

The Future of Cloud Computing: Could the Sky Really be the Limit?

By

Erik A. Swords

Director

Senior Research Analyst

Additional Contributors:

Matthew D. Griffin, CFA

Barry K. Mills, CFA

Introduction

We are beginning to see a significant shift in the information technology (IT) computing model, with this transition continuing to occur over the next five years as IT organizations focus on lowering costs and creating more efficiencies within their businesses. There are several drivers inciting this transition including technological advancements, the high costs associated with the traditional enterprise software model, a lack of infrastructure flexibility and the aging hardware installed base. Most recent industry forecasts for Cloud Computing estimate the market will nearly triple from its current size to more than \$150B by the end of 2013, creating significant growth opportunities for both new and existing technology vendors that have strategically aligned themselves with this ongoing technological shift. In this paper, we will define Cloud Computing, the characteristics of its model, the market opportunities, the key players, the known drivers, and the key risks.

Any statements of opinion constitute only current opinions of The Boston Company Asset Management, LLC (TBCAM), which are subject to change and which TBCAM does not undertake to update. Due to, among other things, the volatile nature of the markets and the investment areas discussed herein, they may only be suitable for certain investors.

What is Cloud Computing?

“Cloud Computing is a style of computing in which scalable and elastic IT-related capabilities are provided, as a service, to customers using Internet technologies.” – Gartner

Cloud Computing has become somewhat of a muddled concept during the past few years as different constituencies have attempted to steer the definition toward their own business interests. However, reality is that most consumers have a much better understanding of this concept simply because, in most cases, they are already using some of these technologies at home. Over the past decade, consumers have grown accustomed to utilizing Cloud Computing technologies through accessing online email (Yahoo! Mail, Gmail, etc.), music services (iTunes, Rhapsody, etc.), online banking, and many other venues that capture the essence of what the Cloud Computing model represents. Most of these venues offer some sort of service, an appealing user interface, mobility options, and metered usage (in some cases).

The major distinction that we address in this paper is how these trends relate to the business enterprise as opposed to consumers. It has become clear that most enterprises are well behind the adoption curve, although they have the most to potentially gain by utilizing this type of model. There are several key attributes to the Cloud Computing model that will accelerate enterprise adoption rates in the years to come: a compelling consumption model, greater flexibility, and increased usage among available users.

Consumption model. One of the most appealing attributes of the Cloud Computing model is “metered use.” In its simplest form, it effectively means that customers pay as they go in terms of usage of the technology. The model is evolving dramatically, to a point where enterprise customers can now pay for what they are using – whether it is access to an individual software application to a suite of software products, or hosting a single website or running an entire corporate infrastructure. Most of the usage models today translate into a fairly straightforward revenue model for the providers. They generally range from a clear-cut subscription model (monthly, quarterly, or annual terms) to models that are specifically based on usage over the course of a month or quarter and billed to the customer in arrears.

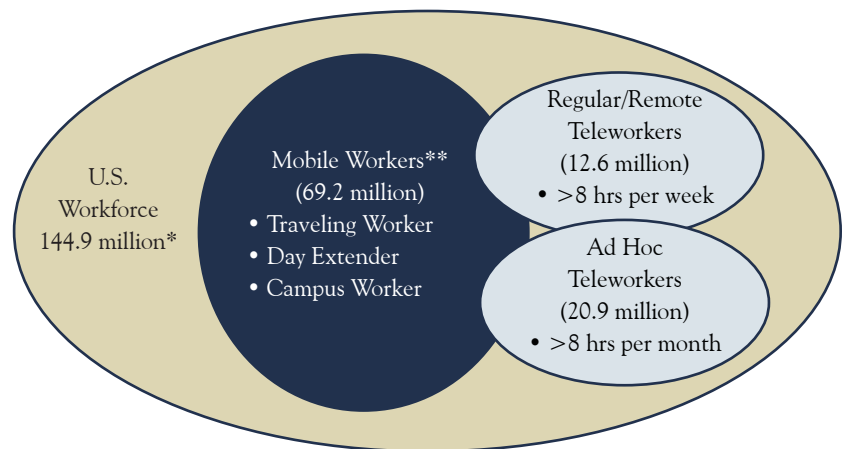
Another interesting topic around the change to a more effective consumption model is the potential shift towards an internal IT Chargeback System. This system, which is sometimes referred to as “responsibility accounting,” provides much greater detail about specific usage. This model can be as simple as assigning a cost for a monthly subscription to a given department or as complex as running an entirely outsourced infrastructure that is billed to appropriate department(s) as needed. In effect, it creates much more department-level accountability and provides decision-makers a better glimpse into a cost/benefit analysis at the department level. In

contrast, most decisions within a traditional IT business model are made at the corporate level which is thought to be more of a capital expenditure decision. The primary issue we see with the legacy model is transparency into who within an organization is incurring the most costs. Therefore, the combination of a more efficient consumption model, coupled with a chargeback system, is very appealing to corporate-level executives looking for the most insight into their own business model.

Greater Flexibility. This is a wide-ranging topic, but we feel it is appropriate to highlight two ongoing trends: 1) workforce mobility, and 2) the balance between the push/pull models within the enterprise.

1. **Workforce mobility.** By the end of 2010, approximately 1.2 billion people will be carrying handsets capable of running rich media. Similarly, a study done in 2006 by Gartner showed that of the 145 million US workers, almost 50% were considered mobile workers (Exhibit 1). In our opinion, this trend will continue for the foreseeable future and it highlights the need for greater IT infrastructure flexibility. While most corporate users today have some form of internet access, whether it is through a smart phone or mobile laptop, the ease of accessing a corporate network is still troubling. In a connected cloud, most corporate users will only require an internet connection and a browser to access the same types of applications utilized on the corporate network without having to utilize a VPN. Separately, the extension of these applications into the smart phone environment is accelerating. This trend is a direct reflection of IT departments attempting to ease the pain of those in the mobile workforce.

Exhibit 1



*Source: Bureau of Labor Statistics (Sept. 2006)

**Gartner definition: Mobile worker is an individual who is away from workstation/desk for more than 8 hours per week.

2. **Push/Pull model.** We believe that consumer awareness around products and technology is beginning to shift the traditional corporate push model into more of a balanced push/pull model. The primary reason for this shift is because the barriers to trial products have been almost entirely torn down. Any willing corporate user can try out a product due to extremely low costs and report back to IT departments with results. This was simply not the case when an effort to trial most software products would almost require a corporate customer to convince their IT department to either replace something existing, or build new infrastructure to support their new endeavor. Therefore, we believe the transition towards more of a balanced push/pull corporate model will accelerate the adoption of Cloud Computing.

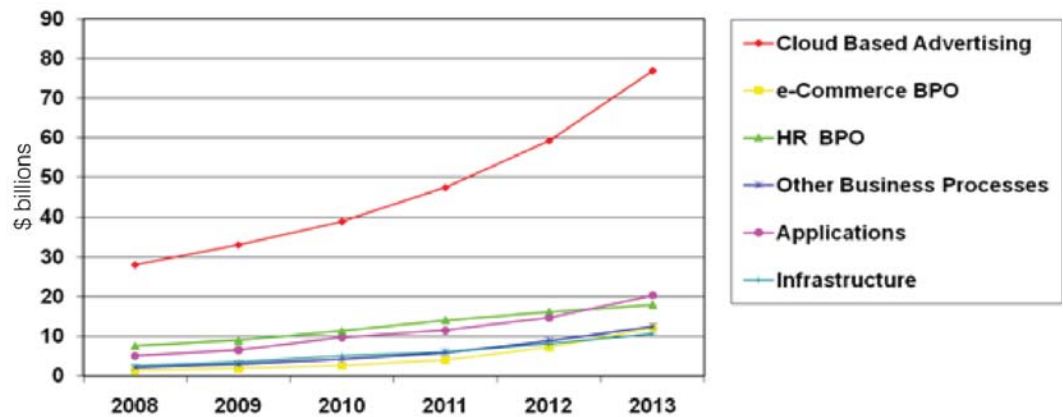
Increased usage among available users. Based on our experience in the software industry over the past decade, we have consistently heard that most software applications within an enterprise only touch between 10-25% of their available users. There are several reasons why this is the case, but we would primarily attribute this low usage to job-specific roles, infrastructure requirements, security, and the pen-and-paper methodologies long used in employee interactions. The use of Cloud Computing technology circumvents many of these problems and significantly broadens the scope of who is an available user – a point that we feel is significant to the success of Cloud Application providers.

A good example of how this works is at The Boston Company Asset Management, LLC, and its parent company, Bank of New York Mellon (BK), which in 2009 streamlined their performance measurement reviews through the use of a performance management software-as-a-service vendor. Prior to using this technology, the process was a combination of paper-based and emailed documents that would be passed around among HR, Managers, and employees. This new vendor allowed BK to streamline the process from HR to managers and employees by moving all of the related documents to the internet while consolidating workflows as the documents were passed to the appropriate people. In addition, it allowed for customized goals from the corporate level to be populated into the performance measurement reviews of all individual workers. As a result of BK's adoption of this product, the annual review process took much less time, lowered costs, allowed for online storage of reviews, and eased the typical employee headaches through the creation of simple customized templates. Interestingly enough, over 95% of The Boston Company's employees used this technology during the review process – a feat only ever accomplished through its use of the current email system.

The Cloud Computing Opportunity

The potential size and growth rates associated with Cloud Computing are expected to climb over the next several years. Below (Exhibit 2) is a chart that plots the course of the expected market sizes for sub-segments within the total Cloud Computing market.

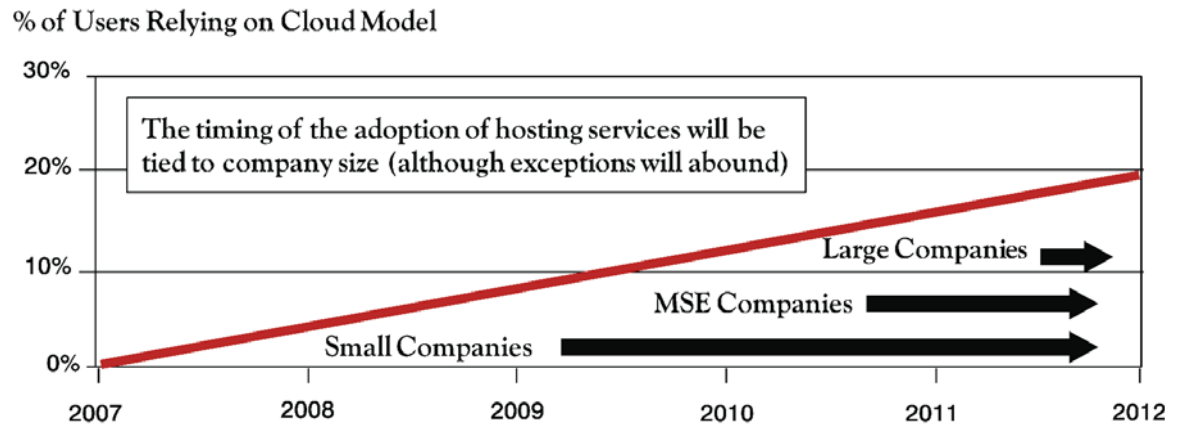
Exhibit 2: The Cloud Market



The Cloud-based advertising model is the largest segment in the Cloud market, which we view as a strategic positive, as companies who have been truly internet-centric (i.e. Google) use their experience in the search and advertising markets to fuel investments in other areas of the Cloud market. The applications market, where we feel significant opportunities remain ahead, is expected to grow from an \$8B market in 2009 to over \$20B by 2013. Putting this growth in perspective, Gartner has estimated the total applications software market (on-premise and Cloud) to be approximately \$115B by the end of 2013, implying only 17% penetration into the available market. Needless to say, we feel very good about the long-term potential of the Cloud-based applications market. The infrastructure market, while still relatively immature, has the opportunity to grow into a market that is estimated to be over \$170B by the end of 2013 based on Gartner's forecasts. Within the Cloud Computing framework, Gartner is estimating a \$10B market opportunity by the end of 2013. This forecast has significant room for upside as Cloud Computing strategies take hold over the next several years.

Still, industry data suggests adoption rates are still relatively low (Exhibit 3). Immediate movement will occur in the small and mid size business segment, followed by the large enterprise segments over the ensuing two years, which is where we think the bulk of the opportunity can be captured.

Exhibit 3: Cloud Adoption - Rapid Growth Predicted



Source: Gartner

The Landscape and Key Players

We think the Cloud Computing matrix below (Exhibit 4) captures most of the relevant players – both public and private – and identifies where they fit in within the Cloud environment.

Exhibit 4: Current Public Company Cloud Computing Matrix

SaaS	Adobe Ariba Citrix Concur Constant Contact DemandTec Google IBM Intuit Kenexa Microsoft	Netsuite Oracle RightNow Salesforce.com SAP Success Factors Symantec Taleo Vocus Workstream
PaaS	Adobe Google IBM Informatica Intuit	Microsoft Netsuite Oracle Red Hat VMware
IaaS	Amazon Accenture Akamai AT&T BMC CA Citrix CSC Dell EMC Equinix	Google HP IBM Informatica Microsoft RackSpace Savvis Terremark Unisys Verizon Wipro

Source: TBCAM and Lazard Capital Management

We have determined three distinct categories of these players: mature companies with significant opportunities, pure-plays, and peripherally involved vendors with ample opportunities.

The relevant mature companies who have been investing in this technology and have the potential to capture Cloud Computing opportunities over the next several years include: Microsoft, Google, Cisco, IBM, Oracle, Adobe, HP, EMC, and Amazon. Pure-play vendors who currently have the most meaningful presence within the space include: Salesforce.com, VM Ware, Taleo, Concur, Constant Contact, Netsuite, Citrix, RackSpace, Terremark, and Equinix. Finally, there are several other vendors who have been increasing investments and the capabilities of building a meaningful presence as the Cloud Computing paradigm shift occurs. Those companies include: BMC, CA, Informatca, Accenture, CSC, AT&T, Verizon, Red Hat, and Quest Software.

The Emergence of Multiple Cloud Models

There are three types of Cloud Computing models that have been defined by most industry analysts: Software-as-a-Service (SaaS), Infrastructure-as-a-Service (IaaS), and Platform-as-a-Service (PaaS).

Software-As-A-Service (SaaS)

Also known as the “on-demand” model, SaaS is currently the fastest growing segment within software, with a market that is estimated to grow from approximately \$6.5B in 2009 to \$32B by 2013, a 32% CAGR (Gartner).

We believe SaaS is the most visible Cloud technology today. Its roots can be traced back to the days of the hosted software model (also called the ASP model) in the 1990s and subsequently reborn in the early 2000’s by technology evangelists such as Marc Benioff (CEO of Salesforce.com). The key premise behind this decision to transform the legacy-hosted software model was that the value proposition contained within the traditional enterprise software model was starting to deteriorate significantly.

Simply put, SaaS is a way for software customers to essentially outsource different components of their application software stack (CRM, SCM, ERP, HR, etc.) to a third party (in most cases the vendor supplying the software) acting as the host. Generally, customers are charged a setup fee and a monthly subscription depending on their level of service and the numbers of users who are accessing the service.

The value this new delivery mechanism creates for a customer is substantial and it is in direct contrast to what has become known as the traditional enterprise software model. The most significant benefit is a reduction in Capex spending. Specifically, it means a customer no longer needs to purchase, operate, and/or maintain

their infrastructure in order to run necessary business applications because it is provided to them through the third-party host. The second benefit is a significant reduction in human capital within IT departments. This reduction will typically span from support roles and network engineers to development personnel who are not as critical within an outsourced model and can typically be moved offshore, creating labor arbitrage. Another key benefit is a significant increase in flexibility. The subscription (or pay-as-you-go) model enables a customer to turn on/off access to the service with much lower penalties. This ability is in stark contrast to the historical model, in which an enterprise would own the infrastructure and associated software licenses for its users, and its ability to curb costs in order to adjust to business conditions was severely limited.

Exhibit 5: Comparison of SaaS vs. Traditional Enterprise Software

	On-Demand Software	Traditional Enterprise Software
Typical Software Pricing	Under \$250 per month	\$50,000 - \$1,000,000+ up front
Hardware Requirement to User	None	Extensive
Implementation Time	1-180+ days	5-30+ months
Support Contract Cost	Included in subscription	15-25% of license annually
Internal IT Requirement	Minimal	Very high
Upgrades	Seamless	Disruptive
User Interface	Web browser	Proprietary

Source: UBS

As pointed out earlier, some dissenters have suggested this new delivery model is very similar to the legacy ASP model that effectively failed in the prior decade. While the comparisons are true in some cases, the new model is strikingly different when considering the underlying technological backbone that is in place today. The simple fact is the IT infrastructure that was in place supporting the old ASP model was not sophisticated enough to make success a reality. Issues such as narrowband internet access, mobility, security, and lack of PC functionality were all significant barriers that were never overcome.

Platform-as-a-Service (PaaS)

We view the PaaS model as loosely related to the traditional middleware layer of an enterprise software stack, as it generally sits underneath a stand-alone SaaS solution and offers developers a platform to exploit and distribute their applications. The parallels we would draw to the traditional enterprise model would be products such as .Net, Java, and Open Source – all programming languages used to write application code and help applications talk to one another. Beyond that, the lines begin to blur because in many ways the PaaS model has essentially combined with the SaaS model as companies look to broaden the scope of their application and platform models. A familiar example of a PaaS in the consumer world is Apple’s

(AAPL) App Store. A consumer buys an iPhone then has access to hundreds of thousands of applications that are approved and distributed through Apple's App Store, all of which equates to the underlying Apple platform. As another example, Salesforce.com's (CRM) Force.com platform serves as a proprietary development tool kit called Apex while its AppExchange platform serves as a distribution mechanism for developers. Importantly, these two capabilities enhance the value of the company's core Sales Cloud product offering as developers have an increasingly significant audience.

We've identified one of the key enterprise vendors in this segment as Salesforce.com (CRM), but there are several others who are gaining traction and have a significant vested interest. Microsoft, through the use of their Azure platform, is looking to help enterprise customers make the shift from on-premise to Cloud Computing while retaining their customers and keeping the development community intact. Similarly, Google is attempting to build out its enterprise presence through their AppEngine platform which generally gives more programming language flexibility to developers. Smaller companies such as Netsuite and Taleo are all trying to create similar environments which are off-shoots from their core product offering, but dovetail into what can be considered a platform.

Infrastructure-as-a-Service (IaaS)

The IaaS model is in earlier stages of deployment, but we expect it to be correlated with broader-based cloud computing adoption. The underlying concept within IaaS is a third-party vendor that provides all of the equipment used to support a typical enterprise infrastructure. More specifically, this includes servers, storage, networking and hardware components that may be used singularly or combined. Two primary reasons this concept is compelling are: 1) it requires essentially no up-front capital investment, and 2) pricing is based on consumption. Beyond that, other items such as automating administrative tasks, upgrading equipment and the lack of need for data center space (including rent, energy consumption, etc.) are all elements that support this type of infrastructure model. Since this segment is still in the earlier stages of evolution, we have seen a vast array of companies who are involved in some capacity. Examples include: Microsoft (MSFT), Amazon (AMZN), RackSpace (RAX), TerreMark (TMRK), EMC (EMC), and Google (GOOG).

Factors that lead us to believe that Cloud Computing adoption will continue

There are several factors that lead us to believe that the opportunity for Cloud Computing remains compelling. The high costs and low flexibility associated with the traditional enterprise software model, the fact that virtualization is now a reality and serves as a key enabling technology for the Cloud model to be built, and companies' aging hardware-installed base are all reasons for IT managers to

reevaluate their infrastructure decisions. We view these factors as the perfect storm for rapid adoption as hardware is less efficient and not cost effective, while new technologies offer significant cost savings. Additionally, most companies aren't satisfied with their current software stack as a result of the cost burden and lack of flexibility. Each of these factors are explained in more detail below.

High Costs and Low Flexibility Limit Appeal of Traditional Enterprise Software

Over the years, IT organizations have gone through the typical ebbs and flows of the macro environment and their respective companies' performance. Not surprisingly, these factors have implications on IT budgets whether times are good or bad. From a CIOs standpoint, IT departments have to work within an annual budget framework that often times changes on the fly. For this reason alone, CIOs are facing the task of trying to create better spending predictability and have the ability to react rapidly to situations that could change their company's overall business performance. These issues have fueled our belief that we are beginning to see the signs of the traditional enterprise software model breaking.

The traditional enterprise software model was built out of necessity. The notion of a hosted business model is not new. The problems that plagued the hosted or ASP model had nothing to do with the concept – it was related to the underlying technological capabilities (broad-band access, computing capabilities, etc.). Ultimately, this led most leaders of IT organizations to own and maintain their own technology infrastructure, which allowed them to have complete control, a defined IT roadmap, and leverage over the IT vendor. This strategy presented significant issues because the purchase of hardware, storage, networking, software, etc. is very expensive, and they have very little flexibility to react to changes in their business environment. A simple example to illustrate these points: if a company has infrastructure built to support 100 people and its business hits the skids, management could be forced to reduce headcount by 15%. Not only is the company left with a physical infrastructure that supports 100 people, but it is probably paying software license fees and support for 15 people who are no longer employed. As you can imagine, a software vendor usually is not thrilled to refund a customer's money based on their business circumstances.

Today, a combination of readily available enabling technologies (virtualization, low-latency, better security, etc.) and a much more flexible cost model (metered use) have allowed for IT managers to start thinking about how to refine their own IT business model to dynamically change according to their business circumstances. Using the previous example, in a full-fledged Cloud Computing model, the company would own very little internal infrastructure, would have the ability to scale back their usage of the external infrastructure without significant penalties, and often times they would be able to turn off a software subscription at the end of the month or quarter.

Virtualization Now a Reality

In our view, virtualization serves as the key enabling technology that unlocks significant value in the underlying infrastructure necessary for a successful Cloud Computing model. Defined as the abstraction of computer resources, this is not a new technology and it was actually first discussed by IBM in the 1960's. Unfortunately, it never translated into wide-spread adoption due primarily to the fact that it was historically used in isolated computing environments mostly related to mainframes. Over the past five years the environment has changed dramatically. Virtualization technology has broken through the technological barriers with a clear value proposition, causing IT buyers across the spectrum to evaluate how they can utilize the technology to reduce costs and make their infrastructure more efficient.

The initial value proposition is fairly straightforward, but it evolves depending on where a company is in terms of adoption. Initially, most companies are looking for ways to reduce capital expenditures, and server virtualization has become a fairly simplistic way to reduce costs while making the infrastructure more efficient. The value comes from the fact that most corporate servers are estimated to be utilized approximately 20-30%, which means a lot of computing capacity is never used. After deploying virtualization technology, companies can significantly increase its utilization rate which lowers the need to purchase new hardware, assuming their server base is virtualization-ready. Today, the server virtualization market is approximately 20% penetrated, implying this is still a relatively immature market. During the progression of virtualization adoption within an enterprise, most companies start with non-mission critical areas, such as test and development and print servers. As the comfort level increases, they move towards more mission critical applications which, in some cases, create an opportunity to lower operating expenses.

Following server virtualization, there appears to be an evolving pattern of adoption that moves well beyond the server while maintaining similar underlying principles. Storage, networking, and desktop virtualization are all in very early stages of adoption, but they are ripe for longer-term opportunities within the virtualization market. Unlike the most common value proposition within server virtualization, these other markets tend to have a more significant opportunity to reduce operational expenses as opposed to just capital expenditures.

Aging Hardware Becomes a Catalyst for Increased Adoption

Based on data we have extracted from industry sources, we believe the average age of the global hardware-installed base is greater than nearly any period in technological history. Below (Exhibit 6), we have included data from the global PC and server markets to illustrate the idea that over the next two to three years

both markets will experience a meaningful replacement cycle, setting the stage for broad-based Cloud Computing adoption.

Exhibit 6:

Expected PC Retirements								
	2006	2007	2008	2009	2010	2011	2012	2013
Total Retirements	146.8	154.5	165.1	186.0	217.1	252.7	282.4	309.6
Total Y-Y Growth	8.5%	5.3%	6.9%	12.7%	16.7%	16.4%	11.9%	9.5%

x86 Server Market			
	2008	2009	2010
Physical Servers			
Shipments	8,659,233	7,298,925	7,827,076
y/y growth	4%	-16%	7%
Average System Age	2.39	2.56	2.62

Source: Gartner

There are several reasons for this phenomenon, including budget constraints, stalled product upgrade cycles, changes in technological infrastructure priorities, and many others. However, it is more relevant to discuss why this aging hardware cycle, coupled with technological advancements, could accelerate the adoption of the key technologies we are outlining. The question becomes: What causes IT buyers to stop dragging their feet and start thinking about how they will run their businesses in the years to come? New hardware, combined with new technology primarily centered on virtualization, can yield IT business model efficiencies that are much greater than existing infrastructure. While we discussed these attributes in other areas within this paper, it is important to consider this trend as a significant catalyst towards the enablement of Cloud Computing.

The Risks to the Cloud Computing Model

There are several risks and concerns that most IT departments have with the Cloud Computing concept. These risks, detailed below, could threaten the adoption of Cloud models.

Security and Compliance. Security is almost always a top priority in a technology strategy. It has become even more important over the past decade with high profile cases that involved massive computer network hacking schemes and data losses. In addition, regulatory scrutiny has been placed on public companies in the US through the enforcement of the Sarbanes-Oxley Act. Most companies also have internal compliance controls in place for user access, management controls, etc.

The harsh reality is that security issues will not go away anytime in the foreseeable future. Any organization that has internet access, regardless of the presence of a

corporate network, runs the risk of an intruder attempting to access their data. Most, if not all, compliance issues that have surfaced have been addressed by software providers. Accessibility options have been present for years and those were characteristics that IT departments have become familiar with over the past decade. Therefore, while we are convinced that security is a legitimate issue, we think it is comparable to current risks facing most IT departments today.

Data Ownership. In a Cloud Computing model, any data that is hosted outside of an individual enterprise inherently involves a third party, and this scenario presents a meaningful risk. Everything from where the data is held to who has access to the data, regardless of where it is being hosted, are significant hurdles that need to be cleared for Cloud Computing adoption. It is our belief that we will most likely see a succinct progression of Cloud adoption in which companies utilize a Cloud strategy in a limited fashion to keep from putting critical elements of their business at risk. In most cases, this implies that areas such as accounting and financial reporting will most likely be the last functions to be moved into the Cloud.

Quality of Service. Since the Cloud model is delivered through the internet, there are risks associated with both performance and reliability. Performance issues center mostly around latency and the speed the actual service is delivered. Most organizations have higher performance network throughput, and broadband capabilities at large have improved significantly over the past decade. However, when an enterprise is running mission-critical applications, speed is always a key concern. Reliability concerns relate specifically to the service providers up-time and the business implications of potential down-time. This concern will vary depending on vendors, but the risk is that if a network experiences down-time, the use of an application could shut down entirely. While most enterprises have experienced network and/or application down-time with their on-premise solutions, in the Cloud model they are at the mercy of the service provider to fix the issues as quickly as possible.

Conclusion

Cloud Computing is one of the most significant technology themes we have identified in the past decade and we think there is a sound investment case to be made for its significant growth opportunities. Fueling our enthusiasm in these opportunities has been a sea-change in the traditional enterprise software model. Increasingly high costs, a lack of infrastructure flexibility, and the aging hardware-installed base have only hastened the unsustainability of the current model. As an alternative, Cloud Computing stands to materially revolutionize and challenge the traditional way of doing business by allowing IT organizations to focus simultaneously on lowering costs and creating more business efficiencies.

At this writing, most large enterprises are substantially behind consumers on the adoption curve, as consumers have already become accustomed with the concepts of Cloud Computing through mass-marketed applications that provide access to online email, music services and banking, among many other examples. Moreover, Cloud Computing technology serves a largely untapped need from today's mobile workforce, which is composed of upwards of 75 million workers who conduct business through the use of smart phones and mobile laptops.

As we outlined earlier, large enterprise segments are expected to begin adopting this new technology in greater numbers over the next several years and represent a considerable growth opportunity for the relevant players in the Cloud Computing market. In our view, it is appropriate to identify and evaluate companies who are exposed to these significant trends as potential investment opportunities.

Author Biographies

Erik A. Swords

Director, Senior Research Analyst

Erik is an Equity Research Analyst on The Boston Company's Core Research Team covering the technology sector, and a co-Portfolio Manager of the Dreyfus Premier Technology Growth Fund.

Prior to joining The Boston Company, Erik was an Analyst at Exis Capital Management, where he was responsible for covering the software, internet and business service sectors. Prior to that, Erik was a Senior Research Analyst at Pilgrim Baxter & Associates, covering consumer cyclical and all software segments.

Erik received a BS in Finance from Lehigh University.

Matthew D. Griffin, CFA

Director, Senior Research Analyst

Matt is a Research Analyst on The Boston Company's Core Research Team, covering the technology sector, and a co-Portfolio Manager of the Dreyfus Premier Technology Growth Fund.

Matt joined the firm in 2006 and has over sixteen years of experience in the industry. His previous positions include serving as a Research Analyst at Integrity Capital specializing in technology; a Portfolio Manager and Analyst at Putnam Investments covering technology, hardware and semiconductor sectors; a Portfolio Manager and Analyst at Harbor Capital Management; and a Technology Analyst at Colonial Management and Arkwright Mutual.

Matt earned a BA in Economics from Duke University. He holds the Chartered Financial Analyst designation.

Continued on next page

Barry K. Mills, CFA

Director, Senior Research Analyst

Barry is an Equity Research Analyst on The Boston Company's Core Research Team, covering the technology sector. Barry is also a co-Portfolio Manager on the Dreyfus Premier Technology Growth Fund as well as The Dreyfus Fund, Inc. and the Dreyfus Research Growth Fund.

Prior to joining The Boston Company, Barry was a Senior Managing Analyst at Dreyfus. He was responsible for covering stocks in the computer hardware, semiconductor and other selected technology industries. He was also a co-Portfolio Manager for the Growth Opportunity Fund. Before Barry joined Dreyfus, he followed technology stocks as a Senior Equity Analyst with Phoenix Investment Partners, Ltd., and was co-Manager of the Phoenix Strategic Theme Fund, a top-performing capital appreciation fund. Previously, he was the Director of Research for Howe and Rusling, Inc.

Barry is a graduate of Hobart College, where he received a BA in Economics. He holds the Chartered Financial Analyst designation.

This publication or any portion thereof may not be copied or distributed without prior written approval from The Boston Company Asset Management, LLC (TBCAM). Statements are correct as of the date of the material only. This document may not be used for the purpose of an offer or solicitation in any jurisdiction or in any circumstances in which such offer or solicitation is unlawful or not authorised. The information in this publication is for general information only and is not intended to provide specific investment advice or recommendations for any purchase or sale of any specific security.

Any statements of opinion constitute only current opinions of TBCAM, which are subject to change and which TBCAM does not undertake to update. Due to, among other things, the volatile nature of the markets and the investment areas discussed herein, they may only be suitable for certain investors.

Some information contained herein has been obtained from third party sources that are believed to be reliable, but the information has not been independently verified by TBCAM. TBCAM makes no representations as to the accuracy or the completeness of such information.

No investment strategy or risk management technique can guarantee returns or eliminate risk in any market environment.

