

What the Enterprise Needs to Know About Cloud Computing

October 2009


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Cloud computing has arrived. More and more organizations are turning to cloud computing to reduce costs and shorten the time to market. While traditional corporate data centers and on-premise software are not going away, cloud computing will have a far-reaching impact on enterprise IT and business in large organizations. CIOs and other business leaders must look beyond the hype to see what opportunities and challenges lie in the cloud.

Although the term “cloud computing” is relatively recent, elements of the concept, such as timesharing and virtual machines, have been around for several decades. What makes cloud computing real now is the pervasiveness of the Internet and Internet technologies, virtualization, hardware commoditization, standardization, and open source software. A key catalyst is the success of major Internet companies like Google, Amazon and Microsoft. The highly global and scalable infrastructure these companies have built to power Internet search, electronic commerce, social networks, and other online services forms the core of cloud computing. In tandem, a cadre of capable, credible pure-play firms has emerged—salesforce.com and Workday among them.

Despite its immaturity, cloud computing is already yielding significant benefits. At Procter & Gamble (P&G), about 25,000 employees are using Google Apps for their desktop tasks. Harvard Medical School has been using Amazon Web Services and Oracle to develop genetic testing models in record time. TC3 Health, a health care claims processing company, tapped Amazon Web Services when a customer put in an urgent request to have 30 million claims checked for accuracy. The cloud gave TC3 immediate additional capacity at less than one-third the cost of a standard processing approach. NASDAQ uses Amazon Web Service’s S3 to store terabytes of historical data on stocks and funds, and leverages a lightweight rich Internet application (RIA) to generate new revenues. And myriad small and medium-size businesses are using Intuit QuickBase for databases.

Cloud computing constitutes a major step in the continuing industrialization of IT and will play a role in enabling high performance. The changing business model, underlying technologies, and architecture will likely lead to a wave of innovations. By using the cloud, an IT professional can quickly add business value to run applications and develop software off-premise. Platforms like Force.com and Windows Azure give developers real-time workflow, programmable user interfaces, real-time mobile deployment, real-time analytics, and more. Cloud computing enables development cycles to shrink from months and years to days and weeks, and it helps to manage peak load demands in computing.

For enterprise IT users, the cloud holds great potential in terms of lower-cost services, greater IT agility, more flexibility, and better user experiences. Insurer Aon, for instance, turned to cloud computing when it had to roll out a new sales and marketing platform internationally. At a recent CIO Council Forum sponsored by Accenture, a senior marketing executive in the insurance industry noted: “We deployed in the cloud to basically 90 countries in less than a year, and we have close to 9,000 users today; had I gone through the traditional model, I would probably still be deploying today.”

Indeed, Accenture’s research identifies virtualization—a major enabler for the cloud—as a key contributor to high-performance IT.¹

These benefits suggest why cloud services likely will make up a significant part of the increase in IT spending growth over the next several years. A Gartner Dataquest forecast notes that while the recent financial crisis and recession dampened demand in the short-term, growth for many cloud services will accelerate as the approaches prove themselves and then benefit from improved macro-economic conditions.²

Like any new technology platform, the cloud brings risks in the areas of data management, security and privacy, integration and service quality. Continued success with the cloud thus will require careful planning, smart navigation and ongoing adaptation. Accenture recommends that companies take incremental steps toward this new environment so they can reap early benefits for applicable business situations and learn how to deal with the associated risks.

¹ “High Performance IT 2008: There’s No Substitute for Substitution,” Accenture, 2008.

² “Forecast: Sizing the Cloud; Understanding the Opportunities in Cloud Services,” Gartner Dataquest, March 18, 2009.

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The evolving enterprise cloud IT stack

Accenture defines cloud computing as the dynamic provisioning of IT capabilities, whether hardware, software, or services from a third party over the network. By combining virtualization and one-to-many architecture with a pay-as-you-go business model, cloud computing represents a new paradigm that will significantly impact the way IT infrastructure, platform, application and business processes capabilities are procured, delivered and supported.

At the infrastructure level, companies have already begun to source raw computing resources—processing power, network bandwidth and storage—from the outside on an on-demand basis. In most cases, these resources are used to augment rather than replace

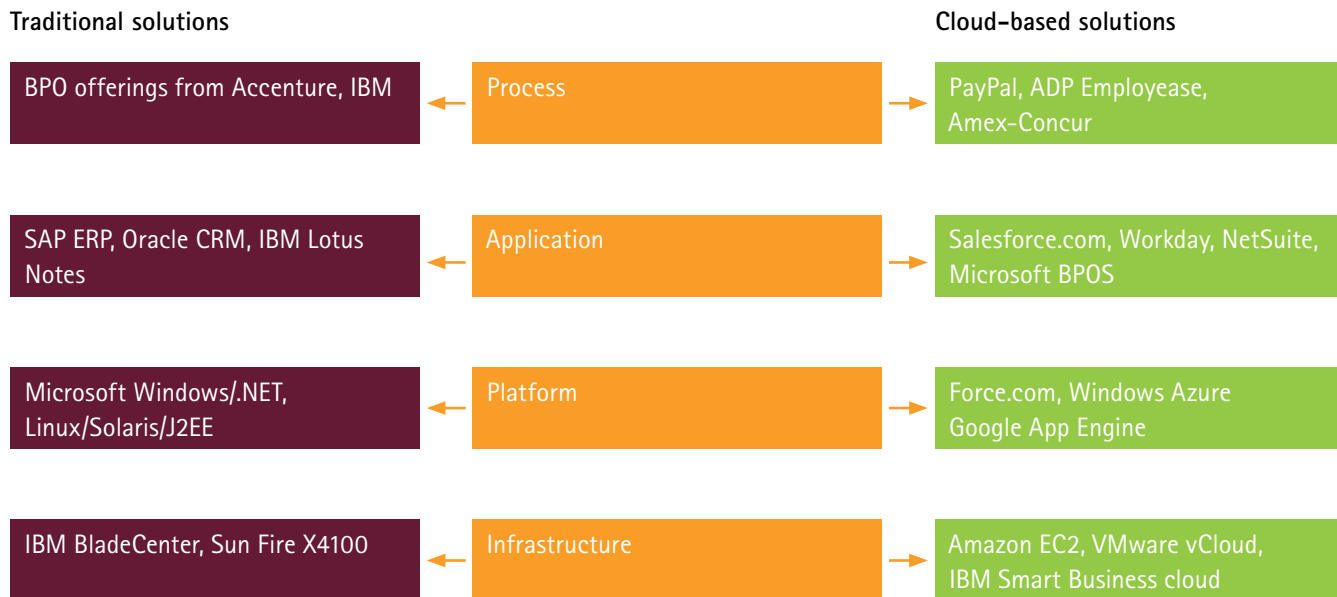
existing in-house infrastructure, which itself is increasingly virtualized. Unlike traditional hosting services, which provide dedicated hardware to customers, infrastructure cloud providers draw from a pool of shared resources and dynamically expand and contract to accommodate fluctuating demand from different user organizations. As a result, they provide far greater elasticity, economies of scale, and cost advantage compared to standalone datacenters. Prime examples are Amazon's Elastic Compute Cloud (EC2), Rackspace's Cloud Hosting, VMware's vCloud, GoGrid, Citrix's Cloud Center and Skytap's Virtual Lab. Many large telecom operators also are entering the field.

At the platform level, cloud-based environments provide application developers similar functionalities as

in traditional desktop settings. Specifically, these include tools and other support for development, testing, deployment, runtime libraries, and hosting. The emergence of such platforms allows independent software vendors (ISVs) and IT staff to develop and deploy online applications quickly using the third-party infrastructure. In the case of Force.com, for example, developers can also take advantage of the existing data and customer base from the core customer relationship management (CRM) application. Google App Engine, Windows Azure and 3tera are other examples.

At the application level, the first wave of cloud-based services (also known as software-as-a-service or SaaS) falls broadly into the areas of CRM, human capital and financial management. The second wave focuses on desktop productivity tools, including

Figure 1. The enterprise IT stack: traditional solutions versus cloud-based solutions



word processing, spreadsheets, e-mail and Web conferencing. Today, application clouds span across all major enterprise solution areas, from procurement to enterprise resource planning and content management. These applications run on the third-party infrastructure. User organizations subscribe to these services based on the number of users or seats. Since these services are available via standard browsers, they support device independence and anywhere access. Major vendors include Microsoft, salesforce.com, NetSuite, Workday, McAfee, Symantec and Google.

At the business process level, cloud-based solutions, also known as business process utilities or platform-based business process outsourcing (BPO), offer an Internet-enabled, externally provisioned service for managing an entire business process, such as claims processing, expense management or

procurement. Unlike traditional BPO, which often requires the service provider to take over an existing software installation, the process cloud uses a common, one-to-many platform to automate highly standardized processes. It differs from application clouds in that it provides end-to-end process support, covering not just software but also processes supported by people, such as contact centers. These processes are typically priced on a per-transaction rather than per-seat basis. Some traditional BPO providers such as India-based HCL Technologies are rapidly migrating their services to the cloud. Other examples include EquaTrax (royalty calculation and reporting), ADP Employeease (payroll), and Amex-Concur (business expense management).

As shown in Figure 1, cloud-based services are available at all levels of the enterprise IT stack. So far, each layer has evolved independently, with application clouds being most mature. That is possible because application cloud pioneers such as salesforce.com rely on their own home-grown infrastructure. We may see an increasing dependency between upper layers and lower layers of the cloud stack. For example, new application players could turn to infrastructure cloud providers to achieve a better cost structure, elasticity and faster time to market. Potential process cloud providers may follow a similar path to offer virtual BPO without owning their own hardware and software platforms.

Accenture believes that the IT department of large organizations will continue to supply the majority of IT services, especially those enabling core business functions.

The rise of a disruptive technology

Cloud computing is a classic disruptive technology. As such, it has its origin in the fringe of the IT market, namely the small and medium-sized enterprise (SME) and consumers, whose need for simpler and lower-cost or even free solutions is underserved by traditional packaged software. As cloud-based services matured, they started to win broader acceptance from mainstream enterprise customers. Now, they compete directly with on-premise and packaged software.

The significance of the cloud, however, lies far beyond cheap computing. The Web-enabled, variable cost model represents a huge departure from existing practice, and carries far-reaching implications for IT providers and users alike. A group of venture-funded startups have developed innovative solutions ranging from

niche applications to cloud middleware and infrastructure services. For instance, RightScale offers developer tools, Twilio focuses on telephone applications, and Ocarina uses the cloud to improve data storage. Cloud platforms ease the entry barrier for such small players.

Pure Internet players like Google, Amazon and salesforce.com are competing with traditional enterprise vendors such as SAP, Oracle and Microsoft, which have been investing aggressively to extend their on-premise capabilities into the cloud. Microsoft has developed Windows Azure, a software-plus-services approach with its "Web operating system" that gives customers a choice among on-premise, partner-managed, or Microsoft-hosted solutions.³

³ www.pcworld.com/article/168388/microsoftreveals_windows_azure_pricing_availability.html.

In general, cloud computing acts as an accelerator for enterprises, enabling them to innovate and compete more effectively. With elastic and theoretically unlimited IT resources on tap, businesses no longer have to wait for the provisioning of servers or worry about project delays. They can quickly enter new geographical markets or launch new products or services in existing markets. As demand grows, they can quickly scale up. Conversely, when demand eases, they can just as quickly scale down and, if necessary, exit the market entirely with minimum loss of time and capital.

For IT organizations, the cloud means that more IT functions will be accounted for as variable costs. This shift from "buy-and-own" to "pay-as-you-go" has broad implications for activities such as procurement and staffing—and it could lead to a new role for the IT department. As the cloud continues to gain momentum, more business units and users will turn directly to SaaS and other cloud-based solutions to meet their infrastructure and application needs. As a result, the IT group's role as the sole provider and operator of IT will slowly diminish. Yet the group will likely see growing demand for security, procurement, data and other similar services from the business units.

Accenture believes that the IT department of large organizations will continue to supply the majority of IT services, especially those enabling core business functions. Nevertheless, these departments must still be ready to accept a gradually shrinking footprint while dealing with new challenges associated with the emerging hybrid environment, including service quality, data and integration.



Why now?

Several forces converged to create the surge in interest in the cloud. On the business front, macroeconomic conditions continue to put pressure on business spending. For organizations eager to delay, reduce, or eliminate capital spending, especially on one-off or marginal projects, the pay-as-you-go model provides an attractive option. Increasingly, companies also turn to cloud-based solutions as a way to counter the rising costs of licensing enterprise software.

Another factor pertains to the growing demand for seamless collaboration. As the globalization trend continues, distributed work has become an everyday reality in large organizations. In contrast to many existing on-premise applications, Web-based productivity applications are inherently collaborative and accessible anywhere. Among

many younger employees, these are the same tools they use outside of work, so cloud-based solutions mesh nicely with their computing habits.

On the technology front, a number of recent developments have combined to make the Internet an emerging enterprise-grade platform. At the center is the widespread adoption of Web services, allowing easy publishing, access, and integration of application functionalities and infrastructural capabilities from distributed sources. For instance, the entire Amazon cloud is accessible through Web services. The second are rich Internet applications (RIAs) like AJAX, Flash/Flex or OpenLaszlo which support desktop-like, client-side functionality within a browser, including local persistence

for offline use, enriched graphics processing, integration with local devices and enhanced user experience. Without RIAs, application clouds such as Force.com and Google Apps would not have been possible. In addition, other advances such as hardware virtualization, multi-tenant architecture, parallelization engines like MapReduce and Hadoop as well as grid architecture are essential to support for the elasticity and scalability of the cloud.



A business case for using the cloud

A global logistics company, ESB, handles tens of millions of packages each day. To help prevent millions of dollars in lost revenues each year due to fraud, ESB looks for a solution that is capable of detecting duplicate barcodes on the shipments originated from different locations around

the world. Among its requirements are large data volumes and near real-time response. The table below shows a cost comparison among three different solutions.

These numbers represent a conservative estimate since they do not take into account

other costs, including energy, software licensing, and the time lost to setup and testing. The result (\$130,000 annual operating cost versus \$4 million upfront capital cost) clearly favors using Amazon EC2 over buying, installing and operating one's own servers.

On-premise approach	Using Amazon EC2 public cloud	Buying internal cloud
<ul style="list-style-type: none"> • SUN E25K: 72CPU + 1 TB memory • TimesTen In-Memory Database 	<ul style="list-style-type: none"> • 150 virtual servers 	<ul style="list-style-type: none"> • 150 servers
<ul style="list-style-type: none"> • Capital cost = \$4-plus million • License cost = \$1-plus million/year 	<ul style="list-style-type: none"> • Variable cost = \$131,000/year assuming 24x7x365 	<ul style="list-style-type: none"> • Capital cost = \$150,000
<ul style="list-style-type: none"> • Power cost = \$70,000/year • 40kW/hour + 40kW/hour 	<ul style="list-style-type: none"> • Power cost = 0 	<ul style="list-style-type: none"> • Power cost = \$39,000/year • 45kW/hour

Six major challenges

Just like other technological advances in the past, cloud computing brings major challenges as well as opportunities to IT organizations and businesses. While some of these issues are technical, for example, performance, others are more organizational, like in the case of data location. How well and how soon these issues are resolved will determine whether cloud computing will eventually live up to its lofty promises.

For most companies, the most important near-term concern is security, namely, how enterprise data is safeguarded in a shared third-party environment. Since their core business is based on securing customer data, major cloud providers have made big strides in this area. In fact, many of them offer more sophisticated end-to-end security and privacy protection than do the data centers in any single enterprise. To preserve the privacy of a customer's data, Amazon augments the standard hypervisor with its proprietary disk virtualization layer that automatically cleans up every block of storage used. The fact that major financial services firms like Citigroup have implemented SaaS solutions shows that the cloud has successfully passed early tests. The pace of future uptake will depend on when cloud providers will be able to obtain official certifications from independent third parties.

The second significant problem is around data, including data location, compliance and integration. Current cloud solutions require data to be stored in the cloud. This approach assumes that a company relies on only one or two providers at a time. Yet, the market is still extremely fragmented, with hundreds of cloud-based application providers, most specializing in a specific vertical market segment. Even though consolidation among providers is inevitable, user companies will probably still end up using multiple clouds. As a result, they will have to deal with data scattered across clouds,

not to mention the data residing behind the firewall in their own data centers. To complicate the situation, cloud operators must also meet government regulations requiring customer data (for example, banking and health) to reside within specific geographic jurisdictions. This fragmentation of data presents huge integration challenges and highlights the importance of developing a comprehensive enterprise architecture.

The third major challenge pertains to service level guarantees. Many enterprise applications require certain levels of service. In the traditional on-premise setting, these requirements are easier to satisfy because the IT department controls the physical and software environment in which the application runs. But this is not true for the cloud. Application cloud providers, which have control over the running environment, cannot guarantee response times because the data has to travel through the Internet. The challenge becomes even greater for the infrastructure cloud, since it essentially supports the software code from other organizations. Despite steady progress made by major cloud providers, this lack of service level guarantee will prevent critical enterprise applications from migrating into the cloud anytime soon.

The fourth major challenge is related to legacy systems. Legacy applications in general do not adapt well to the cloud. Since such systems are often critical to core business functions, today's cloud infrastructure simply lacks the service level to support them. In addition, many legacy applications are tightly coupled to the underlying system software and hardware. Without costly redesign, they cannot benefit from the virtualization and parallelization features of the cloud. The mere presence of legacy applications means

that a significant portion of IT in large enterprises will not be part of the cloud in the near future.

The fifth challenge concerns the actual purchase of cloud-based services. On the face of it, using pay-as-you-go IT services should be highly attractive from a procurement standpoint, moving payment and authorization processes from capital expenditure to operating costs. The procurement of cloud computing, and the whole concept of what an enterprise agreement looks like in a cloud environment, are sticking points that will not be resolved overnight.

The final challenge pertains to licensing. Traditional models of software licensing, based on named users, CPUs, or other metrics, do not translate easily to cloud computing. Calculating enterprise software licenses is difficult enough, and cloud computing, with its inherent elasticity and use of virtualization to scale up, introduces yet another variable, one that is nearly impossible for software vendors to account for and for customers to track. A new licensing model thus may be in order. The new model should address portability of enterprise licenses, so that they can be moved to run in the cloud. It will have to use new metrics such as software use per hour. Upgrades in support levels might be handled through tiered licenses. And the model should directly tie costs to support value, so that support covers ongoing upgrades.

Three steps CIOs can follow to take advantage of cloud computing

Under the current economic conditions, CIOs face more pressure than ever before to cut cost and to do more with less. The “pay-as-you-go” model of the cloud provides them with a potentially attractive option to defer, reduce or even eliminate certain capital spending without sacrificing service levels. Below are three steps for CIOs to take advantage of the cloud.

Build the business case first for each job that will use the cloud

Today’s infrastructure clouds offer a relatively inexpensive and flexible alternative to buying in-house hardware.

They are mature enough for non-business-critical projects including research and development and software development and testing. They are also well suited for computation-intensive jobs, such as data cleansing, data mining, risk modeling, optimization and simulation. A good way to start is to rank your applications by priority, on a scale of P1 (critical) to P6 (marginal). The best candidates for the cloud may be P2 or P3 applications, since success with these can have a large positive impact on value, but if something goes awry, a floundering P2 or P3 application won’t sink the ship.

Be selective in targeting users

Instead of buying or renewing software licenses for every employee in the company, switch workers to cloud-based solutions based on the type of work they do. For example, workers at contact centers and offshore locations are good candidates for using desktop clouds.

Take initial steps toward an internal cloud

One of the CIO’s top priorities is to continue improving the utilization of existing IT resources through virtualization and data-center consolidation. The same effort will eventually lead to an internal cloud.

A guide for action

Even though cloud computing is still at a nascent stage, businesses and government agencies should take steps now to reap some immediate business benefits. Here are a few ideas on how large organizations might begin to do that without undue risk.

Batch and data-intensive applications

Today's infrastructure clouds provide a relatively inexpensive and flexible source of raw computing power for batch-oriented jobs with self-contained datasets. They are especially suited for data-intensive applications that require heavy CPU cycles but not necessarily real-time network response. Examples of such projects include data conversion, cleansing and mining, data compression and encryption, simulation, risk modeling, and graphics rendering.

Software development and testing

For companies with large in-house software projects, moving to a cloud-based development environment makes sense because it provides more intuitive support for distributed projects and global collaboration. Because the project team can obtain development resources on the fly, it can also help minimize potential project delays. As a "virtual test lab," a cloud-based testing environment like SOASTA has a clear advantage for supporting realistic load and performance testing without requiring a cost-prohibitive infrastructure.

Research and development

R&D projects in large companies may also be good candidates for the cloud because they are highly iterative, demanding fast ramp-up and quick scale-up and down—both hallmarks

of the cloud. In fact, IBM's Smart Business cloud has its origins in an initiative that supports internal R&D projects. For the same reasons, advanced product development groups may also take advantage of the cloud to shorten time to market.

Business continuity and disaster recovery

Large providers of cloud services rely on highly distributed, robust and scalable infrastructure. They can store customer data redundantly in multiple physical locations. In the event of a disaster, such data will be more easily recovered than it would be in a typical enterprise data center. Thus, the cloud may also be used to back up business data in critical enterprise systems. Compared to the traditional approach, this type of solution supports quicker retrieval, faster recovery and lower cost.

Desktop productivity tools

Companies might be tempted to move commodity applications like e-mail and personal productivity tools into the cloud to save money and to meet the demands of younger employees. However, desktop clouds are not yet mature enough in terms of feature sets and service levels for such heavy business use.

At this stage, they are best used to augment rather than replace existing productivity suites. Depending on the type and style of work, it makes sense to target select groups for such applications. Offshore and contact center employees are good candidates. Groups that already use other cloud applications may also find desktop clouds appealing.

Peak load demands

There are two broad types of peak load demands: predictable and unpredictable. A good example of predictable peak demand comes up when IT groups at financial service firms have to handle the rush of year-end statements. Similarly, IT departments at large retailers must plan for peak demand during holiday sales periods. In such cases, the cloud can be used to accommodate demand.

Unpredictable peak load is more complex. It requires dynamic load balancing between the applications running on in-house data centers and external clouds. While such software exists, it is not yet ready for widespread use. As these products mature, companies should be able to plan for their internal data center capacities based on stable demand instead of peak numbers. Together with the broad adoption of virtualization, this trend could lead to drastic improvements in the utilization of data center resources.

Public cloud versus private cloud

A common misperception about cloud computing is that eventually there will be only a handful of clouds, all of which are public. That is highly unlikely given the complex IT needs of the typical large enterprise. While some general-purpose public clouds will exist, two other types of cloud are likely to emerge. One type, "specialty clouds," will cater to the particular needs of a select group of organizations, an industry or even a country. For example, a health care cloud based on a central or federated repository of electronic patient records (such as Microsoft Health Vault or Google Health) would bring together payers, providers, drug companies and health care consumers.

In addition, some large multinationals are choosing to build and operate their own "internal clouds" while continuing to tap into external cloud sources. That way, they have more control over service quality, data and other important variables. For example, Bechtel, the big construction and engineering company, created an internal cloud infrastructure serving up in-house applications on demand, in order to more effectively support projects increasingly executed in far-flung geographic locations. Bechtel CIO Geir Ramleth describes the internal cloud as "an enabler and precursor to [embracing] third-party SaaS offerings in the future."⁴

⁴ www.cio.com/article/453214/Cloud_Computing_to_the_Max_at_Bechtel.

Executives considering how to proceed with cloud computing should address several strategic questions, in order to assess the gap between future needs and current technology capabilities:

- Which existing applications should be migrated to the cloud? How ready is each application to move?
- What infrastructure opportunities exist in the cloud? What business development opportunities?
- What technologies are required?
- What specific business benefits can be gained?
- What new analytics can be performed?
- What costs or savings will be incurred?



Three reasons why CEOs should care about the cloud

To compete effectively today, CEOs need every edge they can get, from low cost to speed and employee productivity. As IT becomes a utility, it is now possible to focus more attention on using IT to create business value. CEOs may find that the cloud in particular can contribute to their agenda through the following three areas:

Faster entry into new markets

One key advantage of the cloud is elasticity. By tapping into right cloud capabilities, companies can quickly enter new markets or launch new products or services in existing markets.

As demand grows, they can quickly scale up. Conversely, when opportunities dry up, they can just as quickly scale down with minimum waste of time and capital.

Faster and better innovations

CEOs increasingly recognize that the traditional closed innovation model is no longer adequate to keep up with the rapid pace of today's market. By using cloud-based solutions, companies are able to open up innovation to more employees, customers, partners and even the public

around the globe so that they can harvest better ideas faster.

Improving worker productivity

To attract top talent and stay close to local markets, most companies must deal with a globally distributed workforce. The on-demand nature of cloud computing allows companies to provide their workforce with tools, applications and infrastructure necessary to do their jobs.



Cloud computing will have a major impact on enterprise IT as it transforms to fulfill its role of enabling high performance within a rapidly changing business environment. With the unprecedented economies of scale and elasticity of the cloud, companies will no longer be limited by their in-house capabilities. Instead, IT will become a dynamic resource that adapts automatically to business demand. By relying on the standard Web platform, the cloud will also help improve collaboration, access, and overall user experience. Business users will be able to buy, share, customize and even create their own applications directly. Collectively, cloud capabilities will help reshape IT into a true utility that enables businesses to innovate faster and compete more effectively.

Just as the shift from isolated power generation to an electricity grid took several decades to make an impact nationwide, so IT's migration into the cloud will take years. Significant uncertainties and challenges lie ahead—both technological and organizational. However, those uncertainties should not prevent companies from using the cloud to meet their short-term IT and business needs. For example, companies with one-off applications can immediately benefit from Amazon EC2 and S3 clouds. Existing or prospective customers of salesforce.com should consider leveraging the Force.com platform and integrated Google Apps

to further extend core CRM capabilities to other application areas, such as collaboration.⁵ Over the long run, large companies may find that the hybrid approach from Microsoft and IBM offer the most sensible way to accommodate their on-premise legacy and growing cloud-based applications. The pace of engagement with the cloud needs to quicken, so that companies can reap the advantages in cost, agility and time to market.

⁵ Salesforce.com and Google recently announced a partnership which allows Force.com users to natively integrate Google App's capabilities, such as Gmail, GTalk and calendaring, into their own applications.

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Accenture Technology Labs, the dedicated technology research and development (R&D) organization within Accenture, has been turning technology innovation into business results for more than 20 years. The Labs create the Accenture Technology Vision, a view of how technology will shape the future and invent the next wave of cutting-edge business solutions. Working closely with Accenture's global network of specialists, Accenture Technology Labs helps clients innovate to achieve high performance. The Labs are located in Chicago, Illinois; San Jose, California; Sophia Antipolis, France; and Bangalore, India. For more information, please visit our website at www.accenture.com/Global/Services/Accenture_Technology_Labs.

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Accenture is a global management consulting, technology services and outsourcing company. Combining unparalleled experience, comprehensive capabilities across all industries and business functions, and extensive research on the world's most successful companies, Accenture collaborates with clients to help them become high-performance businesses and governments. With approximately 177,000 people serving clients in more than 120 countries, the company generated net revenues of US \$21.58 billion for the fiscal year ended August 31, 2009. Its home page is www.accenture.com.

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