DYNAMIC WHITE PAPER

Best Practices for Cloud Computing Adoption

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IDC OPINION

Cloud computing models offer a new approach for IT organizations to deliver business services to end users. It is a technology model that provides both flexible IT deployments and dynamic business agility. The model offers capacity on a pay-as-you-go basis. That is, it provides a method of freeing and uniting computing capacity that had been isolated within business units. It makes system resources accessible to applications that span the entire organization. At its full potential, cloud computing can accelerate business innovation and transformation.

The adoption of cloud computing is best characterized as a journey that occurs over time and in stages. IDC research proposes five stages of cloud maturity: Ad Hoc, Opportunistic, Repeatable, Managed, and Optimized. Each stage requires greater investment — not just from IT but from line-of-business (LOB) budgets throughout the organization — and offers, in turn, increasing value. Based on the intensity of business drivers for cloud, organizations can advance to successive levels of cloud maturity at their own pace.

While there are many ways to Rome, IDC research recommends a single set of best practices that can help organizations accelerate their cloud maturity. IT organizations need to implement specific programs for their technology, people, and processes:

- **Technology.** Focus attention on setting up the "right" cloud infrastructure, platform, and software. The cloud journey begins with virtualization, which becomes the foundation for moving to private infrastructure as a service (IaaS) and higher-level platform as a service (PaaS).
- **People**. Build critical organizational attributes such as cloud skills, service-driven culture, leadership, and interdepartmental collaboration (between IT and LOB).
- **Process.** Implement key business processes for managing end-to-end service, enterprise-wide cloud architecture, vendor activity and performance, and overall compliance with organization's standards for cloud deployment.

Organizations adopting a systematic approach to implementing these best practices in cloud computing can overcome the acknowledged challenges of the cloud journey, especially concerns about security, reliability, availability, and skill sets. By focusing on these critical success factors, they can set realistic gradual goals and achieve successful deployment.

SITUATION OVERVIEW

Cloud computing has been increasingly adopted by organizations of all sizes as a means to reduce capital expenditures (capex) and operational expenditures (opex). In fact, IDC's 2012 North American *Global Technology and Industry Research Organization IT Survey* found that 71% of all organizations are using, planning to use, or researching cloud.

This significant adoption of/interest in cloud has translated into substantial growth in IT infrastructure spending. IDC estimates that the worldwide private cloud IT infrastructure market will grow from more than $12 billion in 2013 to $22.2 billion in 2017. This represents a compound annual growth rate (CAGR) of 17.6% for 2012–2017. Similar growth in spending is expected for public cloud deployment.

IDC expects that more enterprise IT organizations will come to view private cloud options as the next logical step beyond datacenter virtualization. Core automation, self-service, analytics, Big Data storage, security, and cloud system software needed to build and operate large-scale private clouds will continue to mature and become simpler to implement and use. Furthermore, a range of industry standards (e.g., OpenStack) promoting cloud interoperability and workload portability are also expected to mature rapidly, helping create a cloud infrastructure software layer that can deliver more flexible and cost-effective resource sharing and pooling.

Much of the public cloud enterprise adoption today has been *ad-hoc* and user-led. IT is looking to gain more control and insight over much of this adoption. One reason for this is to bring back certain workloads for issues of security or control, moving then back to a private cloud running within the boundaries of the enterprise. Another is to track and monitor public cloud workloads through a more managed process. Currently, private and public clouds are generally siloed areas that are managed separately. The long-term goal is to stitch private and public into a seamless hybrid cloud that is managed as a single entity – one that allows workloads to easily migrate between the two cloud environments.

Cloud Benefits Driving Adoption

In recent years, cloud computing has become an alternative deployment model for business services that formerly ran on traditional IT infrastructure. According to IDC research, cloud computing has offered many organizations the following benefits:

- **Greater IT flexibility.** Through the use of virtualization and the live migration of workloads, computing capability can be accessed more easily across the organization to meet end users where they live. Online cloud computing portals are open to end users to access business applications or services. Resources can be adjusted in cloud computing to keep pace with increasing, or decreasing, demand.
- **Improved business agility.** Formerly, silos of processing hampered the creation of new business services. That was often the case where individual business units acquired different computer systems for their own use and without regard to how they would "fit" or interoperate with other computers in the same datacenter.

Now, cloud computing helps new initiatives grow because capacity is added more easily and the computing environment is managed more efficiently.

- **Greater speed to innovation (accelerated innovation).** New projects can take shape more quickly with cloud computing. Prior to cloud technologies, users within a given business unit or business division would have to wait to get on the IT organization's "radar" to have their application developed and deployed. Now, that entire process is sped up internally or outsourced to a trusted cloud provider outside the corporate datacenter.
- **Creation of new business models.** Given the growth of both cloud computing and Big Data analytics, companies are able to leverage the transactional data they have been gathering to create new business services that can be sold to other companies. For example, an insurance company could leverage its actuarial data as a service, or a retail company could host consumer goods promotions based on frequency of responses to a given sale or special offer.
- **Transformation of the business.** In some cases, the entire business is transformed through a new approach to cloud computing. This was the case with Nationwide Insurance, which consolidated its distributed server landscape by migrating Linux workloads to Linux virtual machines (VMs) running on IBM System z mainframes. The resulting private cloud supports a wide range of workloads accessed by end users and end customers. It also happened at Bank of Utah, which leveraged a cloud-enabled IBM PureFlex platform to make datacenter operations more efficient and to launch new business services. For both of these IBM customer sites, adoption of cloud computing supported new business initiatives and sped time to solution as it created new business services that expanded their pre-cloud business models.

  Furthermore, traditional software providers are also starting to leverage cloud to transform their business model and grow the client base. These businesses are either building their own clouds or leveraging public clouds to provide their product as a service, and they look to resilience, security, scalability, etc., as key characteristics for competitive advantage.

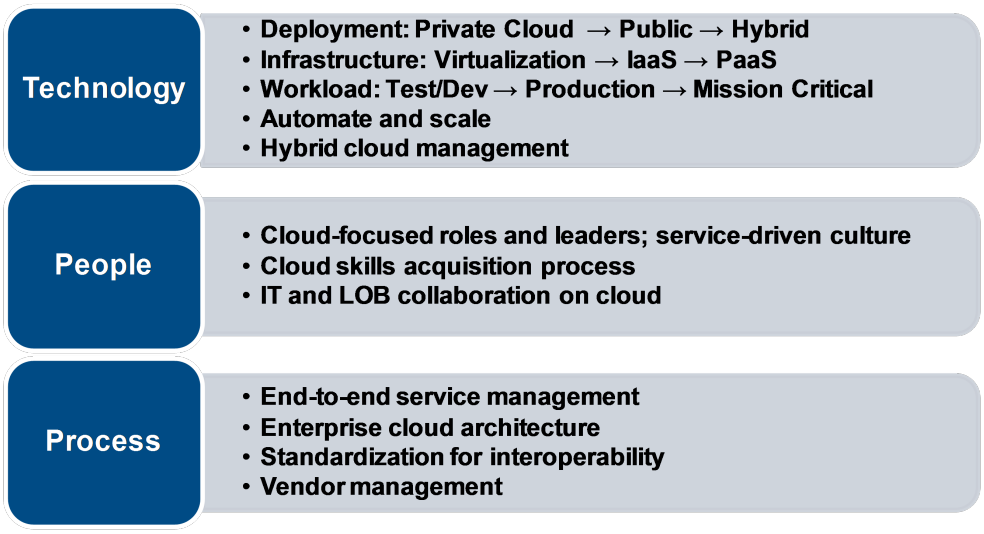
EMBARKING ON A CLOUD JOURNEY: BEST PRACTICES

Adopting the cloud is not a "one-off" engagement. Rather, it is a journey that spans time and stages. IDC's Cloud Maturity Model traces the increasing level of investment in cloud computing and the corresponding increase in value to an organization across five stages: Ad Hoc, Opportunistic, Repeatable, Managed, and Optimized. In the Ad Hoc stage, organizations are beginning the exploration process to increase awareness of cloud technology options, key considerations, and benefits. On the other end of the cloud maturity spectrum, organizations are "optimizing" their cloud investments and best practices to drive new business innovation across the enterprise.

This section highlights best practice "rules" or lessons that IDC has learned from researching organizations that have embarked on the cloud journey. Figure 1 presents the best practice rules within the context of technology, people, and process.

FIGURE 1

Cloud Best Practices: Technology, People, and Process



Source: IDC, 2013

Best Practices: Technology

- **Build private cloud first, then implement public or hybrid cloud.** In general, IDC has seen the trend of enterprises pursuing private cloud first, as an evolution of their virtualization initiatives and for reasons of security and comfort, preferring to keep workloads and data within their own datacenter and under their control. Public cloud is being used for a small slice of workloads and is typically run as a small separate silo. Larger, company-wide adoption of public cloud happens after the organization establishes and becomes comfortable with private cloud. Eventually, the goal is to unify the private and public in a federated, seamless fashion.

- **Virtualize the infrastructure before deploying cloud.** From a technology infrastructure perspective, cloud computing deployment models begin with virtualization — the task of abstracting from physical and "software-defining" compute, storage, and networking resources. In fact, organizations virtualize their infrastructures in stages, progressing from a basic consolidation stage, to a level of integration of storage and networks, to advanced virtualization management. This final virtualization stage provides the foundation for providing a private IaaS cloud. Once an organization completes the virtualization of the base infrastructure, it may then move to provide higher-level PaaS features — that is, technology layers sitting above the hypervisor, such as database management system (DBMS) capabilities or development and testing environments.

  Cloud deployers typically have been virtualizing their environments for more than five years and are running hypervisors on over 80% of their installed servers. Likewise, cloud deployers have virtualized not only server nodes but also storage and network resources, allowing for the pooling and consequent flexible deployment of these resources. They have standardized key technology elements such as hypervisors to enable workload portability and compatibility with other cloud system software.

- **Choose your cloud platform wisely.** While hypervisors may be the foundation for cloud, the emerging layer of cloud system software, often referred to as a "cloud OS," is the real base platform for cloud and the most critical infrastructure software layer. Cloud system software will abstract across large pools of compute, storage, and networking; provide an automation/orchestration platform to manage resources algorithmically and autonomously; and present cloud application programming interfaces (APIs) to users. The choice of cloud system software determines the features, functionality, and architecture of one's private cloud as well as which public clouds it will interoperate with.

  For customers with a hybrid cloud strategy, on-premises workloads can be run inside the datacenter firewall, with inside security and enterprise-wide SLA (service level agreement) enforcement, while some workloads can run off-premises, on the public cloud, as appropriate. Examples include cloud services for human resources (HR), payroll, CRM and the like – which do not lend competitive advantage and customization to the enterprise itself. Rather, these are appropriate services to run in the public cloud (given appropriate security), as is application development (app dev) for prototyping new workloads. App dev is often run on public clouds, given its peak-and-valley profile as applications are developed by programmers – and the ability to "take down" app dev VMs that are no longer needed, following finalization of the applications themselves.

- **Deploy modular, scalable, and standardized hardware configurations. Standardize, standardize, standardize.** While limiting an IT infrastructure to a single configuration architecture would immensely simplify cloud deployments, the requirements for multiple service levels and workload types demand a level of configuration diversity. Most large cloud deployments have reduced their server configurations to a handful of different types. Many successful organizations opt for converged infrastructures that consist of pre-integrated, modular units of compute, storage, and networking that allow IT to add blocks of physical resources in a repeatable, scalable fashion.

- **Target new applications, such as testing and development applications or elastic applications, for the quickest returns and least amount of risk.** In all stages of cloud adoption, workload decisions are crucial. Which workloads to put on the cloud is a complex discussion and varies greatly by organization and by industry. Today, most applications deployed on the cloud are new applications, coded to be cloud optimized and aware. Although they are mostly non-mission-critical workloads, this will change as organizations become more comfortable with service levels and security. In general, the following workloads have been the early successful targets for cloud:

  - **Testing/development applications.** Today, most use cases for cloud revolve around the testing and development of applications, which require flexible resources to be provisioned quickly — a perfect fit for cloud. Systems can be deployed in the cloud in minutes or hours rather than days, weeks, or even months in a traditional environment. Organizations are finding that applications can be tested more thoroughly, and more quickly, decreasing the time to code new features. They are also able to experiment more easily with new ideas, which accelerates innovation, because getting approval for up-front capex investment is removed as an obstacle.

  - **Elastic applications.** These applications, which are deployed in environments where demand is unpredictable or changes greatly, typically include hyperscale Web, batch processing, and high-performance computing (HPC) workloads.

  Even though these workloads may not be mission critical, optimizing them still can provide great returns for the enterprise. As the technology proves itself, organizations will begin running production workloads and eventually progress to mission-critical, tier 1 applications once security and SLA standards can be met.

- **Change capacity planning strategy through public cloud.** Enterprises generally have overbought and underutilized IT resources in order to err on the side of having too many resources rather than not enough when planning for capacity. Those with spiky utilization also have to buy for maximum usage, even if that is not the case all the time. With the promise of a seamless hybrid cloud and applications that can burst into the public cloud, enterprises are looking to be more efficient with their capacity purchasing. Cloud allows customers to be more conservative with their on-premises capacity, knowing that they can leverage public cloud for their overage.

- **Automate everything and constantly think about scale.** While some clouds may be modest in size, planners working on enterprise-wide cloud initiatives must envision the possibility that cloud computing will spread rapidly across the company. The best-run cloud implementations are designed from the very beginning with scale in mind, and scalability is a major factor in every architecture and software/hardware purchase. Automation is one key factor to achieving scale. The methodology of cloud seeks to eliminate traditional, human-based processes that are slow and unscalable. The new cloud style of management involves programming automation and system algorithms.

- **Hedge against lock-in with hybrid cloud management.** Organizations implementing cloud today see a rapidly changing technology and fear premature lock-in. To prevent lock-in, they often look to source from multiple public providers to reduce their risk. In addition, organizations may be managing several private environments such as their virtualized servers and several cloud environments that may have different features, service levels, etc. Successful strategies include the following:

  - Implement a cloud management layer that can span multiple public clouds, multiple private cloud platforms, and even traditional virtualized servers. These solutions provide consistent provisioning across platforms and an integrated view into usage.

  - Avoid proprietary cloud APIs as much as possible. Some proprietary APIs available from only a single source can provide useful functionality. However, these less open APIs may hamper portability in the future. Many organizations use only open APIs available from multiple sources to avoid being locked in with a particular vendor or product.

  - Use cloud templating technology for portability and repeatability across clouds. A rapidly developing area of cloud is the development and standardization of templates, also known as patterns to define a cloud application. These templates contain only logical (versus physical) details of the application and its configuration and dependencies. When an organization decides to deploy the application, it can use implementation tools to convert templates into the necessary cloud-specific instantiations.

- **Set real cloud bursting as a longer-term objective.** This is a much-touted feature of cloud, but most leading early cloud adopters have found it a challenging problem to solve. While organizations can spin up new resources easily and quickly in a public cloud, many issues prevent an application from spanning private/public clouds, including the following:
  - **Distance matters.** The distance between a private datacenter and a public datacenter introduces latency, and while it can be minimized, simple laws of physics impose some amount of latency, which can cause problems.
  - **Sharing application data.** The data that an application utilizes is one of the largest problems with cloud bursting. If your data resides locally, then the public cloud instance would have to access it remotely and deal with the latency issue, which may make it impractical. The other option is to replicate the data to the public cloud. This introduces difficulty and risk because the two sets of data require constant replication and reconciliation. Likewise, replicating large data sets introduces problems of time windows and transmission cost required to transport the data.
  - **Compatibility/portability issues between different cloud platforms.** Today, the easiest way to solve this problem is to select the same platform for both the private side and the public side, but in many cases, this isn't possible or practical. Building an application that will work seamlessly across two disparate architectures is not an easy task.

Best Practices: People

People are often more difficult to change than technology. Cloud requires an entirely different way of thinking. The mindset and dedication of the people within the organization are often the most significant factors in how successfully an organization adopts cloud. It is all too easy to resist change and focus on obstacles and the reasons not to do something. Organizations that are on the leading edge of cloud usually have a core group of people with a vision and an unrelentingly desire to drive change throughout the organization.

- **Build cloud-related skill sets, roles, and leadership.** Long-term success in cloud requires not only technical competency but also a service-driven culture. Building an IT environment takes quite a bit of time and effort. A more "mature" cloud-centric enterprise IT organization typically has gone through some reorganization or, at the very least, resource allocation to enable leadership and a well-articulated cloud strategy. As a result of reorganization, new IT roles are often created to support cloud and its priorities. Furthermore, cloud skill acquisition is viewed as a "must have" competency for the IT organization.
- **Coordinate and collaborate with LOB.** IDC sees an evolution in how IT and LOB groups coordinate and collaborate throughout the cloud journey. In the Ad

Hoc stage, there is typically very limited coordination among groups on cloud requirements. However, as IT and LOB groups progress through the cloud adoption stages, we see increased knowledge sharing, transparency in decision making, and collaboration on cloud service strategy.

- **Reassign IT roles.** With the increased automation and standardization that cloud brings, companies often realize that the staff resources that used to be assigned to doing manual and time-consuming maintenance tasks are now free and can be redeployed to concentrate on new business innovation and projects that will deliver business value faster.

Best Practices: Process

- **End-to-end service management.** Managing cloud service requires a transition from a traditional IT deployment model to an end-to-end service delivery focus that defines and manages IT capabilities in terms of policies and service-level agreements (SLAs). In the early stages of cloud, it is common to see multiple service catalogs and configuration templates developed for single projects with only basic support for internal standards. As an organization reaches higher levels of cloud maturity, service management encompasses the entire IT environment, with end-to-end performance monitoring and ongoing optimization.

- **Enterprise cloud architecture.** Cloud represents a fundamental shift in the way that IT environments are designed and managed. The ability to leverage self-service, portability, and elasticity capabilities that are provided by cloud architectures across the enterprise is fundamental to achieving a mature cloud environment.

  In the earliest stage of cloud maturity, we typically see minimal consideration for cloud impact within the overall enterprise IT architecture, despite a recognition that planning is required for security, risk, and compliance concerns. This typically changes in the later stages of cloud maturity. IT architects enforce key requirements and standards (internal and external) for cloud service delivery to extend securely across all IT enterprise resources. Once the scope has reached across the enterprise, some IT organizations will even try to extend the architecture vision beyond internal clients, introducing new services to their external customers and partner base.

- **Standardization for interoperability.** Ideally, cloud environments should use standards where available to enable workload and information portability across a wide range of internal and external resources. As organizations pass through the early stages of cloud adoption, they typically begin to incorporate cloud standards into the overall IT architecture and monitor developing cloud standard policies for data portability, reclamation, service-level reporting, and security.

Unfortunately, there is no overarching, single comprehensive standard for cloud computing, and many aspects of cloud still have no clear standard. Even so, a number of open approaches can be adopted. Whatever cloud technology is chosen, it is wise to vet the provider as to the use of, and commitment to, open standards where available. In addition, at the API layer, there are emerging *de facto* standards such as OpenStack that may be implemented outside of those projects and services for compatibility and interoperability between clouds. Building bridges to multiple platforms is an increasingly important requirement for IT organizations adopting cloud, and it's crucial to vet suppliers to ensure their commitment to this strategy.

- **Vendor management.** The landscape for cloud systems and/or services is diverse and fast growing. IT organizations need to adapt their vendor management strategies to this ever-changing landscape. Ideally, procurement of cloud infrastructure or services is executed through a centralized and increasingly automated process, which supports a shift to subscription, pay-as-you-go pricing. Ultimately, cloud vendor management must include well-documented requirements and performance measurement, with a defined process for bringing in alternative providers (internal or external).

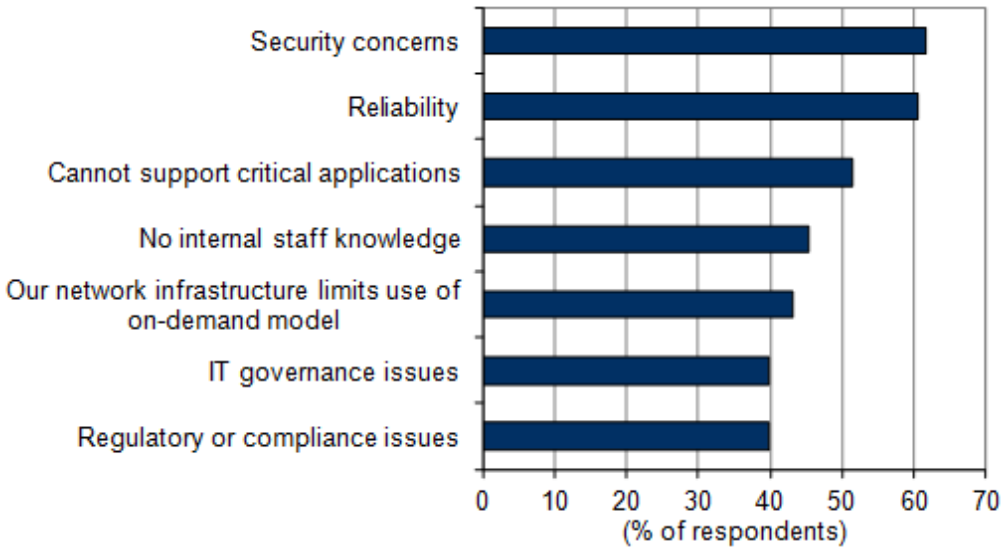
ADDRESSING CLOUD CONCERNS

IDC research reveals key concerns surrounding cloud adoption. Figure 2 lists top concerns for private cloud adoption and usage. These concerns stem from the first wave of cloud computing deployments seen in many organizations in recent years. Many of these concerns have already been addressed by new cloud offerings, while others will require more time to address fully because they are also very much about policies/procedures. But as organizations seek to move more workloads into the cloud, concerns about security, reliability, and availability are understandable and must be addressed by the IT organization that is implementing the cloud projects.

FIGURE 2

Private Cloud Concerns

Q. Which of the following describe your organization's main concerns surrounding the adoption and use of private cloud computing technologies?



n = 801

Source: IDC's *CloudTrack Survey*, 2012

Security

Security is the number 1 issue for IT organizations, and that finding is consistent across many IDC studies year after year. The concern about security stems from the Internet-enabled nature of cloud computing, which requires role-based access, careful authentication of user IDs, and restrictions for access unless security policies are met. Encryption and practices around password protection, user authentication, and awareness about the use of user IDs for access to the cloud computing portals are a means to address security concerns.

The public cloud concerns revolve primarily around the fact that these clouds are off-premises and managed by a third party. Cloud providers are highly aware of security and generally invest significantly into security for their services. The primary issue is the transparency, management, and insight provided to the customers. It is a fine line to carefully balance the level of insight given to a customer and what must be kept secret for intellectual property or security reasons. Customers will need varying levels of transparency, but all will need to be able properly audit the provider to ensure they meet the requirements and have the proper tools to manage and monitor security. In addition, companies that must meet regulatory requirements face challenges as regulations often take a long time to adapt to trends like cloud and cloud providers become better at providing audit controls and access.

Hybrid clouds involve the seamless connection between private and public and it is this connection that must be secured. It can be challenging as one side of the connection is customer managed and the other is managed by a service provider. True hybrid clouds will integrate at many layers of the stack, requiring that security extend across many facets of both private and public in order to create secure links.

Reliability, Availability and Disaster Recovery

Reliability, which is associated with availability of business services, is another key concern and is often connected with outages associated with security flaws. It can be seen as the overall reliability of the server, storage, and networking capabilities supported within the organization.

High availability is vital to mission-critical workloads (applications and databases). These workloads support the organization's business processes and cannot be interrupted or disrupted without having a widespread ripple effect throughout the organization. This concern has often limited or delayed cloud deployment of mission-critical workloads. Many of these workloads require highly custom infrastructure and dedicated physical resources, a scenario that cloud is beginning to adapt to.

One step that infrastructure vendors are taking is to develop, test, and certify converged infrastructure products combining server, storage, and networking components that co-reside in the same cabinet or frame. These converged infrastructure systems can simplify the integration of the basic datacenter resources. Much of the intelligence of cloud lies in the software and its configuration. Cloud system software enables high levels of automation that is algorithmic in nature and today failure is not so much surviving the failure of a physical component, but rather ensuring that the cloud system can handle various scenarios and that misconfigurations don't allow a cloud to spin out of control from a management perspective.

The public cloud has been improving service levels as the technology matures. However, public cloud service levels must be put into perspective relative to the architecture of the cloud, as many public clouds have very different architectures than traditional IT. Many are built for cloud native applications that run in a distributed fashion and only require service levels by zone rather than individual servers.

Hybrid cloud can increase overall reliability of IT operations by providing recovery capacity if the private or public cloud sides have failures and also allow overflow in either direction in case of unforeseen demand.

IT Skill Sets

The IT experts available to work on cloud are not evenly dispersed; that is, some organizations have "deep benches" of skilled IT experts, while others operate with just a handful of IT experts and leverage the resources of consulting services, value-added resellers (VARs), and service providers.

Private cloud practitioners will not only have to have skills in building the cloud itself, but transforming the entire organizational approach to IT to become services-led, which can be more challenging than the technology itself.

Companies adopting public cloud, will have to develop more service brokering and integration skills, as well as transforming IT processes and buying to the public cloud model.

IBM CLOUD COMPUTING PORTFOLIO

This section provides a brief summary of some of the wide array of IBM products and services that address cloud computing:

- **Servers.** IBM systems products include IBM System x, IBM Power, IBM System z, and IBM PureSystem. Each of these server platforms supports cloud computing, but each has some special features that support cloud computing in different ways, giving users flexibility of choice.

- **Software.** IBM Tivoli software products such as IBM SmartCloud Provisioning, IBM SmartCloud Orchestrator, and IBM SmartCloud Monitor provide provisioning, management, and orchestration support for cloud computing. Virtualization technologies, such as PowerVM and zVM, enable cloud computing and support provisioning of software workloads across the server infrastructure.

- **Storage.** IBM storage products address many customer deployment scenarios for cloud computing. For example, enterprises and midmarket companies may install IBM StorWize V7000 and StorWize V7000 Unified systems, which support both block and file storage. They may also select IBM System Storage DS8000 storage systems for high-capacity repositories for cloud computing. Another choice is the IBM Scale Out Network Attached Storage (SONAS) for NFS-based file storage. But smaller companies may decide to install integrated systems, or cloud appliances, as platforms for rapid deployment of on-premises storage capacity. The integrated systems have storage that is preconfigured and optimized for specific workloads, removing the need to do custom configurations at sites that have limited, or no, IT staff onsite. For high-performance storage, IBM offers the IBM FlashSystem family. These products address high speeds of data transfer for transactional data workloads and updates to data warehouses for business analytics purposes.

- **Integrated systems.** IBM PureSystems support multiple tiers of computing within the datacenter. The PureFlex system provides highly virtualized, cloud-enabled infrastructure, while the PureApplication system supports transactional software and middleware enabling cloud computing. PureData systems host scale-up and scale-out relational databases and link to unstructured data resources, such as Hadoop clusters. IDC is studying integrated systems as an approach to hosting specific workloads in an optimized way. For example, so far there are four separate PureData systems — each organized around a specific workload (e.g., transactional, analytics, and operational analytics).

- **Services.** IBM Global Services (IGS) works with customers to evaluate, design, and deploy new cloud computing infrastructure. By leveraging IT skill sets built on deep experience with thousands of cloud computing environments, IGS works with customers to automate the deployment and management of cloud infrastructure. This allows IT organizations to avoid overhiring for special projects related to cloud, bridging the IT skill set gap related to cloud projects. This approach to IT buildouts of cloud infrastructure speeds the progress of cloud computing projects, saving both time and money for new projects.

IBM SmartCloud Entry

This software offering automates the deployment and management of cloud computing infrastructure. Its support for streamlined design processes — moving from virtualized environments to cloud-enabled environments — allows IT system administrators to customize images more quickly while reducing operational errors and labor costs. SmartCloud Entry is unique in that it is supported on IBM Power, IBM System x, and IBM PureFlex and PureSystems. Key benefits associated with this approach include ease of use, rapid creation of "gold master" images for virtual servers, conserving image storage, conversion of images from physical servers to virtual servers, and supporting the exchange of VM instances between hypervisors. Overall, IBM SmartCloud Entry reduces application development cycles and provides an integrated foundation to speed deployment. Simplifying the administration of cloud computing environments eliminates provision backlogs and allows operational costs to be reduced because IT staff time is redirected to high-value products and services and repetitive management tasks are reduced.

CHALLENGES/OPPORTUNITIES

The worldwide marketplace for cloud computing is competitive — with many suppliers for cloud products and services. Because it is an emerging and fast-growing market space, new opportunities are arising on a worldwide basis. But new entrants will need to compete with companies that have already become proficient at addressing the cloud computing marketplace.

Competitors are varied, with smaller companies bringing new solutions to the market. These small firms, including start-ups, are often interested in licensing their solutions to others or in being acquired by larger companies. In contrast, larger suppliers must wear "many hats" in cloud computing — providing server, storage, or networking products while also providing cloud services in many cases. These varied roles give vendors insights into emerging market trends.

IBM has been in the cloud computing space for many years — providing servers, storage, cloud-enabling software, management software, and services that have helped thousands of customers deploy private clouds within their datacenters. At the same time, IBM has built a network of more than 15 cloud computing centers worldwide, with sites in Europe, Africa, Asia/Pacific, and the United States. The cloud computing centers offer cloud computing services directly to enterprise and midmarket companies that have identified workloads they would like to have hosted by IBM in its role as a cloud service provider.

CONCLUSION

The path to cloud computing can be daunting for many organizations given the preparations that must be made to plan, deploy, and maintain business services running on cloud computing infrastructure. The journey can be eased through the adoption of best practices that were developed based on the experiences of other organizations and what worked and what didn't work in their cloud deployments.

IBM has a broad portfolio of products and services centered around cloud computing. These products include server, storage, software, and networking solutions as well as integrated systems (e.g., PureFlex, PureApplication, and PureData) that enable cloud computing. IBM's products are optimized to deliver cloud computing capabilities to customers who are building a cloud-enabled infrastructure.

IBM's services are designed to help customers plan for cloud computing and to support the stages, or steps, associated with cloud computing adoption. IBM is well positioned to work with customers who have decided to build a more efficient and capable IT infrastructure and to adopt cloud computing as a way to improve business agility.

Private cloud is a model that appeals to companies with large scale and high security requirements.

Public cloud will be the primary computing model for many smaller companies and startups looking to save on capital, while serving as a supplement for larger companies.

Integrating private and public into a hybrid cloud allows customers to reap the benefits of both and easily migration and transition between the two as needed.

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These products include server, storage, software, and networking solutions as well as integrated systems (e.g., PureFlex, PureApplication, and PureData) that enable cloud computing.

IBM's products are optimized to deliver cloud computing capabilities to customers who are building a cloud-enabled infrastructure, along with the professional services needed to deploy it.

LEARN MORE

Related Research

- *IDC Maturity Model: Cloud — A Guide for Success* (IDC #239772, March 2013)
- *IDC's CloudTrack 2012 Summer Survey, Part 2: Expansion of Functional Use Cases* (IDC #238690, December 2012)
- *IDC's CloudTrack 2012 Summer Survey, Part 1: Cost Savings in the Cloud* (IDC #237693, November 2012)

GLOSSARY

- **Cloud computing** is a model of computing where IT resources are delivered in several key ways:

- On demand, as resources are needed with the ability to scale elastically
- Provision and configure through a self-service portal without human intervention
- Resources such as compute and storage that are pooled and shared with all users for higher efficiency, often using virtualization technology to do so
- Billed in granular, pay-as-you-go, pay-for-only-what-you-use increments
- Broadly accessible through standardized network mechanisms from a broad variety of devices
- Accessible through cloud APIs that allow users and software to interact with the cloud

- **Public cloud** is a cloud external to an organization that is run by a service provider. Public clouds are multitenant, where multiple customers share the cloud infrastructure with logical separation and isolation done in software.
- **Private cloud** is a cloud that is dedicated to a single organization. A private cloud most typically refers to a cloud that is located within an enterprise's datacenter and managed by the enterprise. It can also refer to a hosted private cloud, where the cloud is located at a service provider and managed by the provider. The provider has dedicated hardware for each customer; there is no sharing of the infrastructure as in public cloud.
- **Hybrid cloud** is the result of connecting multiple clouds, typically a private on-premises cloud and one or more external public clouds. Means of connection and the extent of the connection vary, but the idea is that it should be seamless and allow applications to move between the clouds, resources to be managed similarly across all clouds, and identity/authentications to be federated.
- **Infrastructure as a service (IaaS)** is a type of cloud that provides infrastructure such as compute, storage, and networking as a service.
- **Platform as a service (PaaS)** is a type of cloud that provides application platform services, such as programming language execution environments, database, and Web servers. Users focus on developing their application code rather than managing the underlying infrastructure. PaaS is typically a software layer built on top of an IaaS cloud.
- **Software as a service (SaaS)** is a type of cloud that provides a finished application as a service, typically over the Web.
- **Cloud bursting** is a concept of application scaling where an application is running in an on-premises datacenter and "bursts" out to a public cloud when additional capacity is needed.
- **Service catalog** is a catalog of all IT services that an organization or a cloud provides. It contains descriptions and definitions of each service, such as what the

service does, SLAs, costs, how to request the service, etc. The service catalog is typically stored in a database and published via various methods to users.