will help you make wiser choices. Burrus points out the cloud can turn any mobile device into a “supercomputer.” This means you can access processing power as needed from the cloud to analyze virtually any type of information wherever you are. Imagine, for example, that you combined live stock market data, weather projections, scanned news stories, tweets and comments in blogs, gauging the sentiment or subtle changes in public opinions. Put those streams of information together, feed them into an advanced simulation on your mobile phone and you could gain unique insight that leads to profitable stock choices. Even if you don’t play the market, processing power on demand will make it easier for you to do original research on any topic that comes to mind, such as combining sales projections with just-in-time raw material inventories to make sure your department meets customer demands.

Small businesses will go global...in days. To satisfy the new markets being created by the cloud, small- and medium-size companies will leverage the cloud and get a bigger slice of the action. “Small- and medium-size businesses will go from being constrained to certain geographies due to

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Illustrations by Alex Williamson

the cloud is the answer. it's also the question.

The cloud has the potential to transform business by offering faster, cheaper, on-demand access to services and resources. But it's also one of the great business questions: How much cloud? What kind? How to manage it? How to secure it? How to make it work with what I already have?

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Creativity in the Cloud

What Can Researchers Do with 10,000 Computers for a Few Minutes?

When a pharmaceutical researcher needed 50 servers to complete some crucial data analysis, the IT department told him it would take three months to bring that many servers online. Instead of waiting, the researcher whipped out his credit card and ordered up a cluster of servers from a public cloud provider. He was hard at work on his analysis later that day, moving a new treatment closer to reaching the marketplace.

Why is cloud computing such a game changer? Theoretically, anyone has immediate access to an unlimited amount of computing resources. Consequently, technology is no longer a constraint to creativity and innovation.

"For so long, we've been taught that massive computing resources and storage meant massive costs and efforts, hence they were out of the question for most people," says Chuck Hollis, vice president and global marketing chief technology officer for EMC Corporation, the global information infrastructure technology provider. "Now, that's changing quickly. We're only limited by our imagination."

Space-Age Problem Solving

"People can now ask themselves, 'What could I do with 10,000 computers

for an hour?'" says Art Fritzon, a senior vice president with Booz Allen, the consulting firm. "They can experiment with problems they couldn't solve before, because they couldn't dream of buying and installing 10,000 computers that they might use for just a few minutes for one problem. But now companies can direct massive resources against data sets, such as crunching 20 years worth of airline ticket purchases, to find patterns they never saw previously."

As exciting as all that is, it represents only the initial thrust of how cloud computing will change research and spur innovation across many industries. The next stages of the cloud, which are just beginning to emerge, will shift from providing technology resources to human resources on demand, allowing companies to tap into the brain power of thousands of experts around the world to solve complex business and scientific problems at a surprisingly minimal cost.

David Patterson, a professor of computer science at the University of California, Berkeley, notes that many researchers, limited in the availability of technology resources, resort to wringing

out their answers over weeks or months by running their desktop PCs 24-7.

"Cloud computing eliminates the need to wait," he says. "It costs just as much to use one computer for a thousand hours as a thousand computers for one hour. There is no extra cost to getting the answer tomorrow as opposed to next week."

This prompts researchers to think in terms of "big ideas." Students at Berkeley, who will be the next wave of innovators in academia and industry, now routinely think of tackling huge problems because of the availability of cloud resources. Patterson tells about one of his professorial colleagues who wanted students to assist him on a large project. The professor asked the students how many computers they needed, expecting the answer to be 10 servers.

"The students said they wanted 1,000 servers!" Patterson says. "They are more comfortable dealing with problems that are 10 to 100 times larger than in the past."

Patterson says the potential of the cloud to improve innovation is similar to giving an astronomer a much larger telescope: "He can see planets that we didn't know existed before. Cloud computing is going to have the same effect

in software development, pharmaceuticals and many other fields — we are going to find many things we didn't realize could exist before."

Innovations in Research

Research-intensive industries, like life sciences, have been some of the earliest adopters of the cloud. Developing a new drug can take up to 15 years and cost \$800 million. Delays in bringing promising pharmaceutical projects to the market cost pharmaceutical companies an estimated \$150 per second. And the demands for computing power can be insatiable.

"Investment in R&D has doubled over the past decade while the output from the R&D engine has halved," says Arjun Bedi, head of the Life Sciences R&D practice for Accenture, a consulting firm. "The innovation engine is broken, and many companies need to cut costs by as much as 30 percent while improving R&D outputs by 100 percent or more."

These seemingly contradictory goals — produce more at a lower cost — are moving life sciences to the cloud. These initiatives are coming in

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15 Ways

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budget limitations to having the ability to scale globally with significantly reduced overhead costs," says David Dobson, an executive vice president at CA Technologies, a maker of IT management software and solutions that enables the cloud for SMBs through its managed service provider customers. "Perhaps the most fascinating part is all of this can happen without building a physical data center at a new location. For example, instead of deploying on-site infrastructure to run their operations, companies can access infrastructure as a service, via managed service providers." And they'll be able to do it in days, rather than the months this often took in the past, giving them a huge advantage over slower competitors, and allowing them to keep pace with larger companies.

Road trips will be less stressful. If you've ever caravanned with a group of cars, you know the pressure of constantly looking in your rear-view mirror to make sure everyone is keeping up. Leave it to a group of college students to figure out how cloud computing could improve the road trip. As part of a class project, some University of Michigan students developed a mobile app that uses cloud computing to allow a cluster of vehicles traveling together to track each other during the journey. The app lets travelers view vehicle telemetry about their speed and fuel usage; send alerts about stops along the way; notify fellow caravanners by texting road condition and hazards; and select the best route. The combination of location tracking, social media and cloud-based analytics could improve all types of transportation scenarios.

Laptop security breaches will decline. One study found that some 10,278 laptops are reported lost every

week at 36 of the largest U.S. airports, subjecting companies to embarrassment and financial risk if important information is exposed. "In the traditional model, people can carry a laptop with all their secrets, like customer and payroll information," says Greg Bell, practice leader for information protection at KPMG, LLP, the U.S. audit, tax and advisory firm. "To protect that information, we encrypt it. But there is a fear that many countries restrict the importation of encrypted laptops, so we run the risk of breaking local country laws and having the laptop subjected to review which might disclose that information." The cloud can eliminate those concerns by having all data securely stored on the Internet. The laptop no longer stores the data; rather, it becomes the instrument by which to access it.

"Bedside manner" will become app-infused. Over the past year, the number of medical students who said they turned to the Internet for information dropped from 52 percent to 33 percent, while those who cited "mobile" as their preferred information source zoomed from 19 percent to 34 percent. The desire for info-on-the-go dovetails with the growth of mobile dashboard applications, which are becoming a red-hot niche with the many new touchscreen smartphones hitting the market. "Imagine a doctor or dentist who is able to pull up a patient's radiograph and zoom into particular areas of the radiograph with the touch of a button," says Dan Shey, practice director, Enterprise for ABI Research, a technology research company. This development would harness the cloud's computational ability to render the image so it could be viewed on a mobile device with the touch, zoom and screen resolution of the device itself. This would allow medical practitioners to make medical decisions almost instantaneously, regardless of their location or whether they have access

to a desktop computer. It is just one example of how the cloud can overcome the processing power and data storage limitations of mobile devices.

Public/private clouds will make homes healthier. Honorio J. Padrón III, a principal and global practice leader at the Hackett Group, a global consulting firm, sees great opportunities in the convergence of the enterprise and consumer clouds. Consider the burgeoning area of home health monitoring. The cloud allows doctors to wirelessly monitor patients with sleep apnea, collect information and then tap into a network of experts to devise a treatment plan. At a recent trade show, experimental technology was showcased that uses an infrared camera mounted above the bathroom mirror to take a daily photo of a person's face. Over time, the images can be stored and analyzed for changes, alerting doctors of pre-cancerous skin cells so treatment can begin earlier.

Developing countries will become new markets and new competitors. Bell notes that China and other emerging countries have not developed robust IT infrastructures, which means they can embrace the cloud quicker — and exploit new opportunities faster — since they won't be as delayed by tasks like integrating legacy technology. At the same time, the cloud will provide new opportunities in these emerging countries. In India, for example, far more people use cell phones than landlines. As the cloud eliminates barriers to what mobile devices can do, the devices will become the conduit to open up huge new markets.

Companies will use more suppliers. The desire for greater efficiency has dictated that companies should streamline the number of suppliers they use. The cloud could reverse that by allowing companies to coordinate a more diversified group of suppliers, giving these companies the flexibil-

ity to meet unanticipated needs. The secret is "community clouds" — an embryonic type of cloud computing that allows business partners to coordinate their activities over a secure platform (which protects their secrets even from each other). One community cloud, for example, supports employees with complicated travel itineraries, coordinating the changes to hotel bookings and restaurant reservations if, say, a flight is cancelled.

Everyone will bootstrap. The cloud offers individuals exciting ways to collaborate, develop products and test ideas rapidly and cheaply, which could accelerate the rising rate of entrepreneurialism. "You see small startups using the cloud to do complex modeling of new product offers," Hagel says. "The speed at which you can identify what people are interested in, and what they will pay, really changes the nature of innovation."

Language barriers will fade. "Today, cloud computing gives mobile-device users a level of speech recognition accuracy that is virtually on par with call center-based transcription services," says Marcello Typrin, vice president of product development for Yap, a company that makes a free iPhone application that converts voicemail messages into text. The cloud's massive computational power may make language barriers fade in other ways as well. Imagine you were at a client site and needed to confer with a colleague in another country who speaks only Italian. You contact him on your mobile device and both your words are instantly translated into each other's language using voice recognition and translation software. "The scenario is possible today with latency near real-time, assuming you have a network with capable bandwidth on each end," Typrin says.

Joe Mullich has received more than two dozen awards for writing about education, technology and other topics.

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three waves: provide infrastructure on demand; farm out key components of the R&D processes; and find better ways for global collaborators to work together.

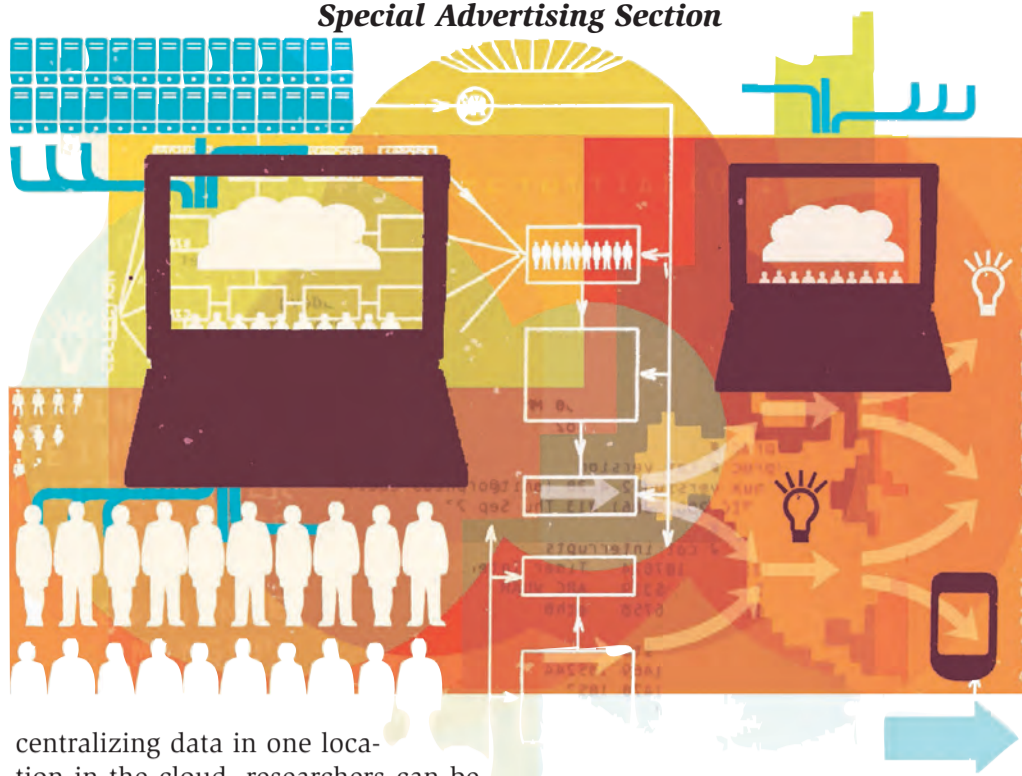
The initial thrust of cloud-based R&D is providing flexible infrastructure on demand — such as those 10,000 servers ordered up by a credit card.

In 2010, the U.S. government began launching cloud-computing pilots to improve the delivery of IT services across federal agencies. NASA is beta-testing a cloud approach called Nebula to allow scientists and engineers to pool computer resources, using them only as needed, instead of requiring scientists to purchase new equipment. The project is an alternative to building costly new data centers, and it also addresses the underutilization of dedicated computer and storage servers, which still eat up energy and require expensive environmental controls even when not put to full use.

Like many initial cloud research initiatives, Nebula is limited to publicly available data rather than proprietary data that would require more stringent security. Lynette Ferrara, a partner at the IT consultancy CSC, notes that the pharmaceutical industry “has rightly been slower to move clinical research to the cloud because of the need to comply with regulations on data protection and validation.” However, she expects that to change rapidly over the next year as cloud providers begin to offer “orchestration services,” which will manage user access to cloud services, manage backup and help ensure reliability and security.

Basic cloud services like storage, even applied to publicly available data sets, can have a dramatic benefit on speeding research and reducing costs. In the past, gaining insight from huge volumes of data required researchers to move the data to more powerful computers or divide their projects into modules that could be spread across mainframes in dozens of countries. By

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centralizing data in one location in the cloud, researchers can be sure they are accessing the most current data sets, while gaining more security and control.

The cloud removes the burden on researchers to be computer experts so they can focus their time and attention on the complex problems they want to solve. With the cloud, a scientist can use a familiar tool, such as a spreadsheet, to analyze enormous volumes of genomic information that are stored across 600 servers. A researcher can turn to the cloud to access information from remote sensors in the rain forest and pull the data into a desktop PC for visualization and analysis.

EMC's Hollis says the ability to juxtapose large data sets and find new relationships and insights that weren't conceivable before will change everything from power generation to macroeconomic forecasting. It will also require learning to do things differently. “We'll have to train a new generation of researchers and innovators in these new data analysis and correlation techniques — it's not a widespread skill set these days,” he adds.

Global-Scale Collaboration

The second wave of cloud research, which is just beginning to emerge in pilot projects, is to break apart key R&D processes into components and use the

cloud to assign those components to the most effective internal or external collaborator around the globe. One example is collecting, tracking and reporting of adverse events associated with drugs in development. Pharmaceutical companies are looking into models that allow external providers to operate this process and its associated technology through a cloud-enabled environment.

The third wave will be finding new ways for external workgroups, vendors, customers, the larger research community and even regulatory bodies to collaborate. In one instance, for example, researchers used cloud-based video collaboration to observe therapies for treating mental illness, overcoming issues of the costs of setting up video conferencing equipment for physicians around the world.

Given the far-flung nature of much research, experts say such initiatives will become increasingly important. Understanding how to deal with an oil spill, for example, requires collaboration between experts in computational fluid dynamics and marine biologists. The cloud can build communities of researchers across many disciplines who need to work together to solve complex problems.

The Internet has also opened up the potential for mass collaboration

with the general public, a process called crowdsourcing; a good example of this is when customers are asked to take part in helping invent and refine products. Experts believe the cloud can enhance crowd sourcing by providing better ways for large groups to share documents and thoughts, building off one another's ideas.

Already, “open-innovations market-places” are allowing large companies to poise complex scientific or business questions to 100,000 researchers and only pay if someone comes up with a suitable answer. “It's innovation on demand,” Bedi says. “The cloud lets you capture the best ideas no matter where they live. Currently, collaboration is now point-to-point, so it is difficult to create effective and scalable collaboration communities.”

Imagining the Future

The University of California, Berkeley just launched a project called AMP (which stands for Algorithm, Machines and People) to examine the intersection of cloud computing and crowd sourcing. “The synergies of combining an unlimited number of computer resources with an unlimited number of human resources is really exciting,” Patterson says.

Indeed, the cloud can help companies develop software much faster by sending rapid iterations to large numbers of users through their mobile devices. The power of the cloud may unleash new ways to spot outbreaks of disease quicker. It will allow medical researchers to analyze huge data stores, such as the folding process of global DNA samples, which may provide answers to new treatments and cures for cancer, Alzheimer's and other diseases.

“When books went from hand copied to printed versions, human learning and understanding took a big leap forward,” says Hollis. “The same can be said for the impact of computing, and later the Internet. Ultimately, the advent of massive pools of computing and storage — freely available — may hold the same potential.”

— J.M.



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