Dot.Cloud
Excerpt: Chapter 2
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Actual photo of Dubai City, taken from atop the Berj Tower.
Dubai is a classic example of a hydrocarbon-economy leader
that wants to become an epicenter of the Cloud economy.

Watch the Introductory Video
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What they are saying…

It is amazing how Peter Fingar manages to aggregate streams of evolving behaviors, business trends and enabling technologies in a way that captures the imagination. Don't just skim through this book, for it is certainly worth the time to consume and digest the business insights found throughout its pages.
 —**Jim Sinur**, Vice President, Gartner, Inc**.**

The thing that caught my attention the most about Peter's book was how much was really about embracing change in the workplace... allowing technologies like Web 2.0 to facilitiate better global collaboration and for BPM to re-invent fundamental processes in a way that is more sympathetic to today's multi-party, *impromptu* processes. The Cloud is nothing more than the platform upon which to build better businesses. This is a *business* book for the future, and the future is now!
—**Gregory R. Simpson**, Chief Technology Officer, GE

Dot.Cloud elegantly and methodically lays open and describes the vital elements that form the new business platform, and provides the understanding you'll need to fully realize the business potential that it makes possible.
—**Bryan Maizlish,** Northrup Grumman, and author, *IT Portfolio Management: Unlocking the Business Value of Technology*

I became a fan of Peter Fingar's abilities to take complex topics and reduce them to understandable, logical flows after reading his book *Extreme Competition*. And now, *Dot.Cloud* serves up a crisp understanding of why cloud computing is critical, and where and how to apply it to gain true business benefits.
—**Andy Mulholland,** CTO, Capgemimi, and author, *Mashup Corporations* and *Mesh Collaboration.*

Peter's gift is that he can discern and communicate significant points of convergence that offer the potential to differentiate organizations from their competitors. With *Dot.Cloud*, he once again signals a sea change in how one can better deliver customer value by taking advantage of the Cloud, not only as a mode of delivery, but as a way of thinking about how organizations innovate and execute. The unique value proposition of this, and Peter's prior works, is that it doesn't focus on the technical aspects, but rather on how the Cloud can, and should, affect how organizations organize and behave; how they retain and engage their clients. If you want to adapt, survive and thrive in a world that has become location agnostic and expects ubiquitous solutions from you, read this book!

—Richard Welke, Director of the Center for Process Innovation, Georgia State University

Landmark Books by Peter Fingar

EXTREME COMPETITION:
INNOVATION AND THE GREAT 21ST CENTURY
BUSINESS REFORMATION

BUSINESS PROCESS MANAGEMENT:
THE THIRD WAVE

IT DOESN'T MATTER:
BUSINESS PROCESSES DO

THE REAL-TIME ENTERPRISE:
COMPETING ON TIME

THE DEATH OF 'E' AND
THE BIRTH OF THE REAL NEW ECONOMY

ENTERPRISE E-COMMERCE

THE BLUEPRINT FOR BUSINESS OBJECTS

NEXT GENERATION COMPUTING:
DISTRIBUTED OBJECTS FOR BUSINESS

Acclaim for our books:
Featured book recommendation
Harvard Business School's *Working Knowledge,*
Book of the Year, *Internet World*

Dot.Cloud

The 21st Century Business Platform Built on Cloud Computing

Peter Fingar

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Foreword by Jim Sinur

It is amazing how Peter Fingar manages to aggregate streams of evolving behaviors, business trends and enabling technologies in a way that captures the imagination. *Dot.Cloud* is both visionary and realistic in that each of the pieces of the vision have working examples today, but not woven together like in this writing. The goal of the virtual business platform is not just a dream, but attainable once all the contributing pieces are brought together. Peter brings them together here in a way that will work under any number of situations, across just about any industry.

Peter's *Dot.Cloud* vision supports the tenets of shared processes that are enabled, optimized, tuned and changed to meet changing business demands while balancing the needs of multiple and diverse business partners and collaborators. All of this is leveraged with powerful technologies and shared infrastructures that, in the past, were only available to large organizations that had sufficient capital to invest in large-scale information technology, making them exclusive and unattainable for the average business or individual. But now with cloud computing, I can see, for instance, the opportunity to link super computing to analytic driven optimization for small businesses that would not dream of having this kind of resource and the supporting infrastructure.

To say that we are living in an exciting time is an understatement, and Peter has captured, in large part, the essence of how business will work going forward. Don't just skim through this book, for it is certainly worth the time to consume and digest the business insights found throughout its pages.

—**Jim Sinur,** Vice President, Gartner

Foreword by Bryan Maizlish

Supply-side opportunities for cost savings and efficiency enabled by cloud computing receive the majority of attention and focus. But now, *Dot.Cloud* explores the demand side and reveals the game-changing opportunities for businesses large and small. Market leaders understand that in today's hypercompetitive and cost optimization environment, a key differentiator is time-based competition. Time-based competition is centered on optimizing the time from innovation to operations, and gaining the agility needed to sense and respond to customer demands with speed and precision. This requires that traditional organizational hierarchies be replaced with dynamic self-managed, self-organizing teams. Cloud computing provides the infrastructure foundation required to support this new organizational dynamic.

Cloud computing enables a new business operations platform that combines key aspects of Web 2.0, human interaction management, business process management and real-time business intelligence. This 21st century business platform represents a new paradigm for coordination, collaboration, and decision making that will result in new discoveries, combinatory innovations, and significantly enhanced operations.

Dot.Cloud elegantly and methodically lays open and describes the vital elements that form the new business platform, and provides the understanding you'll need to fully realize the business potential that it makes possible.

—**Bryan Maizlish,** author, *IT Portfolio Management: Unlocking the Business Value of Technology*

Preface

I first became interested in the intersection of "technology and business" in 1968. What a remarkable journey it has been since then. I was a kid then, and now I'm a grandpa, but for some reason, I stay young—at least partly by not coming from a *position of knowing*, but from a *position of learning*.

In addition to my research and writing, I now give keynote talks around the world and do consulting for leading-edge companies in the U.S. and abroad. I've held technical and management positions, including at the earth's largest oil company and the second largest telecommunications company; taught graduate computing studies in the U.S. and abroad; coauthored a landmark book on distributed object computing, and later a book cited as the seminal work on business process management—but so what?

The "so what" is that when I see something really new, something I know is game-changing, I start writing as a way of learning. Lately, I've been researching and writing about the next generation of the *business* Internet, the Cloud. Although I explain the main ideas of Cloud Computing in lay terms, and quote several other experts to round out perspectives, this is not a technical book about Cloud Computing technologies; it's a business book.

- It's about what the Cloud portends for business.
- It's about transformation in the ways companies are managed.
- It's about business models for the 21st century.

These are interesting times, and I'd like to share my discoveries with you.

Tampa Florida, 2009

Two

The Gathering Storm:
Get Your Head into the
Clouds

The Next IT Platform Shift and a Really Big Question:
"Why is Consumer IT so simple and Enterprise IT so complex?"

Key Points: What Exactly Is the Cloud?

Just as it was with that new-fangled "Internet" thing a decade ago, the Cloud and Cloud Computing suffer from confusion and hype. Sorry, but pat definitions won't do when it comes to understanding these two new buzzwords. But, as they are game-changing phenomena, business leaders—and the rest of us—must gain an understanding of what these terms really mean and how they will affect us. Remember how the Internet affected the retail book industry that was slow to grasp an understanding of the Internet before it got *Amazoned?* To gain a wide perspective, we will turn to some reporting, bringing together the ideas of the movers and shakers who are actively building the Cloud and delivering Cloud Computing.

What is the Cloud?

> "It's complete gibberish. It's insane.
> When is this idiocy going to stop?"
> —Larry Ellison, CEO, Oracle[1]

> Cloud Computing was originally defined by
> John Gage of Sun Microsystems—way back in 1984!
> "The Network is the Computer."

Fast forward to the 21st century:
"In Cloud Computing: The data center is the computer."
—Lew Tucker, CTO, Cloud Computing, Sun Microsystems

What is the Cloud?
In short, it's the "*Real* Internet," or what the Internet was really meant to be in the first place—An endless computer made up of networks of networks of computers.

Who coined the term Cloud Computing?
In May 1997, NetCentric tried to trademark "cloud computing" but later abandoned it in April 1999. So much for that.
In 2006 , Google's Eric Schmidt used the term in response to Amazon's Jeff Bezo's Elastic Compute Cloud, originally named Elastic Compute Capability—but "cloud" sounded sexier.
Correct answer: Who cares? It doesn't matter.

For Venture Capitalists (VCs) the Cloud means
"no more having to build one data center per startup!"
In short, the Cloud is a profit center, not an IT cost center.

Cloud Computing is poised to change the way we access technology, and it may be as game-changing as the commercialization of the Internet over a decade ago. Definitions of Cloud Computing vary widely, but the big idea is that:

For geeks, Cloud Computing means grid computing, utility computing, software as a service, virtualization, Internet-based applications, autonomic computing, peer-to-peer computing, on-demand and remote processing—and various combinations of these terms.
Information factories anyone?
For non-geeks, Cloud Computing is simply a platform where individuals and companies use the Internet to access endless hardware, software and data resources for most of their computing needs, leaving the mess to their Cloud Service Providers (CSPs).

Carl Howe, director of Anywhere Consumer Research at the analysis firm Yankee Group, explains, "It's things that you can use from your desktop computer or from your mobile phone—that you don't have to spend a lot of deployment money to make happen; they are just *services* that you can use."[2]

How about the Cloud as your PC? Sure, why not? Citrix, the 26th largest software company in the world, known by Windows users across the globe for it's GoToMyPC and GoToMeeting (in the Cloud), and New Delhi startup, Nivio, among others, are ready to become your virtual Desktop in the Cloud. That means they take care of the typical PC messes: crashes, lost data, viruses, upgrades, et al. And it doesn't matter what you use to connect to your virtual desktop in the sky: Windows, Mac or Linux. Word, Powerpoint, Excel and other PC applications are "just there." Companies with thousands of PCs to keep up and running and loaded with current versions of software just had their lives made easier with the Desktop in the Cloud.

A really big game changer for businesses is that they will need to make only minimal hardware and software investments to achieve a new level of IT cost savings as the entire spectrum of business technologies and services becomes accessible in the Cloud. But it won't be just cost savings.

> Cloud Computing makes it possible to create new "business operations platforms" that will allow companies to change their business models and collaborate in powerful new ways with their customers, suppliers and trading partners —stuff that simply could not be done before.

Cloud Computing is the next step in the evolution of the Internet as a source of "services." It's those services that users are interested in, not the underlying technologies.

While most people have become accustomed to using services such as emailing or searching or shopping on the Internet, by extension, it makes sense that business technologies should be accessible in the same way.

> When small and midsized businesses learn of the potential benefits
> of Cloud Computing, they will be able to tap
> IT infrastructures, platforms and software
> that only huge enterprises could deploy in the past,
> making the Cloud the great *leveler*.
> The Cloud opens a new world of entrepreneurial opportunities,
> not just to those in the industrialized world,
> but also to emerging economies across the globe,
> including three billion new capitalists from
> China, India, Brazil, and the former Soviet Union.
> Even you and I as individuals
> will be able to use one of the world's largest supercomputers,
> without having to house it, manage it, power it,
> administer it, provision it—or buy it.

ET, call home!

Seti@home is an example of how distributed computing can add up to something really big, really powerful. A big processing job gets split up into lots of little jobs and distributed out to different PCs to get the power of a supercomputer without having to build or buy a supercomputer.

The Search for Extra-Terrestrial Intelligence (SETI) is a collective set of projects that gives you an idea of how a swarm of millions of home computers can make for one big "virtual supercomputer." SETI@home is a computing project that was launched by U.C. Berkeley in 1999.

Ordinary people like you and me contribute to SETI research by downloading and running the SETI@home software package onto their PCs. Harnessed by the Internet, over 5 million computer users in more than 200 countries have signed up for SETI@home and have collectively contributed over 19 billion hours of computer processing time.

As of January 29, 2008 the Seti@home achieves an average throughput of 387 Teraflops, making it equivalent to the second fastest supercomputer on Earth.

This platform shift in technology to networks of interlinked computers enables a *business platform shift* to networks of intercon-

nected companies that will create new winners and losers as the world rises from the ashes of the Crash of 2008. The importance of swift and deep cost-cutting, of focusing scarce resources on core activities, and of convincing investors that your business can adapt to unexpected change are but three reasons companies will put their heads into the Cloud.

Sure, there will be "oops" along the way, for example, SWIFT, the organization that manages international bank transfers, is planning to build a data center in neutral Switzerland. That will allow it to keep data about European transfers on the old continent, where it cannot be subpoenaed by the American government.

In addition to many forthcoming technical challenges, there will be political challenges. Let the law suits begin. Bring on the technical challenges of privacy, security, availability and reliability. So it is with any technological advancement.

The Technologies Behind the Cloud

Look! Up in the sky! It's a bird! It's a plane!
No. It's Hadoop, the elephant in the Cloud!

Doug Cutting, a search specialist, named his new creation Hadoop, after his son's stuffed elephant. Cutting's creation, Hadoop, is an Apache Lucene sub-project in a Free Java software framework that supports distributed applications running on large clusters of commodity computers that process huge amounts of data. It's a globally accessible fabric of resources, rather than local machines or remote server farms. The driver has been making hundreds of petabytes of data searchable.

Now, what search pioneers like Cutting have been pursuing has turned into general-purpose computing platforms, vastly more powerful than any ever built before—a massively parallel, scalable

architecture that happily accommodates multifarious software.

> In short, the Cloud is the Computer.

Here's a simplified definition of cloud computing from Wikipedia, "Cloud Computing is a computing paradigm shift where computing is moved away from personal computers or an individual application server to a "cloud" of computers. Users of the Cloud only need to be concerned with the computing *service* being asked for, as the underlying details of how it is achieved are hidden. This method of distributed computing is done through pooling all computer resources together and being managed by software rather than a human." All this new capability is driving the need to manage these advances as a *unified* Cloud.

> The Cloud is in its infancy,
> as was the Internet in the early 1990s.
> But considering how the Internet transformed the world,
> buckle up and get ready for the ride ahead.

It seems we could be moving from computing-on-a-chip to computing-on-a-planet. Did you know that Google chose the little Oregon town of The Dalles, at the end of the fabled Oregon Trail along the Columbia River Gorge, to build a new 30-acre campus?

The Dalles campus will be the base for a server farm of unprecedented scale. You see, there's a dam there with a 1.8-gigawatt power station serving up electricity at one fifth the cost of Silicon Valley electricity, plus a fiber-optic hub linked to Harbour Pointe, Washington, the connection point of PC-1, a fiber-optic super pipe that was built to handle 640 Gbps between Asia and the U.S., and taps into the Northwest Open Access Network, a node of the experimental Internet2 (Yeah, I know Alaskan Senator Stevens calls them "tubes").

Pacific Crossing 1
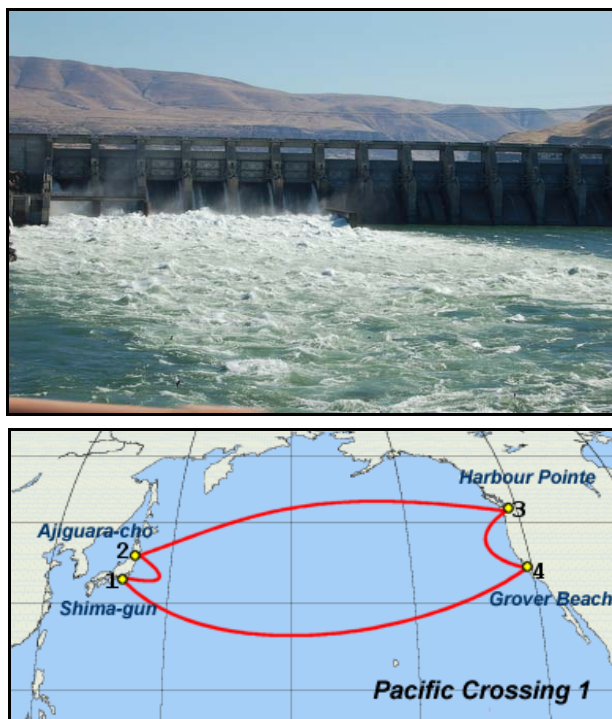
Update! It won't be just The Dalles in Google's next genera-
tion data center plans; it's also the high seas, where the company is
planning data centers powered by wave farms.[3]

Google is pondering a floating data center that could be pow-
ered and cooled by the ocean. These offshore data centers could sit
3 to 7 miles offshore and reside in about 50 to 70 meters of water.
Google filed for a patent that outlines a concept that would not
only be savvy engineering, but deliver great financial returns.

Google is talking about self-contained units that would sit off-
shore much like oil rigs—and, "look Ma, no property taxes!"
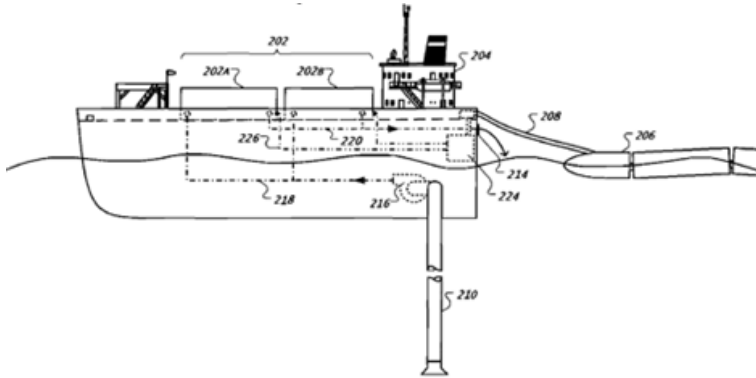
Hmm, is Google the only one that gets it? Not a chance!

Debra J. Chrapaty, Corporate Vice President, Global Foundation Services of Microsoft, isn't about to let Google take over the clouds in the sky. She says, "Google has done a great job of hyping its prowess, but we're neck and neck with them."[4] Her group is on a building spree to create some 20 one-billion-dollar data centers that already includes a huge complex in rural Quincy, Washington that taps cheap energy provided by the Grand Coulee Dam. "We're going to reinvent the infrastructure of our industry," she says. Microsoft packages 2,500 servers into preconfigured shipping containers, and each hyper scale data center can hold up to 224 containers or 560,000 servers. Danny Kim, the chief technology officer at FullArmor Corp. in Boston, has already moved his company to Microsoft's Windows Azure, and he isn't alone.

Meahwhile, IBM has recently invested in data centers specifically geared for the delivery of cloud services. It has new centers in Sao Paulo, Brazil; Bangalore, India; Seoul, Korea; and Hanoi, Vietnam, bringing the total number of its hubs to 13.[5]

And let's not forget Salesforce.com and its on-demand platform, Force.com, one of the original purveyors of the Cloud via it's customer relationship management systems offered as a service; no hardware needed. Its latest messaging is, "It's the fastest way to get from ideas to applications. It's about more innovation and less infrastructure. It's about running your business in the Cloud." Salesforce.com was founded in 1999 by former Oracle executive Marc Benioff, who pioneered the concept of delivering enterprise

applications via a simple Web site. Salesforce.com is building on its legacy and its AppExchange directory of on-demand applications. By the way, it's not all about corporate greed. Benioff is coauthor of *Compassionate Capitalism: How Corporations Can Make Doing Good an Integral Part of Doing Well* and *The Business of Changing the World.*

And this just in from the company that coined the term, "the network is the computer." Sun Microsystems' CEO, Jonathan Schwartz, gleefully explained, "As it turns out, midway through our due diligence in the acquisition of StorageTek, we learned they were the owners of Network.com. They hadn't really ever used it—a hidden gem. In hindsight, it may end up being one of the most valuable domain names in the history of computing."

The Way Back Machine

If computers of the kind I have advocated become the computers of the future, then computing may someday be organized as a public utility just as the telephone system is a public utility... The computer utility could become the basis of a new and important industry.
—John McCarthy, MIT Centennial in 1961

The key ideas behind Cloud Computing aren't new. So, before continuing, let's set some historical context, via the WayBack-Machine, and go back to GTE Data Services (GTEDS) in 1969. General Telephone and Electronics, one of the largest telephone providers in the world, took to heart the ideas of *Grosch's* law, "Computer performance increases as the square of the cost. If you want to do it twice as cheaply, you have to do it four times faster. The law can also be interpreted as meaning that computers present economies of scale: Bigger computers are more economical."

According to Dr. Herbert R. J. Grosch, "Grosch's Law was originally intended as a means for pricing computing services. IBM's Tom Watson Jr. ordered me to start a service bureau in Washington. The first question was 'how much do I charge.' So I developed what became known as Grosch's Law." While Grosch's law was far more pertinent to the 1960s and 1970s mainframe era, the underpinnings of "utility computing" were quite the same as today's rationale for Cloud Computing. In other words, rather than

companies such as Savings and Loan institutions buying and maintaining their own mainframes, they could instead turn to a "computer utility," such as the one envisioned by GTEDS, and gain the efficiencies of Grosch's law. GTE could make a profit by consolidating its data centers and becoming a "service bureau," as it was called back them.

Being fresh out of college, my colleague Ken Bruggeman and I, along with our former IBMer boss, Ken Gold, went to downtown Tampa with a shovel and camera to take some pictures of ground being broken in front of the big billboard announcing the place where the GTEDS data center would be built. We were, of course, impatient youngsters with a passion for this new idea of a computer utility.

Tampa, Florida, USA

Oops. Darn. It sort of never really happened. Along came lower cost minicomputers (Dec's VAX, IBM's System/3, et al). Then came the PC revolution. Then the *almost* killer revolution proclaimed by Sun Microsystems' John Gage in 1984, "The Network is the Computer." Another oops, sorry, John, that didn't happen either, because the network wasn't fast enough in 1984. And oops, sorry, Larry Ellison of Oracle, the Network Computer (NC) was also before its time; the typical home had dialup Internet access in 1996—the network still wasn't fast enough.

As Eric Schmidt, former CTO of Sun Microsystems and now CEO of Google, observed,

> "When the network becomes as fast as the processor,
> the computer hollows out and spreads across the network."

Ah, so now that the overabundance of dark fiber laid down during the dot-com boom is being lit up, perhaps it's time for a "computer utility redux;" perhaps it's now time for the great computer in the sky; perhaps it's now time for Cloud Computing.

Who is leading the charge in massive-scale computing of the kind needed for Web 2.0 and beyond? All the titans shown in the figure below have stepped up to the plate, along with spades of smaller players such as Ribbit, "Silicon Valley's First Phone Company," the startup that wants to take your telephone to the Cloud.

IBM's Blue Cloud
Amazon's Elastic Compute Cloud
Sun Microsystems' Network.com
Google Apps TNG
Dell's Cloud Computing Solutions
Microsoft Office Live Workspace
Yahoo's M45
HP's Adaptive Infrastructure
**   as a Service**
... to name a few

Now, that's the gist of it, the gist of Cloud Computing. If, like many business people, that's more than you care to know, stop here before taking a closer look, and jump to Chapter 3: What's It For?.

A Closer Look

Russ Daniels, vice president and chief technology officer of Cloud Services Strategy at Hewlett Packard, writes in his blog, *Designing the Cloud*, [6] "It's impossible to overestimate the industry's ability to hype any new concept, stretching it to mean virtually eve-

rything, and so nothing. The Cloud is the latest example. Here I propose a narrow, limited definition, intentionally excluding as much as possible, because in that narrow definition something profound is occurring, something that will extend the reach of information technology to vast new markets, increase its value to existing ones, and ultimately transform the structure of our industry. The Cloud comprises three aspects:

- *Cloud Computing*, a design pattern that enables self-service automation, scaling , flexing, variable costs, and rich data analytics;
- *Cloud Platforms*, the tools, programming and information models, supporting software runtime components, and related technologies. Platforms facilitate implementing Cloud Services that depend on the Cloud Computing design pattern to meet their requirements, particularly those related to cost;
- *Cloud Services*, a delivery model for information services.

"The Cloud will not replace other forms of IT delivery any time soon. We'll still find value in software running and storing data on local devices, in complex mission-critical applications running on scale-up hardware, in virtualized and automated internal IT environments, in outsourced delivery, and so on. There are many reasons: today's inability of the Cloud to meet mission-critical requirements, the cost and risk of rewriting software to the Cloud Computing design pattern, and an unwillingness to change things that aren't broken among them. This means that most enterprises will execute in a hybrid model, providing and consuming Cloud Services, with those services integrated into traditionally delivered IT services as needed.
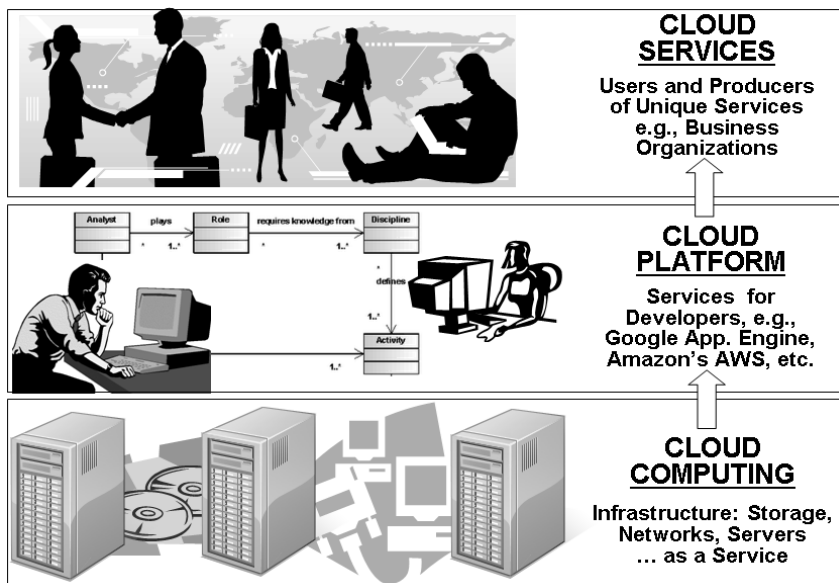
"If not to replace existing IT services, where will the Cloud fit? The best use of the Cloud will be to exploit its advantages and address un-served markets beyond the reach of traditional IT approaches. Because of their low-cost, pervasive accessibility, and ability to capture, persist, and analyze massive amounts of data, Cloud Services allow us to identify an individual's intentions, preferences, and circumstances and offer assistance. We can shift the focus of experience from an application/device pair to the user's concerns. Technology can provide continuity and consistency across services and devices, removing layers of complexity, serving more people in more circumstances.

"None of this will happen without the appropriate incentives for the businesses needed to enable it. The good news is that Cloud Services enable businesses to create richer, deeper relationships with customers, to treat each one as an individual, to customize offerings to meet the specific needs of each, and to integrate with the business partners to make this happen smoothly and affordably."

Shane Robison, executive vice president, chief strategy and

technology officer at HP, elaborates,[7]

> "The technology industry is in the early stages of a big shift
> —one that will transform how we access information,
> share content, and communicate."

"This next wave will be driven by a new model of computing: Instead of installing packaged software applications on their computers, people and businesses will use their browsers to access a wide range of cloud services available on-demand over the Internet. As this transition accelerates, the IT industry has an opportunity to drive a quantum-leap improvement in the user experience.

"Picture cloud services that are intelligent enough to anticipate your needs, based on a real-time understanding of your location, time of day, and preferences. In this next phase, the search for information will be done for you, not by you. You will have a seamless, consistent experience across all of the different devices you own, and all of the various on-demand services you care about.

"To realize the full potential of this new model, the technology industry needs to think about the cloud as a platform for creating new services and experiences that we have yet to imagine. We're moving to a future state where everything will be delivered to you as a service, from your work life to entertainment to various communities. We call this "Everything as a Service," and we believe this is where the world is headed. Individuals and businesses will have full control to customize their computing environments and to shape the experiences they want to have. This applies to individual consumers looking to personalize a variety of cloud services based on their lifestyle, as well as the largest global enterprises, which will increasingly turn to dynamic cloud-based offerings to meet their most demanding computing requirements.

"The true power of the cloud happens when you have continuous interaction between your device—your smartphone, laptop, TV—and the network, and they jointly act on your behalf. Here's a simple example: say it's 2 p.m. and your calendar shows you're booked on a flight to Toronto at 6 p.m. Your device should have the smarts to anticipate what information you'll need for this

trip and then proactively gather it for you—a weather forecast for the Toronto area, a status update on your flight, a recommended route to the airport based on up-to-the-minute traffic conditions, and so on. In this scenario, the big step forward is the pervasive, proactive and highly personalized nature of cloud services.

> "Some may say they heard this before during the 1990's Internet bubble. But here is the difference: back then, we were living in a world of painfully slow Internet access. Despite all the hype, it simply wasn't possible to use the Internet as a platform for anything more than static pages."

"Fast forward to today. As broadband Internet access goes global and mobile, we have a legitimate opportunity to complete the transition from a web of static pages to a web of dynamic services. This can only happen if the IT industry does the hard work necessary to put the final pieces of the puzzle in place. That brings us back to the need for a higher level of intelligence built into our devices, our networks, and the software that ties it all together.

> "The shift to cloud computing will dramatically reduce the cost of information technology, but let's be clear —the implications of this shift go far beyond cost savings."

"The big disruptor over the next several years will be our ability to deliver a meaningful improvement in the user experience. If we are successful in doing that, we will create the next wave of growth for the technology industry. As we move from the desktop model to the cloud and a world where everything will be delivered as a service, there are five trends that are worth paying close attention to:

1. The digital world will converge with the physical world: Back in 1995, the mantra was, "Everything is virtual. Geography is irrelevant." But from now on, factors such as your physical location mean a lot. Cloud services will be increasingly aware of the context you're in, right down to details such as the time, the weather, where you're headed, and which friends or busi-

ness colleagues happen to be present nearby.

2.   The era of device-centric computing is over. Connectivity-centric computing will take center-stage: People often ask, "When am I going to get that one device that does everything I can imagine?" Flip that equation on its head. What you really want is the ability to use any number of devices, and have them all provide easy access to the services and content you care about. Devices will continue to play an important role, but in the next phase they become interchangeable — and the cloud services become the focal point.

3.   Publishing will be democratized. A global Internet population of 1.2 billion people now has the tools to produce everything from books and magazines to music and videos. This represents a massive disruption of old publishing models. People will soon have the ability to print on demand any book ever published. The concept of "out of print" will be a thing of the past. Similarly, warehouses of physical inventory in the publishing world will no longer be necessary.

4.   Crowd-sourcing is going mainstream and will change the rules of the game forever. Fortune 50 companies will access top talent on a global basis via the Internet, saving millions of dollars in professional services, from occupations as diverse as accountants, advertising experts, attorneys, and engineers. Reputation systems will lower the risks involved by exposing the poor performers. One example of this shift to crowd sourcing is HP's Logoworks service, which is transforming the graphics design industry.

5.   Enterprises will use radically different tools to make key business decisions, including systems to more accurately predict the future. A merger is taking place between the structured data that fuels business intelligence and the unstructured data of the web. This combination represents a kind of Holy Grail that will advance the state of the art in business intelligence. At the same time, market-based systems that enable companies to accurately predict the future will become common practice in the enterprise.

"As Everything as a Service evolves, we have an opportunity to reshape the computing industry forever and, more importantly, create more dynamic services that enrich our everyday lives and improve how we do business. To realize this potential, the technology industry must innovate by building a higher level of intelligence into the next generation of devices, networks and software. When we are successful in providing a dramatically better user experience, we will be poised for the next wave of growth."

Scalability

Utility computing and on-demand computing have been around for quite some time, and serve as foundations of Cloud Computing. Geva Perry, chief marketing officer at GigaSpace Technologies, explains, "The main benefit of utility computing is better economics. Corporate data centers are notoriously underutilized, with resources such as servers often idle 85 percent of the time. This is due to over provisioning—buying more hardware than is needed on average in order to handle peaks (such as the opening of the Wall Street trading day or the holiday shopping season), to handle expected future loads and to prepare for unanticipated surges in demand. Utility computing allows companies to only pay for the computing resources they need, when they need them."[8]

A special report in the *Economist* expands on the benefits to corporate data centers, "Before Ford revolutionized car making, automobiles were put together by teams of highly skilled craftsmen in custom-built workshops. Similarly, most corporate data centers today house armies of 'systems administrators,' the craftsmen of the information age. There are an estimated 7,000 such data centers in America alone, most of them one-off designs that have grown over the years, reflecting the history of both technology and the particular use to which it is being put. It is no surprise that they are egregiously inefficient. On average only 6% of server capacity is used, according to a study by McKinsey, a consultancy, and the Uptime Institute, a think-tank. Microsoft's data center in Northlake, just like Henry Ford's first large factory in Highland Park, Michigan, may one day be seen as a symbol of a new industrial

era."[9]

Perry expands his discussion to Cloud Computing and what it means for corporate IT, "Cloud computing is a broader concept than utility computing and relates to the underlying architecture in which the services are designed. It may be applied equally to utility services and internal corporate data centers. Wall Street firms have been implementing internal clouds for years. They call it 'grid computing,' but the concepts are the same.

"Although it is difficult to come up with a precise and comprehensive definition of cloud computing, at the heart of it is the idea that applications run somewhere on the 'cloud' (whether an internal corporate network or the public Internet)—we don't know or care where. But as end users, that's not big news: We've been using web applications for years without any concern as to where the applications actually run.

"The big news is for application developers and IT operations. Done right, cloud computing allows them to develop, deploy and run applications that can easily grow capacity (scalability), work fast (performance), and never—or at least rarely—fail (reliability), all without any concern as to the nature and location of the underlying infrastructure.

"Taken to the next step, this implies that cloud computing infrastructures, and specifically their middleware and application platforms, should ideally have these characteristics:

- *Self-healing:* In case of failure, there will be a hot backup instance of the application ready to take over without disruption (known as failover). It also means that when I set a policy that says everything should always have a backup, when a failure occurs and my backup becomes the primary, the system launches a new backup, maintaining my reliability policies.
- *SLA-driven:* The system is dynamically managed by *service-level agreements* that define policies such as how quickly responses to requests need to be delivered. If the system is experiencing peaks in load, it will create new instances of the application on more servers in order to comply with the committed service levels—even at the expense of a low-priority application.
- *Multi-tenancy:* The system is built in a way that allows several

customers to share infrastructure, without the customers being aware of it and without compromising the privacy and security of each customer's data.

- *Service-oriented:* The system allows composing applications out of discrete services that are loosely coupled (independent of each other). Changes to, or failure of, one service will not disrupt other services. It also means I can re-use services.

- *Virtualized:* Applications are decoupled from the underlying hardware. Multiple applications can run on one computer (virtualization a la VMWare) or multiple computers can be used to run one application (grid computing).

- *Linearly Scalable:* Perhaps the biggest challenge. The system will be predictable and efficient in growing the application. If one server can process 1,000 transactions per second, two servers should be able to process 2,000 transactions per second, etc.

- *Data, Data, Data:* The key to many of these aspects is management of the data: its distribution, partitioning, security and synchronization. New technologies, such as Amazon's SimpleDB, are part of the answer, not large-scale relational databases. And don't let the name fool you. As my colleague Nati Shalom rightfully proclaims, SimpleDB is not really a database. Another approach that is gaining momentum is in-memory data grids."

> While utility computing can change the economics of IT, Cloud Computing could change the economics of business, allowing companies to adapt and scale their business models and markets.

"It is a sign of lively 'combinatorial innovation,' made possible because entrepreneurs as well as incumbents can cheaply try new combinations of technology," says Google's HalVarian in the *Economist*'s special report on Cloud Computing.

"Many start-ups would probably not even exist without the cloud. Take Animoto, a service that lets users turn photos into artsy MTV-like music videos using artificial intelligence. When it launched on Facebook, a social network, demand was such that it

had to increase the number of its virtual machines on AWS from 50 to 3,500 within three days. 'You could give me unlimited funding,' says Adam Selipsky of Amazon Web Services (AWS), 'and I wouldn't know how to deploy that many servers in 72 hours.'"

"Combinatorial innovation should also be made easier by the fact that the cloud will be a huge collection of electronic services based on standards. But this service-oriented architecture will be even more important for existing firms because it should free their inner workings—their 'business processes'—from the straitjacket of their ERP systems and allow these processes to be more easily adapted, for instance to launch a new product."

The Cloud Isn't Just for Garage Startups; It's Also for the Fortune 500 and Beyond

Indeed, the Cloud isn't just for startups, its for incumbents as well. Just consider how Nasdaq and the New York Times have embraced the Cloud to augment their existing legacy IT systems. Both tapped into Amazon.com's Internet-provisioned computing and storage services (Elastic Compute Cloud (EC2) and Simple Storage Service (S3))to augment their own IT resources. The Times processed 4 terabytes of data through Amazon Web Services by simply using a credit card to get the service going. In a matter of minutes it converted scans of more than 15 million news stories into PDFs for online distribution—$240! Look, Ma, no New York Times IT infrastructure needed. Meanwhile, Nasdaq uses Amazons's S3 storage system to deliver historical stock and mutual fund information, rather than add the load to its own computing infrastructure.

In other examples of early Cloud Computing adopters, Infosolve Technologies uses Sun's Network.com to scrub customer addresses rather than implement the needed infrastructure internally. The medical robotics firm Intuitive Surgical and recruitment services provider Jobscience use the Cloud to provision their own applications. Both companies use the Force.com platform.

How about using a *galactic* internal, private cloud to gain economies of scale? GE seems more than interested in that idea. According to GE chief technology officer, Greg Simpson,

- "Three years ago, only a quarter of the money GE spent on computing power was allocated to its centralized data centers: the rest of it was spent by the group's individual operating companies. Today, that data center share has climbed to 45 per cent and GE's units 'buy' far more of their computing as a service from the center. Centralization has taken hold."
- "A year ago, in 85 per cent of the cases where it had a new computing task to handle, GE bought a new server to deal with the task. By last December 2008, that proportion had fallen to just 50 per cent. In place of all those extra computers are 'virtual machines,' using software from companies like VMware, GE is loading extra work on its existing computers, then moving it between computers as needs change."

But then comes an even bigger proposition. How about a huge company like GE blending both internal clouds and going beyond the firewall to reach out to customers and suppliers in the Cloud? GE's supply chain is huge, including 500,000 suppliers in more than 100 countries that cut across cultures and languages, buying up $55 billion a year. GE wanted to modernize its cumbersome home-grown sourcing system, the Global Supplier Library, build a single multi-language repository, and offer self-service capabilities so that suppliers could maintain their own data. So did CIO Gary Reiner and team start programming? The short answer is no, they looked to the Cloud for a solution. In 2008, GE engaged software-as-a-service (SaaS) vendor Aravo to implement its Supplier Information Management (SIM) SaaS that would ultimately become the largest SaaS deployment to date.

"They're using SaaS for 100,000 users and 500,000 suppliers in six languages: that's a major technology deployment shift," said Mickey North Rizza, research director at AMR Research. She said that the sheer volume of transactions, combined with the fact that GE supply chain and procurement employees around the world can now access the same sourcing partner information, all from one spot. It is significant not only for the supply chain management space, but also for the SaaS and cloud computing world.

"Finally we have a very large company tackling the data trans-

parency issue by using a SaaS product," North Rizza continued. "It's a huge deal." When GE goes outside its "firewall" to innovate, you betcha, other CEOs will be asking their CIOs lots of questions about harnessing the Cloud, internally, with tightly controlled external clouds provisioned by third parties, and finally, with public clouds.

According to Forrester Research's 2008 survey of software IT decision-makers, just 16 percent of respondents said they were already using or currently piloting SaaS applications. Conversely, more than 80 percent were still on the sidelines—curious, for sure, but not yet completely sold or running SaaS applications right now. Forty-six percent said they were interested in SaaS or planning to pilot; 37 percent said they were "not at all interested." As news spreads about GE and other Fortune 500 companies innovating with private and public Clouds, interest in intra-, inter-, private and public clouds will likely skyrocket. And, of course all these cloud formations will need to interoperate to become one Intercloud, much as we have one Internet today.

As IT veteran and Cordys chief strategy officer, Jon Pyke, wrote in "Weathering the Perfect Storm," "There will be not just one cloud but a number of different sorts: private ones and public ones, which themselves will divide into general-purpose and specialized clouds. People are already using the term 'Intercloud' to mean a federation of all kinds of clouds, in the same way that the Internet is a network of networks. And all of those clouds will be full of applications and services."

> Yesterday, the Internet—tomorrow, the Intercloud.

Want more proof that the Cloud isn't just for garage dot.com types of startups? How about the super-sensitive, super-guarded military? Although many think Cloud Computing is nowhere ready for prime time or mission-critical usage, John Garing, the CIO of the Defense Information Systems Agency (DISA) at the Department of Defense (DoD) thinks otherwise. As reported in "On-Demand Enterprise," Garing called Cloud Computing something we absolutely have to do. "If you deploy a force somewhere in the world for disaster relief—or a special operations team, they ought to be able to connect to the network like you or I can from home,

and bring together or compose—the services and information they need for what they're doing at that particular place and time, rather than have to connect to a bunch of applications." When DISA's RACE (Rapid Access Computing Environment) went live, and he saw someone experimenting on RACE to provision services in only seven minutes. he joked, "That's pretty impressive for the Department of Defense, or the federal government. Seven months would be more like it." Although RACE is a private cloud located entirely within DISA's walls, government customers still get the public cloud experience with a Web portal, 24-hour-a-day availability, and a service catalog.

Meanwhile, Kevin Jackson of Dataline, a technology solutions provider to DoD and federal agencies, emailed me and wrote that his company is working with DoD organizations to define and address tactical military requirements. These requirements have always been there, but shipboard compute and storage capacity limited the commander's ability to address them. The advent of cloud technologies, however, has led to the concept of a "Tactical Cloud" where battle group resources can be immediately pooled to run high fidelity models and simulations, the results of which are used in crafting a commander's decisions.

Jackson recalled that when Cloud Computing first came into vogue, there was a rather serious discussion about the private cloud concept. The whole idea of cloud computing seemed to argue against implementing such a capability behind organizational walls. Although in some circles, the idea of a private cloud is being subsumed by the more acceptable "Enterprise Cloud," Jackson used a different cloud concept, the "Tactical Cloud." In the view of many, the development of a private or Enterprise Cloud for the DoD is a fait accompli, so private clouds seems like an appropriate evolution. Enterprise Clouds, however, overlooked the need for military formations to simultaneously leverage this new IT approach and operate independently. Individual units could combine their IT infrastructure virtually using Cloud Computing concepts. One case hypothesized the use of high fidelity tactical simulations in faster than real-time to help commanders better evaluate tactical options before committing to a course of action. This Tactical Cloud

would also need to seamlessly reach back and interact with the DoD's Enterprise Cloud. There could even be situations where the Tactical Cloud would link to a public cloud in order to access information or leverage a infrastructure-as-a-service. A naval formation seems to be the perfect environment for a tactical or "Battlegroup Cloud." Although each ship would normally operate its IT infrastructure independently, certain situations could be better served by linking all the resources into a virtual supercomputer. Even more interesting is the fact that the Tactical Clouds could go beyond DoD and meet the needs of police, firefighters, medical professionals and homeland security organizations. If the DoD could improve its operations with a Tactical Cloud couldn't these other organizations benefit as well? After all it was the DoD's Arpanet that gave us the Internet.

Managing resources in the Intercloud will be a technological challenge. Sun Microsystems' Lew Tucker said that Sun's acquisition of Q-layer, a Belgium cloud computing company was to gain the capability to automate the deployment and management of both public and private clouds. With Q-layer technology, Sun can provide a self-service virtual data center where companies can manage virtual components, via a management layer. Enterprises will be able to define a system architecture at Web scale, and Tucker explained that as businesses continue to rely more on technology to drive mission-critical processes, the agility of the data center will become more important to the flexibility of the entire company.

Geroge Barlow, CEO of Cloud Harbor, explains another aspect of cloud management, "Few people yet understand the major role enterprise software appliances will play in the upcoming cloud computing revolution. Appliance-based Software Delivery (AbSD) is an emerging technology that puts ready-to-run applications on a server (appliance) that is built specifically to be deployed on-premise, behind the firewall of an enterprise computing installation. These appliances will contain the same applications that run on servers in the cloud and be maintained exclusively by the cloud application vendors at the same application release level as the corresponding cloud offerings. The main advantage of AbSD applica-

tions is that they are securely connected to both the cloud and the organization's on-premise network concurrently. This affords the enterprise the safety and convenience of keeping data and connections to existing on-premise applications behind the organization's firewall while still allowing most of the advantages of the Software-as-a-Service or Platform-as-a-Service computing models."

Barlow also argues, "Some of the interesting ways On-Demand will appeal to larger businesses include budgeting the expenditures as operating expense rather than capital expenditures, creating business performance dashboards by combining information from cross-functional enterprise systems such as CRM and ERP, and collaborating across geographic and organizational boundaries to create core-function pilots and innovation projects. If there is an urgent need for an application, being able to assemble a team and begin creating processes or using available pre-created applications without having to incur the typical costs and delays can significantly impact strategic imperatives like time-to-market."

Jon Pyke summarizes, "There will be many ways in which the cloud will change businesses and the economy, most of them hard to predict, but one theme is already emerging. In the teeth of the Perfect Storm of the current economic turmoil and advancing technology, businesses will have to become more like the technology itself: more adaptable, more interwoven and more specialized. Organizations should use the Perfect Storm as an opportunity to get fit and healthy. There is an idiom that states 'a better built ship can weather a storm.' An organization should take a good look at what it does, but most importantly it should take a long hard look at how it does things."

From Then to Now

Just as GE's legendary CEO, Jack Welch, learned about the power of the Internet in the 1990s by watching his (now former) wife shopping online, consumers are out front of companies when it comes to using the Cloud and Web 2.0. Just think Google, Yahoo, eBay, Amazon, and Flickr—all with very sophisticated and powerful Cloud infrastructures. On the other hand, it's been tough to convince the largest enterprises that the Cloud represents the

next infrastructure, the next computing platform.

As Sun Microsystems' CEO, Jonathan Schwartz blogged,

> "I'm sure George Westinghouse was confounded
> by the Chief Electricity Officers of the time that resisted buying
> power from a grid, rather than building their own internal utilities."

He goes on to write, "We learned a lot, but mainly that most enterprises today define On Demand computing as hosting—they want to give their computers, software, networking and storage to a third party, and rent them back for a fixed price. But that'd be like an electricity company collecting generators and unique power requirements, and trying to build a grid out of them. That's not a business we're in (nor one in which technology plays much of a role—it's all about managing real estate and call centers, as far as we can tell). Grids are all about standardization and transparency—and building economies of scale."

Schwartz isn't too concerned about early adoption by large enterprises, ". . . rumor has it there's a good business in the long tail. My view—most computing will be purchased by that tail. There are, after all, far more small financial institutions than large. The same applies to movie studios, pharmaceutical companies, academic institutions, and nearly every other industry on earth. I'm very comfortable betting on the value in volume—and the willingness of those smaller firms to change culture, process and lifestyle to get a competitive advantage through network services." As with most new paradigms, Cloud Computing may start at the edges of enterprises and slowly be absorbed into more and more functions.

My very first experience touching a PC, I'm guessing around 1971 and way before "real" PCs were developed, was a Datapoint 2200, the device that also led to the development of the first 8-bit microprocessors, and whose specifications led to the creation of the Intel 8008 single chip microprocessor. Now, not so many years later, I'm waiting for the specification from OMG's Business Process Management Initiative, or whoever, that will make it possible to put business process management in the Cloud—with Web 2.0 simplicity. The time is ripe.

Over time, Cloud Computing could help IT managers dramatically reduce the complexities and costs of managing scale-out IT infrastructures in the Web 2.0 era, and could also help manage the complexities of scale-out inter-enterprise business process management—including requisite real-time petabyte-scale business intelligence, business rules via intelligent agents, inter-enterprise business process modeling, complex event processing, and human interaction management.

Old-line CIOs will certainly cling to their in-house infrastructures, claiming *security* as the major concern (and don't forget compliance: SOX, HIPAA, GLBA, FFIEC, PCI, COBIT, et al). Of course, security is, and always will be a major concern, even for in-house located systems, though one that can be overcome in the Cloud. For every major technology shift, commensurate new management controls and auditing procedures are needed, as I explained in a BPTrends column, "EDP Audit and Control Redux."[10] So, watch for FWaaS (firewalls) and VPNaaS (virtual private networks) as standard services in the Cloud.

As the *Economist* noted, "The Cloud lends itself to similar hyperbole [as Internet 1.0]. Yet so far there has not been much debate about its economic fallout—probably because the "new economy" ended badly and the newest one is currently doing even worse.

> "There will be many ways in which the Cloud will change businesses and the economy, most of them hard to predict, but one theme is already emerging. Businesses are becoming more like the technology itself: more adaptable, more interwoven and more specialized. These developments may not be new, but Cloud Computing will speed them up.

"Corporate IT has always promised to make companies more agile. In the 1990s many companies re-engineered their business processes when they started using a form of software called enterprise-resource planning (ERP), which does things such as managing a firm's finances and employees. But once these massive software packages were in place, it was exceedingly difficult to change them. Implementing SAP, the market leader in ERP, is like pouring

concrete into your company, goes an old joke among IT types.

"This helps to explain why in many firms IT departments and business units have traditionally been at loggerheads. In recent years tensions have worsened. Companies must grapple with ever-changing markets and regulations, yet IT budgets are being cut. Many firms now have a huge backlog of IT projects."[11]

- Hello, business process management in the Cloud.
- Hello, business operations platform in the Cloud.

Bruce Richardson of AMR Research wrote in December 2008, "Executives from one of the best-known ERP vendors [enterprise systems] recently talked to us about their 2009 product plans and strategy. At the end of the call, I expressed my astonishment that there were no plans to offer any part of their company's product line as software as a service (SaaS) [in the Cloud].

"As they talked, I was transported back to the early 1980s, where I found myself in a room filled with mainframe and mini-computer vendors. They were screaming about the need to kill off internal PC development initiatives because these lower cost, limited function desktop boxes would cannibalize sales of higher margin systems. While it didn't exactly play out that way, the hardware landscape was changed forever. IBM reinvented the mainframe as a giant server. PCs spread like kudzu, obliterating dumb terminals and small business computers. The only remaining minis are in computer museums.

"Is the same about to happen to the enterprise applications market? Are the largest ERP vendors becoming the new mainframes by holding on to the traditional deployment model? Looking out five years, which applications will run on premises versus on demand or in the *cloud?*[12]

The forward-thinking CIO will no doubt put his or her head in the clouds, and change his or her title to CPO, Chief Process Officer, for it's agile business processes that companies want to manage, not technology infrastructures. And, it's not one size fits all. It will likely be a combination of private and public Cloud infrastructures. But it will be a new paradigm, surely as the PC was a new paradigm to mighty-mainframe IBM in days gone by. So

here's a word of warning to those who have shrugged off Web 2.0 and the Cloud as its platform, "Do so at your own peril, even though where all this will end up is still up in the air." Let the dot connecting begin.

Takeaway

In its essence, Cloud Computing is about using swarms of computers to deliver unprecedented computing power to people and organizations across the globe. Because much of the power is about information management versus just computational power, many advances in Cloud Computing have come from researchers taking on the challenges posed by Internet searches (Google's MapReduce and the open-source Hadoop systems). In everyday terminology, cloud computing uses sophisticated tools to harness the Internet to:

1. spread computing tasks across multiple clusters of machines,
2. provide a platform for new tools and techniques that can make the computing ecosystem far simpler, thus, available to all,
3. provide a platform for human collaboration and interaction never before possible, and
4. make all the world's information accessible anywhere, anytime.

Cloud Computing can deliver *tens of trillions of computations per second* in a way that users can tap through the Web, making super-computing available to the masses. It can do so by networking groups of thousands of servers that use low-cost consumer PC technology, with advanced operating systems to spread computational chores across them. By contrast, the newest and most powerful desktop PCs process only about three billion computations a second.

The economic and innovation implications are game changing, for technology will not only be available to handle the worlds business and financial transactions, but will also open a whole new world of human interaction and collaboration on a scale never before possible. In the past, information technology was about productivity; now it's about collaboration, a shared information base

and collective intelligence.

Cloud computing will take globalization to a whole new level, and globalization is indeed the greatest reorganization of the world since the Industrial Revolution.

One shared world; one shared computer; one shared information base.

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