Clouds in the enterprise
Navigating the path to business advantage

March 2011

pwc

Table of contents

The heart of the matter 2

A fundamental change in business automation and new revenue opportunities

An in-depth discussion 4

How computing became a business imperative as a revenue driver as well as cost reducer

Critical enterprise constraints: agility, timeliness, distance
Business case for moving to a cloud-oriented environment
Organic emergence of the cloud
Automation, key to efficiency and scale
Private, public, hybrid clouds

What this means for your business 14

Identifying the right path for your company: three scenarios

Cloud adoption continuum
Gaps, challenges and next steps

The heart of the matter

A fundamental change in business automation and new revenue opportunities

Today most businesses automate on a piecemeal basis. That's no longer good enough. Businesses need a systematic plan for extracting maximum efficiency and agility from their IT infrastructure through cloud computing.

Enterprise cloud computing represents a fundamental change in the automation of business functions and a sea of change in the planning, design, and architecture of the enterprise data center. Through the integration of various technologies, many of which have already been deployed, cloud computing at the enterprise level dramatically reduces the time, cost, and negative business impacts organizations have always been forced to reconcile with their use of information technology. Resources can be rapidly engaged, scaled, and terminated anywhere at any time, and in the public cloud, organizations pay only for the resources used. As a result, a new set of business opportunities and challenges will emerge for revenue generation, risk management, and cash flow.

C-level executives currently are challenged to convert fixed costs to variable costs while remixing the budget to increase the focus on innovation and decrease the cost impact of fixed assets such as IT. At the same time, they want to extract the maximum efficiency possible from the IT infrastructure, something that organizations have achieved only through large commitments of capital to IT. Through cloud computing, it is now becoming possible to assemble a highly dynamic technology environment that deploys computing resources where and when needed while retaining the efficiency of traditional environments. The results can drive multiple value propositions such as green IT, continuous application availability, and instant application environment scale-up and scale-down accompanied by a consumption-based cost model. Cloud computing is so significant it even raises questions of how the model will be leveraged to gain a competitive advantage.

PwC has identified 33 enabling components of enterprise cloud computing spread over five levels of cloud maturity. Many specific departments or functions in large and midsize enterprises already have deployed some of the components needed for the emergence of this new cloud-capable environment. They have been, in effect, automating on a piecemeal basis—deploying server, storage, network, capacity, performance, and change management tools to varying degrees. Very few seem to be guided by a systematic plan for extracting maximum efficiency and agility from the IT infrastructure through cloud computing.

To that end, this paper describes three common enterprise cloud scenarios PwC has encountered:

- Companies that have articulated a strategy, begun assembling the pieces, and are ready to start connecting them together
- Companies that are using virtualization technologies and some of the other necessary components but that have not developed a vision, strategy, or road map for deploying a true cloud infrastructure
- Companies that are attracted to the cloud vision but unsure of where they are and how to move any further

The paper then summarizes these three paths for enterprise leaders determined to get to where they want to be in terms of a cloud-oriented efficient, flexible, and scalable environment. It also identifies five levels of cloud maturity and the cloud components associated with each level. You can use the maturity framework for a high-level assessment of how far along the path to cloud agility and performance your IT infrastructure currently stands.

An in-depth discussion

How computing became a business imperative as a revenue driver and as a cost reducer

For almost a decade, CIOs have been hearing about system virtualization. Over the past few years, enterprises have implemented virtualization in some manner and to some extent. Most have been satisfied with the initial results, typically savings related to server consolidation, and have begun exploring how to expand virtualization throughout the IT infrastructure.

Virtualization is one of the key underlying technologies that make cloud computing possible. Virtualization consists of a set of technologies that enable systems and applications to securely share IT resources such as servers, storage, and networking. It masks the complexity of the resources being shared and their location, which effectively simplifies the use of the IT environment. In the process, virtualization loosens the coupling between resources and removes the interdependencies among infrastructure layers, which ease the transition to cost-saving automation in the data center. To date, the majority of virtualization efforts have been limited to infrastructure: networking, servers, and storage.

Infrastructure virtualization is a major part of the first of five levels of the PwC Cloud Component Maturity Model. Virtualization and several other fundamental software and management components represent the base level of maturity. Each of the other four levels consists of additional components that reflect an organization's adoption of technologies and techniques that further refine its cloud computing footprint. Full cloud computing maturity comes from addressing all 33 components in an integrated and coordinated fashion.

Here is a summary of the five levels and the major components included in each level:

- **Level 1**—A set of software components considered prerequisites for a successful cloud computing deployment, especially for large organizations adopting the private cloud model. These include all the components of basic system and network management and virtualization, such as virtual local area networks (LANs), virtual machines, the hypervisor, and virtual machine management.
- **Level 2**—A combination of technologies and management tactics, including such capabilities as rapid manual resource provisioning, an automated provisioning engine, and components integrated to support automated provisioning.
- **Level 3**—The fine-tuning of how applications use infrastructure resources efficiently, which will include the adoption of service-oriented architecture (SOA) and the development of various infrastructure, application, and business services.
- **Level 4**—The automation of resources shared among applications to meet needs on the basis of priority and the highest efficiency possible, including automated responses and automated orchestration.
- **Level 5**—Tools and processes that enable the IT stack to be viewed and managed from the business point of view, narrowing the discussion gap between how the business operates and how IT supports the operation. This level includes such capabilities as business process management, metering, and service management and governance.

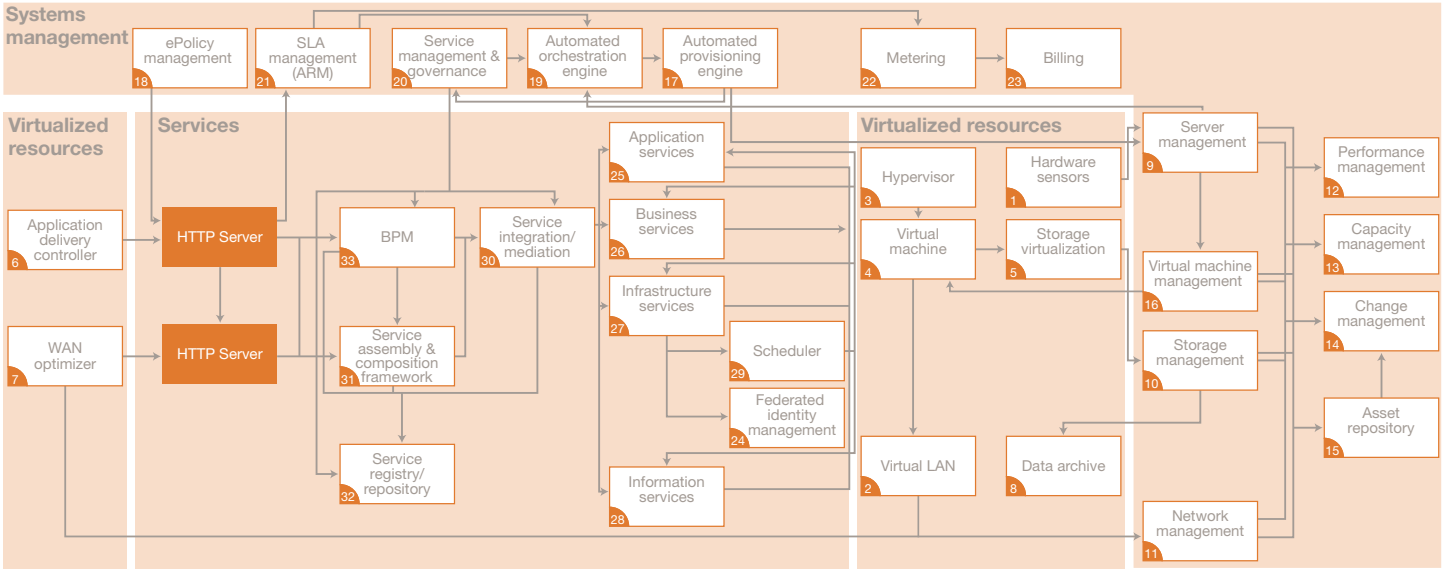
A table on the following page provides more details about each of the 33 core components, which also are depicted in the adjacent diagram.

The real value of cloud computing isn't isolated to the benefit of virtualization in the data center. Through cloud computing technologies, IT can finally deliver the full payback businesses have long desired from technology investments in terms of business efficiency, flexibility, and scalability by enabling a fundamental change in the automation of business functions and operations.

Key cloud components described

Virtualized resource components		Systems management components			
Component	**Description**	**Component**	**Description**	**Component**	**Description**
1 Hardware sensors	Hardware monitor software that collects health and performance data that is used as input to server management software	9 Server management	Server administration console used for installation, configuration, and management of servers; may include components of change, performance, and/or capacity management	17 Automated provisioning engine	Executes scripts to provision hardware based on input from a human or another system such as an automated orchestration engine
2 Virtual LAN	Logically managed LAN overlaying a physical network requiring support within network devices such as routers, switches, and controllers	10 Storage management	Storage administration console used for installation, configuration, and management of data storage resources; may include HSM capabilities as well as components of change, performance, and/or capacity management	18 ePolicy management	Management tool to define and enforce security policies at the network level
3 Hypervisor	Administration layer tool for managing the virtual machines on a physical server, including device, storage, and network configuration	11 Network management	Network administration console used for installation, configuration, and management of network devices and virtual LANs	19 Automated orchestration engine	Monitors load and system performance to automate provisioning tasks (automated provisioning engine) and to achieve operational goals (availability, response time, etc.)
4 Virtual machine	Virtual computer resident within a physical server partitioned by hardware or software from other virtual machines	12 Performance management	Monitoring and management of resources to identify availability, abnormal behavior, and report on historical metrics	20 Service management and governance	Monitors and enforces service governance, including availability, versioning, migration, ownership, message model security
5 Storage virtualization	Software or hardware virtualization of access to storage (SAN, NAS, tape, etc.)	13 Capacity management	Monitoring and analysis of resource performance to ensure adequate capacity for current and future state loads	21 SLA management	Ensures SLAs are met by monitoring end-to-end transactions and triggering orchestration processes (automated orchestration engine) when SLA's are threatened
6 Application delivery controller	Provides application acceleration such as compression, caching, connection multiplexing, application layer security, SSL, and content switching in addition to load balancing	14 Change management	Monitoring and historical record of changes to an environment to enable rollbacks and analysis; uses a configuration management database to record changes	22 Metering	Monitors and reports the consumption of resources
7 WAN optimization	Optimizes network performance over WAN lines to maximize bandwidth and transmission speed	15 Asset repository	Repository of all software and hardware assets, including location, date of install, vendor, etc.	23 Billing	Uses resource consumption reports of metering system to generate a bill for services rendered
8 Data archive	Long-term archive for data, not intended for use in recovery from outages or failures	16 Virtual machine management	Management environment for virtual machines and includes VM health, provisioning, deployment, relocation, and recovery		

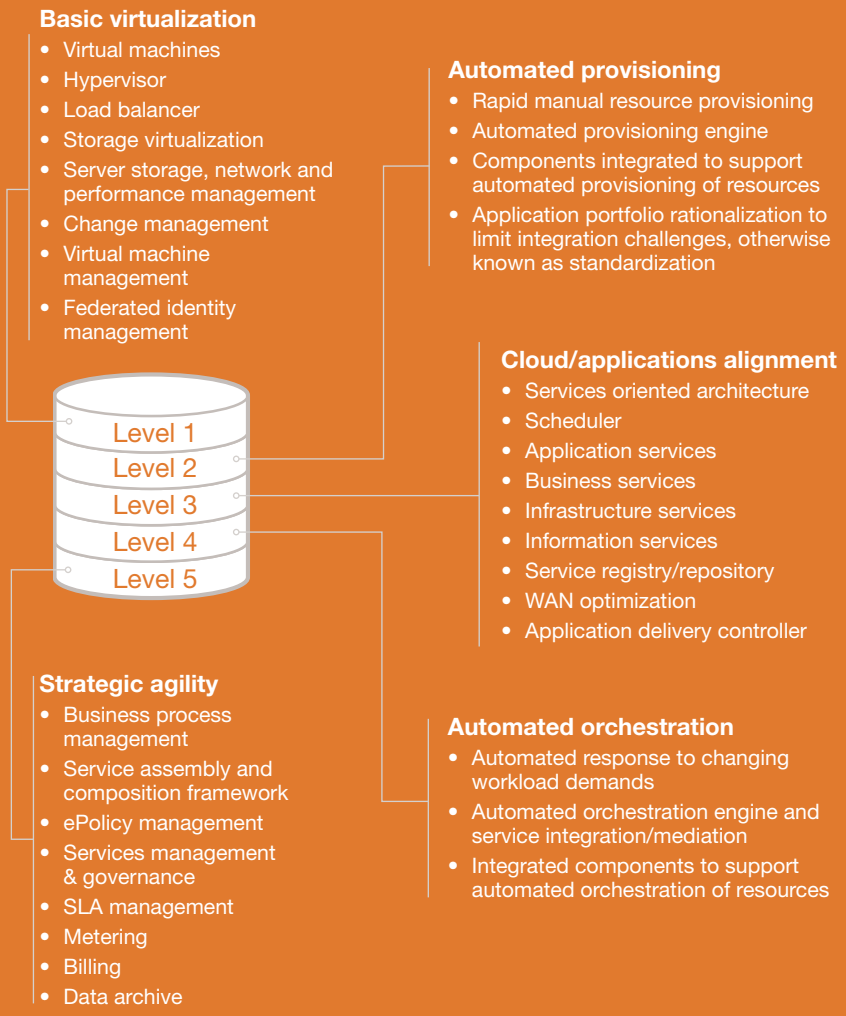
How the cloud components interconnect



Service components

Component	Description
24 Federated identity	Manages identity information across a federated (distributed) environment
25 Application services	Services related to the execution of a software application, such as policy enforcement, translation, delivery, and registration
26 Business services	Services related to the execution of a business process, such quote to order, order to cash, and procure to pay
27 Infrastructure services	Services related to infrastructure resources, such as storage, archival, federated identity management, and scheduling
28 Information services	Services providing access to data stores, including databases, flat files, and third-party repositories
29 Scheduler	Schedules jobs for execution, often used in conjunction with computational grids
30 Service integration/ mediation	Service integration, often through an enterprise service bus, including the ability to negotiate protocol and payload requirements between services
31 Service assembly and Composition framework	Enables the creation of new services through the composition of existing services
32 Service registry/ repository	Index of available services and related metadata that also participates in enterprise governance tasks, including access control and policies
33 Business process management	Process engine, analytics, content management, and collaboration tools used to automate activities, collaboration, and integration with other partners in the value chain

PwC cloud components maturity model



Critical enterprise constraints: Agility, timeliness, distance

Traditionally, organizations have wrestled with what project managers call the triple constraint: resources, schedule, and budget. In today's highly competitive, global business environment, executives in enterprises are beginning to understand they face an additional set of constraints: agility/flexibility, timeliness, and distance:

- ***Flexibility***—The ability to change without disruption to the business
- ***Timeliness***—The time lag between business need and deployed solutions
- ***Distance***—The impact of geographic distance in a global market

Flexibility, also referred to as agility, enables an organization to respond to change by adding new functionality or capabilities, such as processing a new type of transaction, without disrupting the established processing. Timeliness addresses the need to deliver functionality or capabilities fast to pursue quickly emerging or short-lived opportunities. Shrinking distances, typically through communications, allows businesses to work closely with distant partners and collaborate to better satisfy customer needs or to capture opportunities.

These three constraints produce what can be referred to as the indirect costs of success in addressing the traditional constraints of resources, schedule, and budget. In combination, these new constraints create a multiplier effect, driving up costs across the business overall in unpredictable ways.

Business units have learned how to efficiently and profitably scale up through flexible work arrangements, leasing, highly automated supply chains, and global 24x7 operations. However, IT executives and managers have continued to focus on minimizing the size and cost of IT—the direct costs of people, process (the time required to performs jobs), and technology while generally downplaying the indirect costs that also impact the success of IT. These indirect costs fuel an ever-increasing IT budget, and maintenance costs emerge as the largest component. Now as companies call on CIOs to help drive or lead the innovation agenda, they can be hamstrung by these indirect factors. The fundamental requirement is an IT that matches, even enhances, the agility profile of the business.

To reduce direct process costs, enterprises have turned to standardization and outsourcing. They also have

deployed automation to reduce staffing costs, and they have executed consolidation and rationalization initiatives to reduce the cost of technology. Best-in-class enterprises certainly have achieved some measure of success reducing direct costs in this way. They have right-sized IT to meet the needs of the business as long as nothing changes too fast. Now the focus must shift to optimizing the indirect costs and the flexibility of organizations to synchronize IT to the ever-changing business environment. The increasing pace of change in markets and the broader economy demands it.

To address these indirect costs, enterprises have focused on the distance constraint by implementing high-speed, high-bandwidth networks to facilitate outsourcing and offshoring; collaboration tools; and remote management. Still, enterprises remain saddled with slow-moving, complex IT environments unprepared to deliver improvements on the flexibility and timeliness dimensions. IT remains unable to keep pace with rapidly changing business needs.

Our recommended approach: deploy cloud computing to help address the remaining indirect constraints of flexibility and timeliness. The cloud, in short, enables the enterprise to align its technology footprint more closely with the actual needs of the business. This alignment should not be just as a onetime event—businesses are too dynamic today to target such a one-dimensional solution. The key value of cloud computing is to bring alignment between IT and the business as it changes over time—day to day, hour to hour, month to month. In the process, cloud computing may reduce overall direct and indirect technology spending or, more likely, substantially slow the growth in that spending while improving the organization's speed and agility. In the end, it is speed and agility, supported by an equally capable IT department, that will enable the business to achieve and sustain competitive advantage.

Business case for moving to a cloud-oriented environment

Today's IT environments are built on a series of costly compromises that lead to unintended consequences. For example, administrators monitor systems and make manual adjustments corresponding to a set of rules, which ought to be automated but typically aren't.

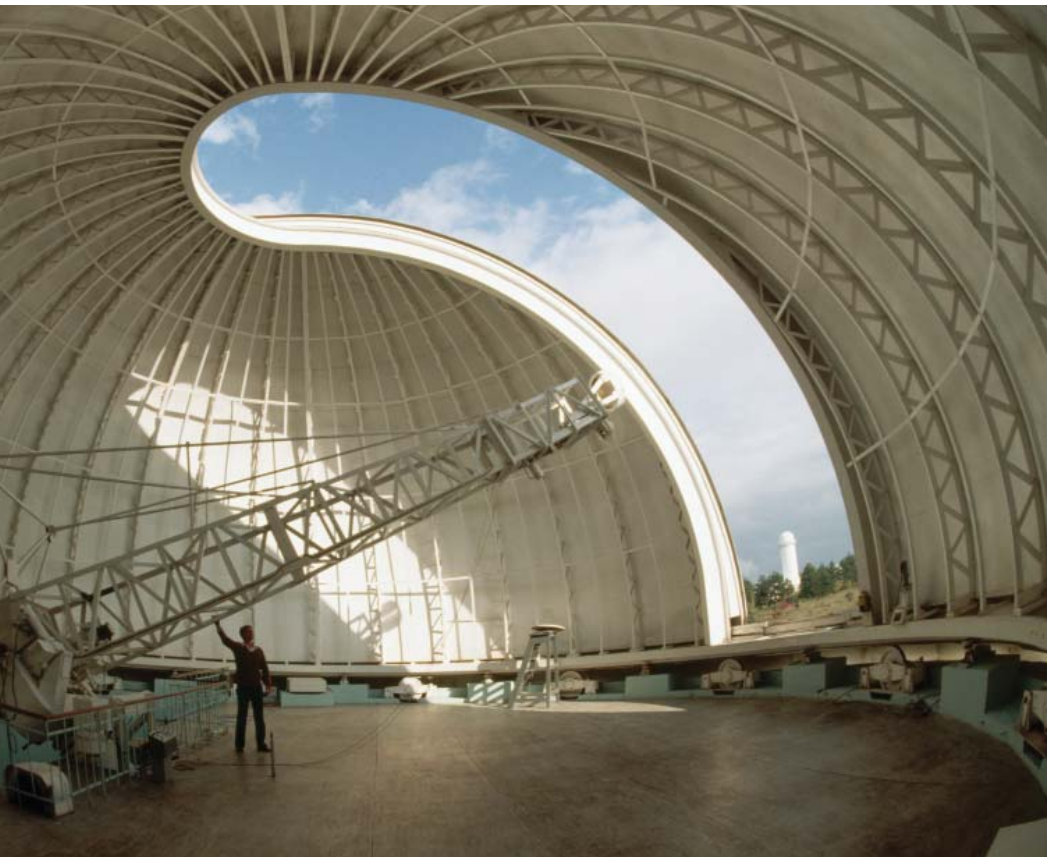
Similarly, IT environments are configured and over-provisioned for just-in-case traffic scenarios and then sit largely idle until the extreme case occurs, if ever. Hardware, too, is often planned and purchased to meet long-term operational goals such as transaction increases, although in the immediate term the technology sits underutilized. Ironically, by the time the anticipated long-term goal arrives, the hardware can be purchased for less.

A cloud-oriented environment avoids these compromises, enabling high levels of efficiency, flexibility, and responsiveness while still helping to

control IT costs. At the same time, a cloud environment facilitates new business models and opportunities. For example, it can deliver levels of customer self-service previously not possible or allow the creation and delivery of new automated on-demand revenue-producing services.

Specifically, a cloud-oriented environment enables the following:

- Efficiency—Organizations can achieve efficiency through the automation of formerly manual processes, which becomes essential to handle the scale of operations that cloud environments can support.
- Flexibility—Organizations gain flexibility through the ability to configure and provision systems and resources on demand, effectively scaling systems up or down as needed.
- Control of IT costs—By eliminating the need to over-buy and over-provision IT resources far ahead of demand, and relying instead on an on-demand, pay-per-use model and the virtualization of shared compute resources, organizations can control IT costs.
- Scalability—Organizations can scale resources up or down as needed.
- Extensibility—Hybrid clouds let organizations extend the scalability of their private cloud temporarily through linkages to public clouds based on a pay-per-use model.



Efficiency, flexibility, cost control, and scalability can reduce expenses enough and improve operational performance sufficiently to justify moving to a cloud-oriented environment. Then, add to that the revenue captured through new business models and revenue opportunities, typically revolving around on-demand services, and the business case for a cloud-oriented environment starts to look very attractive. How attractive depends on the creativity and innovation of the organization.

Organic emergence of the cloud

Organizations are not moving to the cloud as part of a deliberate big bang migration or strategic decision. Rather, organizations are adopting virtualization and other cloud technologies organically from within, often to address the IT department's cost and complexity in an ad hoc way and to ease immediate pain points. However, by doing so without a strategy and road map, significant gaps and risks are emerging.

When organizations stop to tally the number of cloud-oriented elements already deployed, they may be quite surprised. PwC research suggests that many CIOs are unaware of how far down the cloud computing path some operations staff have taken their organizations without the benefit of strategy or architecture. They need a controlled way to move purposefully toward the cloud—something like the systematic pursuit of the five levels of cloud components summarized earlier—rather than the piecemeal assembly of various components, new and existing, which is mostly the case today.

The result of this ad hoc, organic activity, while admirable in some ways, can prove troublesome as well. In it grows the roots of yet another round of dysfunctional IT: silos of tightly coupled applications, data, and infrastructure and the limited use of process automation, which together translate into higher costs, less efficiency, and less agility for the business. In short, the three indirect constraints facing IT are more important than ever—timeliness, cost, and distance—but without a strategic cloud road map they will inevitably be negatively affected.

In addition, such an approach leaves a number of gaps, which create more risks. These include:

- Inconsistent and confusing governance
- Incomplete and conflicting standards
- Insufficient and inconsistent policies
- Misalignment of enterprise strategy, lines of business, and IT
- Lack of integration with existing IT strategies and enterprise architectural frameworks

Instead, companies need a way to move purposefully toward the cloud—a way that would identify and address gaps as they appear while mitigating risk. The goal of such an approach is IT and business efficiency and agility, not cloud computing per se.

So what might this more deliberate approach to the cloud look like? PwC sees it consisting of four core architectural targets:

1. Loose coupling between the distinct layers of the IT stack
2. Systematic transition of IT operations from manual to automated
3. Modernization of legacy systems
4. Continually refreshing all aspects of IT as needed without worrying about interdependencies among layers

The result would be a business-value-driven, methodical approach for the adoption of cloud computing technologies based on the five levels of cloud computing maturity previously identified. It would utilize a customizable framework and a business-focused, strategy-led approach similar to the IT Infrastructure Library (ITIL) and the Control Objectives for Information and related Technology (COBIT). At the same time, it would reduce the risk of adopting cloud technologies by identifying and prioritizing likely solutions based on the business case. The framework would ensure the solutions integrate with the business and technology environments, effectively preventing isolated implementations.

Automation: Key to efficiency and scale

Two immutable facts of business life: people are expensive, and profitable business growth requires the ability to scale efficiently. Cloud computing makes it possible for organizations to scale IT very quickly and efficiently to accommodate business growth. The catch is the cost of the people required to monitor, administer, and manage fast growth and rapidly scaling systems.

The solution to the challenge of efficient scaling is policy-driven automation and policy-based management:

- Policy-driven automation consists of software that monitors and senses actions and events occurring throughout the IT infrastructure and that initiates defined steps that conform with an appropriate set of rules. Such policy-driven automation reduces the need for people to monitor and respond to everything that occurs in the systems environment, which results in the need for fewer people. Instead, people are required to intervene only when exceptions, which also can be defined by policy, occur.
- Policy-based management is the process of defining business policies in the form of rules that systems can implement in response to actions, events, or activities. For example, if a developer has allocated a number of virtual machines that are sitting idle for several weeks and consuming virtual storage, and that developer asks for another virtual machine, a rule can block the request and direct the developer to previously allocated virtual machines. As this example suggests, tools that enable the cloud can raise new management challenges that, if unaddressed, can diminish the expected payoff of migrating from legacy approaches.

The combination of policy-based management and automated monitoring, provisioning, and orchestration enables the IT infrastructure to scale quickly and easily without the need to continually add skilled people. Based on policies, for example, additional virtual servers can be fired up, applications can be moved between servers, or storage capacity can be provisioned and allocated to meet service levels. Those service levels can be defined by policy in response to rapidly changing conditions in the systems environment, which are driven by equally rapid changes in the business. This can be handled systematically without the involvement of people.

As the cloud becomes an integral piece of the enterprise IT mix, policy-driven automation also can reach into the cloud for additional system resources or for specialized applications required only under specific, well-defined circumstances. This capability allows the organization to efficiently scale up or down quickly in response to changes in the business environment.

Private, public, and hybrid clouds

Mainframe data center veterans wonder why there are such high levels of interest in virtualization, software as a service (SaaS) and infrastructure as a service (IaaS), or cloud computing. As they see it, the mainframe data center was the original internal cloud. It also was the original virtualized computing platform. Certainly, the technologies involved today have evolved considerably, but these data center veterans are correct from a historical perspective.

Today some might describe the enterprise data center, the classic glass house, as a private cloud simply because it is a single resource delivering IT as services over the network to applications and to users behind the corporate firewall. What mainframe veterans may be forgetting, however, is the huge truck that showed up every two or three years with a bigger and better mainframe. This old-style private cloud actually introduced huge amounts of unused capacity and a risky transition from one machine to the other during which applications would be unavailable for hours or days.

A better definition of private clouds is the acquisition, provisioning, and management of data center resources in a hyper efficient and agile way. This approach emulates the leading practices of public cloud service providers such as Amazon.com, Google, and Microsoft while adding the needed security and controls appropriate to specific enterprises.

Today, organizations should approach cloud computing as an architectural option driven by the desire to extract the maximum efficiency and agility possible from infrastructure. Such a proposition calls for the delivery of computing resources on demand, where and when needed. And, as noted previously, cloud computing maximizes business agility while minimizing the timeliness and distance dimensions, which reduces the indirect cost of IT while aligning the technology footprint to the needs of the business.

Cloud computing, private and public, produces a highly dynamic technology environment that can drive multiple value propositions. These include green IT, continuous application availability, and instant environment scale-up and scale-down in a consumption-based cost model.

Organizations, as noted earlier, tend to evolve their cloud computing capabilities organically by starting in the existing data center and implementing various components on an ad hoc basis to address immediate needs. Gradually, they need to develop and execute an appropriate strategy that delivers their desired cloud computing outcome, which will likely be some form of private cloud.

The public cloud exists today and many organizations already use it for SaaS solutions or to augment their existing IT capabilities through IaaS offerings. By extending the private cloud to access public cloud resources, usually IT infrastructure resources, the organization creates a hybrid cloud, which combines both private and public cloud resources. Policy-driven automation can be used to initiate requests through the hybrid cloud for IT resources or data residing in the public cloud. In this way, organizations create an environment that can scale up or down as needed on demand.

What this means for your business

Identifying the right path for your company: Three scenarios

When it comes to the enterprise view of the cloud computing opportunity today, PwC has determined that companies fall on a continuum from not considering cloud computing at all to fully leveraging cloud computing. Most fall at various points in between. Where their data center operations specifically fall may not even be clear, because, as noted earlier, the adoption of various cloud computing components often is ad hoc rather than the result of a systematic strategy to pursue cloud computing.

For conceptual simplification, however, PwC has defined three common paths that reflect where most organizations are today, and has described the cloud component maturity level for each path. Senior executives should identify which cloud path their organization appears to be on, determine which cloud path is most appropriate for the future, determine if there is a significant gap, and set a strategy for how they will close the gap.

Path 1: Have strategy and pieces but need to connect the dots

- *Starting point:* Have some cloud components deployed and have a strategy
- *Desired outcome:* Transition to an internal cloud environment with the ability to connect to the external cloud as desired
- *Likely gaps:* Confusing governance; conflicting standards
- *Obstacles/challenges:* Filling in the remaining cloud components internally, connecting legacy back-end systems, and porting applications to the internal cloud
- *Next steps:* Continue to add cloud components, simplify governance, and enforce a single set of standards
- *Cloud component maturity level:* Level 1 and possibly some of Level 2 and Level 3

Path 2: Have virtualization and some cloud components but lack vision and strategy

- *Starting point:* Have deployed mainly virtualization components and a few cloud components, and are implementing point solutions
- *Desired outcome:* Transition to a fully virtualized environment capable of transitioning to an internal cloud environment
- *Likely gaps:* Lack of vision; no cohesive strategy for cloud computing
- *Obstacles/challenges:* Educating both IT and management on the opportunities and value of cloud computing; lack of technical and business leadership on this issue
- *Next steps:* Identify a management leader, paint the organization's vision for virtualization and cloud, and secure buy-in from management and IT
- *Cloud component maturity level:* Level 1 and possibly some of Level 2

Path 3—Have the interest and vision but unsure of getting started

- *Starting point:* Have interest and the beginnings of a cloud vision, but are not sure where they stand in regard to virtualization, IT automation, and cloud computing
- *Desired outcome:* Transition to an efficient IT environment that uses virtualization, SOA, and cloud computing to achieve an agile organization
- *Likely gaps:* Benchmarking needed to identify where they are and how to proceed
- *Obstacles/challenges:* Developing a workable strategy and beginning an orderly implementation of cloud components
- *Next steps:* Develop a business and IT strategy and initiate implementation based on the results of benchmarking
- *Cloud component maturity level:* May have implemented some of Level 1

Today most organizations have begun the migration to virtualization technologies, but due to concerns and lack of understanding, they are excluding clouds from their plans. In organizations further along the path, IT already is virtualized, enabling private cloud solutions focused on customer and vendor integration. These organizations are implementing all or parts of Levels 1, 2, and 3. Other organizations are willing to let public clouds handle commodity collaboration and desktop productivity. Ultimately, everything should run on a cloud platform with both private and public versions of many applications, where access to compute resources is determined by policies.

The goal is to get to Level 5. Components in Level 4 and Level 5 address automation, orchestration, and management of policies, business processes, and service levels. Organizations at Level 4 and Level 5 use virtualization and cloud resources in pursuit of higher levels of efficiency and agility.

Conclusion and recommendations: Cloud computing is not the goal; business advantage is

Many enterprises are beginning to test the waters and engage with cloud computing. Many others are holding back, seeing cloud computing as too bleeding edge. PwC believes the goal isn't cloud computing at all. The goal is business agility and efficiency. The ability to respond to changes in the business quickly and efficiently is the key to sustainable competitive advantage, increased revenue, and an attractive return on investment (ROI). Cloud computing is a way to deliver these key business goals.

This occurs because cloud computing allows the organization to address today's three big constraints in traditional IT: inadequate timeliness, challenges in dealing with technology distributed globally (distance), and ever-increasing cost. If in the process cloud computing enterprises can enable new business opportunities, so much the better.

Still, the question remains: how does an organization get there? PwC recommends the following:

1. Start by knowing where the organization stands on the cloud computing continuum. Use benchmarking and gap analysis to understand where the organization is today.
2. Conceptualize and communicate a compelling vision for using cloud computing to advance business objectives.
3. Develop a cloud strategy and execution plan that incorporates any ad hoc components implemented already and lays out a systematic approach to moving forward.
4. Understand the goal, which is not to get to cloud computing or Level 5 but to achieve ever-greater levels of business efficiency and agility.
5. Progress systematically through the five levels of cloud computing components, realizing that not all components are appropriate in all situations.
6. Balance the use of private and public clouds to form a hybrid cloud that draws on both private and public cloud resources as needed.
7. Focus on automation, which is the key to efficiency, agility, and scalability.

www.pwc.com

To have a deeper conversation about how this subject may affect your business, please contact:

Michael Pearl
PricewaterhouseCoopers
408 817 3801
michael.pearl@us.pwc.com

Phil Garland
PricewaterhouseCoopers
703 918 4523
philip.a.garland@us.pwc.com

Cindy Warner
PricewaterhouseCoopers
313 903 8787
cindy.warner@us.pwc.com

Brian Butte
PricewaterhouseCoopers
704 651 6159
brian.butte@us.pwc.com