

# Cloud Computing: Preparing for the Future

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Organizational leaders need to understand and prepare for the next major step in the evolution of technology and business collaboration – a change that eventually could have as much impact as the Internet.

Since 1960, information processing has moved from mainframe computing to personal computers to server-centric computing and to the Web. Now cloud computing is poised to change how most organizations conduct business within the next decade. Like its predecessors, cloud computing will have significant repercussions for society, laws, employment, and the environment.

Various definitions of cloud computing have been put forth during the past few years. The working definition put forth by the National Institute of Standards and Technology (NIST) has gained wide acceptance: “a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.”<sup>1</sup>

For purposes of this article, cloud computing refers to a computing resource deployment/procurement model that enables an organization to obtain its computing resources and applications from any location via an Internet connection. The computing architecture, applications, and data an organization requires to operate may or may not reside in the organization’s infrastructure or on its premises.

In CIO circles among Fortune 500 companies, cloud computing has been a topic of discussion for the past few years. Well-recognized companies such as Akamai, Amazon, Google, Hewlett-Packard, and IBM are marketing sophisticated and robust cloud solutions in the marketplace.





The following are several examples of organizations already using cloud computing solutions:

- NASDAQ and The New York Times use Amazon's Elastic Compute Cloud (EC2) and Simple Storage Service (S3) solutions to augment their computing and storage resources. The Times can convert 15 million news stories into PDFs for online distribution in a matter of minutes. NASDAQ uses S3 to deliver historical stock and mutual fund information, rather than add the load to its own database and computing infrastructure.<sup>2</sup>
- General Electric uses software-as-a-service (SaaS) solution via a cloud computing platform from Aravo for its supply chain process, in which thousands of users and suppliers transact business around the world.<sup>3</sup>
- The city of Los Angeles has replaced its Novell GroupWise® e-mail and Microsoft® Office applications with Google Apps. Under the \$7.25 million plan, the city moved about 34,000 users to Google's e-mail and office productivity products.<sup>4</sup>
- Eli Lilly used Amazon's EC2 service to launch a 64-machine cluster computer to work on bioinformatics sequence information. The EC2 service cuts the time to install the machine cluster from 12 weeks to 20 minutes.<sup>5</sup>

Organizations are trying cloud computing for two primary reasons: to save money by avoiding inherent IT infrastructure and support costs and to address the business demand for speed of computing resource fulfillment.

## The Projected Direction

Cloud computing is not just a technological change. It will ultimately change the way organizations operate internally and externally. In the cloud computing world, merely having technology and robust application systems does not provide a competitive advantage. Computing power is destined to become a necessary utility like electricity and water. As cloud computing becomes part of the business mainstream, the number of individual data centers throughout the world will drop significantly. Instead, organizations will need to draw their competitive advantages from the employees who can best harness and adapt computing resources from the cloud to meet their organizations' needs and business objectives.

The respondents to an InformationWeek Analytics survey<sup>6</sup> of organizations receiving or considering services from a cloud provider indicated that their organizations likely will move to the cloud environment for these uses (listed from very likely to not at all likely):

1. Storage, archiving, and disaster recovery;
2. Business applications;
3. Services;
4. Raw computing power;
5. Dedicated data-center space;
6. Databases; and
7. Specialized IT services such as security, management, and compliance.

The factors driving the adoption of cloud services are generally the same regardless of organization size. Executive leaders in small businesses list cloud computing as a priority at the same rate as executives with large companies. In fact, with cloud computing, small businesses are likely to enjoy new computing services and benefits that investment constraints previously had made unavailable to them.

## Cloud Computing Deployment Models

Cloud services are deployed and characterized in four primary ways, according to the NIST.<sup>7</sup> Organizations must choose one of the deployment models – each of which comes with a number of benefits and risks.

1. **Private cloud.** The cloud infrastructure is operated solely for an organization. Managed by the organization or a third party, it may exist on or off the premises. A private cloud is sometimes referred to as a virtual private cloud or VPC.
2. **Community cloud.** Several entities share the cloud infrastructure, which supports a specific community that has shared concerns (such as a mission, a policy, security requirements, and compliance considerations). Managed by the organizations or a third party, it may exist on or off the premises.
3. **Public cloud.** The cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services.

4. **Hybrid cloud.** The cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that makes data and application portable.<sup>8</sup>

No specific model is necessarily the best. The optimal model will depend on an organization's needs and priorities relative to costs, security, and the degree to which it needs to control its information technology.

## The Benefits and Risks of Cloud Computing

Owning and operating its IT function is costly and time-consuming for any organization. Complex IT infrastructure decreases an organization's ability to respond to business needs quickly and limits its agility and growth. These limitations can drive organizations to cloud computing.

Some of the typical benefits that make cloud computing attractive to organizations are:

- **Cost savings.** Both cloud providers and customers realize cost savings. Customers pay only for the capacity they use and are freed from expenditures related to purchasing and maintaining their own hardware. They can pay on a subscription basis (for example, a two-year contract with monthly payments) or enlist in a pay-as-you-go model. For providers, cloud computing takes advantage of scale and higher rates of resource utilization.
- **Speed of deployment.** Computing resource fulfillment via a cloud provider can be much quicker for an organization than developing its own applications or building a data center from the ground up.



- **Scalability and resource flexibility.** Large organizations can shift resource use among server farms and data centers, maintaining higher availability and reliability. Customers can ramp up capacity from one to 20 servers without the need for incremental lump-sum capital spending. They are not forced to purchase excess capacity for infrequent high-demand periods.
- **Operational benefits.** A cloud-based system, with a robust, massive, and redundant infrastructure, will provide greater uptime and availability. Further, cloud services start with a prebuilt foundation of technology, which facilitates better organizational support. This foundation makes providing computing resources easier, in turn paving the way for more consistent technology upgrades and expedited launches of new IT projects.
- **Collaboration and community computing.** Collaboration and community computing allows multisource input and multiparty computing – benefits that are not attainable with local computation only. An example is cloud-based threat services such as distributed denial-of-service (DDoS) attacks or spam detection. A cloud service, which has a wider view of the Internet traffic, would see the onset of an attack more quickly and accurately than any local threat detector.
- **Environmental and green benefits.** If every organization no longer requires a private data center, significant savings in power consumption, carbon emissions, and use of physical land will accrue.



- **Tax and accounting benefits.** An organization that obtains all of its computing resources from a cloud service provider can expense all of the dollars it would have normally had to capitalize/amortize for traditional data center architecture.  
Before engaging in cloud services, an organization should conduct a risk assessment. It should also conduct periodic assessments after adopting the cloud computing model. In any cloud scenario, these risks should be evaluated and addressed to the satisfaction of management:
- **Reliability concerns.** IT departments are often evaluated by uptime metrics. Although service-level agreements can be structured to meet the demands of various customers and downtime is likely to be less with cloud computing, an organization should anticipate some level of failure.
- **Performance issues.** Applications that require very high performance are unlikely to be deployed in a standard cloud solution. Proprietary servers may need to be optimized to serve certain high-performance applications in a power-efficient manner.
- **Security and compliance concerns.** Several issues arise related to the security and retention of certain information. For example, regulations related to the *Sarbanes-Oxley Act*, the *Health Insurance Portability and Accountability Act*, and the various data privacy laws of different countries must be considered. In the cloud, data is usually located on hardware outside of the organization's direct control, which could make compliance difficult.



- **Creation of a high-value terrorism target.** If cloud computing is adopted widely in the future, the infrastructure and vendors delivering cloud computing resources could become very attractive targets for terrorist organizations; the data and resources stored in a cloud would be vulnerable.
- **IT organizational changes.** The adoption of cloud computing by an organization reduces the need for its own private technology deployment, application development, and maintenance staff. The morale and dedication of any IT personnel who remain in the organization could be diminished.
- **Increased reliance or emphasis on data classification.** Cloud computing will compel organizations to truly understand the nature of their data in terms of importance, sensitivity, location, and permitted access. In many organizations today, managers can take reasonable comfort in thinking that their data is contained somewhere in their organization's infrastructure (unless it has been outsourced) and that only organization personnel have access to it – assuming that reasonable actions have been taken to configure firewalls and secure in-bound public Internet connections. This level of comfort could change dramatically when all of the organization's data is stored in the cloud.

## The Questions Management Should Be Asking

When a major shift in the way business is conducted is on the horizon, critical questions must be addressed prior to making the decision to change. Although the answers will vary by organization, we recommend that management reach definitive and satisfactory answers for the following questions before embarking on their cloud journey.

*An organization with multiple data centers, off-the-shelf software, a backlog of projects, or widely fluctuating computing needs should consider cloud computing*

### What are the costs and benefits?

For each computing option, an organization needs to determine which choice yields the greatest benefits in relation to the costs. This can be determined by comparing the costs of its current computing model with the projected costs of cloud computing (including the cost of real estate, IT personnel, electricity, hardware, software, and networks). The organization should also compare the current benefits with the projected benefits (such as delivery speed, tax benefits, and overall savings in terms of cost of ownership).

**When does it make sense to adopt the change?** Considering cloud computing options is likely to make sense if the organization:

- Has many separate data centers;
- Uses off-the-shelf applications with minimum required support;

- Has a significant backlog of application maintenance and implementation projects for which its current personnel resources are insufficient, and it is anticipated that more computing power will be needed when the upgraded application set is deployed in the future; or
- Has computing resource needs (that is, personnel and infrastructure resources) that fluctuate significantly throughout the year or has computing resource needs that go below a utilization rate of 50 percent.

**Who would the change affect?**

If the organization relies on SaaS cloud computing vendors for its applications, its need for in-house application programmers will greatly decrease. The need for an in-house help desk support group may also decrease.

**What additional skilled personnel would be necessary to succeed in using and supporting the organization with this new solution?**

In the cloud computing paradigm, organizations will need employees with expertise in:

- Contract management;
- Service-level evaluation;
- Data logistics;
- Legal compliance;
- Data significance;
- Current services and solutions available through cloud technologies and service providers; and
- Application levels and cloud solutions in terms of how they can be applied to improve or replace existing business processes.

**What preparations would a successful transition require?**

Much of the preparation will relate to personnel with new skill sets and some additional oversight and monitoring processes, especially if the organization is using a third-party cloud service provider. Consolidating data centers into a private cloud or outsourcing a significant portion of the organization’s IT function to a third-party cloud provider increases the risk of a single point or consolidated point of failure.

To minimize the associated costs of failure, an organization should evaluate its current business interruption insurance coverage, make alternative arrangements with other sources for cloud computing support in case the primary source is down or evaporates, and scrutinize the liability clauses in any third-party cloud computing contracts. A good contract with explicit stipulations for service levels and succinctly defined policies related to liability and data ownership is just the beginning. Precise measures of success for the organization’s computing needs also should be defined and used to evaluate the cloud service provider on a regular basis.

The organization might need to add new functions when it reaches a certain level of cloud dependence. New job descriptions might include:

- A cloud contracts/supplier manager to handle dealings with cloud suppliers, legal contracts, and the ongoing evaluation of service levels and performance of cloud suppliers;
- A chief data officer to help ensure that processes and appropriate

actions are taken in classifying all data and to know the resident locations of the organization’s data, who should have access to the data, and the levels of access; and

- A chief cloud technologist/officer to monitor the changing needs of the organization, as well as its core operational and business objectives.

**What process changes would maximize the benefits of the new paradigm?**

This question is probably the most challenging. To date, cloud computing has changed the processes for e-mail, supply chains, education and training, and on-demand simulation and testing environments for evaluating applications and processes. On the personal consumer side, the delivery of entertainment media and provision of electronic gaming environments are already accomplished to varying degrees with cloud computing.

The processes yet to be born are limited primarily by imagination and the ability of employees to change how they perform current processes. Processes that would be improved by greater deployment speed, collaboration, resource flexibility, or a significant decrease in upfront investment for equipment and infrastructure are likely to benefit from the deployment of a cloud solution.

For example, when a merger or acquisition occurs, the IT departments of the merged entities must integrate their technologies. Often the entities continue to maintain autonomous data centers, with distinct application bases joined within a common network. Another scenario is the “conversion” of one organization’s technology platform (for example,

PeopleSoft) to the other organization's platform (for example, SAP). In this case, the chosen platform would require additional computing power, which might divert IT employees of one or both entities from other work to handle the conversion.

But what if a single, united technology base is built in the cloud? Contract resources familiar with the chosen technology base could configure the application base, and the merged entity could choose an internal entity to carry out planning and strategic tasks. In this scenario, the data centers and personnel of each entity could continue to operate as usual with minimal disruption. Testing and user training could be carried out in the cloud with no disruption to the present infrastructure. Once everyone is satisfied with the new computing environment, all business processes could be switched to the cloud solution for any or all parts of the newly merged entity.

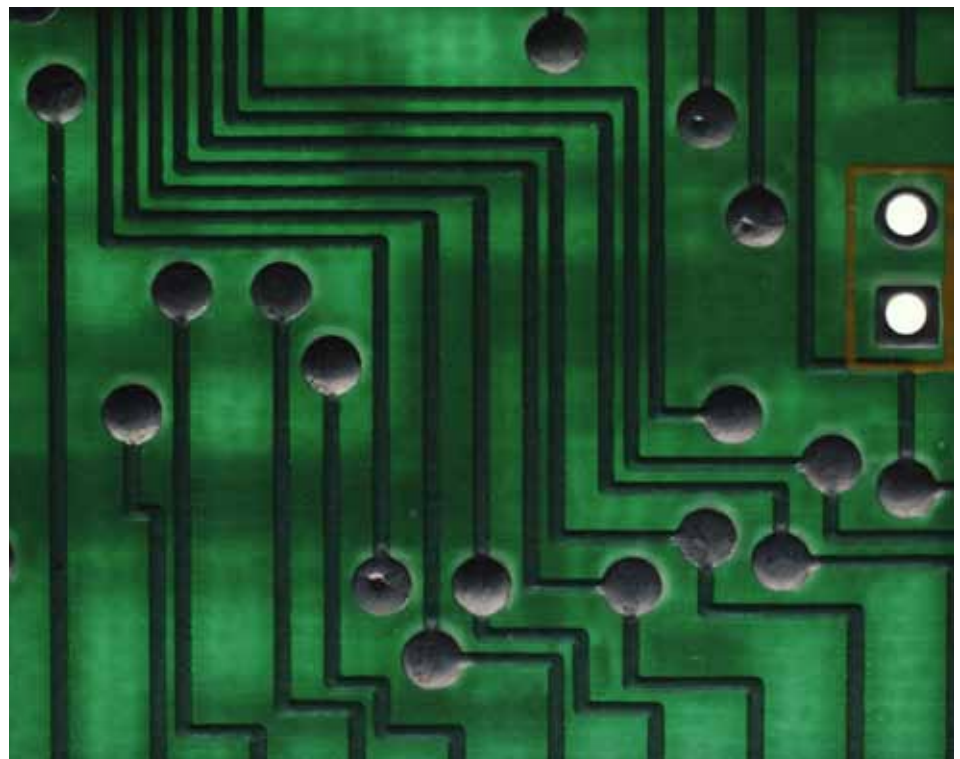
## Here to Stay

Now in an exciting period of growth and high potential, cloud computing will undergo many changes during the next several years before it becomes the norm among businesses. Truly, however, it is not a matter of *if* cloud computing will become commonplace; rather, it is a matter of when.

Peter Fingar might have summarized the future of cloud computing best in his book *Dot.Cloud*: "The Cloud isn't just about technology; it's about a new platform for human interactions in business, that, in turn, requires new organizational structures and styles and new team behaviors."<sup>9</sup>

An increasing number of organizations are now implementing some form of cloud computing, often testing the waters with a simple single application such as e-mail. As management's comfort level rises, so will the cloud computing adoption rate and the variety of applications that make the transition.

Although cloud computing will continue to offer many organizations benefits that justify the transition, the new paradigm will not relieve an organization of its technology concerns. Moving to cloud computing is merely the start of a new journey that requires an organization to plan far in advance as well as to check in periodically to ascertain whether it's still heading toward where it wants to be tomorrow.



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