IBM Smart Business
Thought Leadership White Paper

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Dispelling the vapour around cloud computing

Drivers, barriers and considerations for public and private cloud adoption

IBM

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Introduction

In recent years, cloud computing environments have been gaining popularity. In the IBM Global Chief Information Officer (CIO) Study 2009, when asked about their most important visionary initiatives, cloud computing was cited by more than one-third of CIOs as being among the most important.

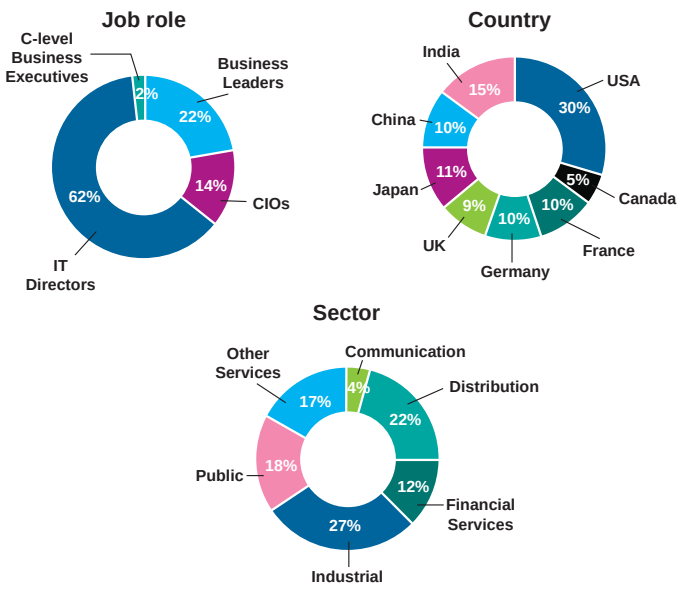
The many inherent benefits of a cloud environment make it attractive to organisations looking to speed service delivery and increase IT efficiencies while supporting information management, service management and service-oriented architecture (SOA) initiatives. While cloud computing offers distinct advantages, organisations that are considering adoption must carefully strategise about delivery models, workloads and infrastructure readiness.

Before developing a cloud strategy, it's important to understand what cloud computing really is. Cloud computing is both a user experience and a business model. It is an emerging style of computing in which applications, data and IT resources are provided to users as services delivered over the network. It enables self-service, economies of scale and flexible sourcing options. In addition, cloud computing is an infrastructure management methodology – a way of managing large numbers of highly virtualised resources, which can reside in multiple locations, so that they resemble a single large resource that can be used to deliver services. Additionally, there are multiple cloud delivery models available – some are internal (private), some external (public) and some are a combination of both (hybrid).

To better understand the current rate of adoption, as well as drivers, barriers and considerations that are influencing the adoption of cloud computing, IBM conducted a survey in June and July of 2009 of 1,090 IT and line-of-business (LOB) decision makers around the world. The purpose of this white paper is to share the survey findings and to provide the IBM point of view regarding key steps and considerations for cloud adoption. The findings validate that many organisations are at least considering cloud computing – most favour a private cloud delivery model at this time – yet significantly, less than a quarter of organisations surveyed have mature service management and infrastructure capabilities that are essential for cloud.

Survey scope and definitions

The popularity of cloud computing and its potential to transform service delivery has led a growing number of organisations to implement cloud computing for one or more workloads, while many others are actively considering it. Those surveyed included IT and LOB decision makers across the U.S., Canada, France, Italy, Germany, the UK, Japan, China and India. Most were from companies of between 1,000 and 9,999 employees (see Figure 1). Respondents represented a variety of industries, including public sector, communications, distribution, financial services, industrial and others.



Source: IBM Market Insights, *Cloud Computing Research,* July 2009. n=1,090

Figure 1. Survey demographics. Respondents to IBM's cloud computing adoption survey included IT and business decision makers from eight countries, representing a cross section of industries and company sizes.

The survey addressed three aspects of cloud computing:

- *Sourcing choices* – adoption or consideration of cloud delivery models, plus drivers behind and barriers to adoption
- *Workload considerations* – public and private cloud preferences by workload type
- *Service delivery within the cloud* – service management considerations and infrastructure readiness.

Survey definitions

Clouds were defined according to three types: public, private and hybrid.

Public clouds – IT activities/functions are provided 'as a service,' over the Internet, which allows access to technology-enabled services without knowledge of, expertise with, or control over the technology infrastructure that supports them. Also called 'external cloud.'

Private clouds – activities and functions are provided 'as a service,' over a company's intranet. It is built by an organisation for its own users and everything is delivered within the organisation's firewall (instead of the Internet). The private cloud owner does not share resources with any other companies, so multi-tenancy is not an issue. Also called an 'internal cloud.'

Hybrid clouds – the external and internal service delivery methods are integrated. Rules and policies are established by the organisation based on factors such as security needs, criticality and underlying architecture, so that activities and tasks are allocated to external or internal clouds as appropriate.

While 73 percent of respondents said they were already familiar with the internal and external (private and public cloud) delivery models described in the survey, there was little consistency in the terms that respondents associated with these delivery methods. For example, 30 percent of respondents selected 'software as a service (SaaS)' as the term that best described the delivery models, while only 24 percent selected 'cloud computing.' Other choices included 'hosting' (19 percent), virtualisation/consolidation (16 percent) and utility computing (four percent).

As part of the study, respondents were asked to rate workloads they would most consider for deployment in a public or private cloud environment.

Workloads – the kind of work that an organisation needs to accomplish. Each workload has characteristics that make it run most efficiently on certain types of hardware and software. Some demand fast transactions, like Automated Teller Machines (ATMs), while others, like predictive analytics, require intense calculations. The full list of 25 workloads included in the survey is shown in Table 1.

Workload type	Workload
Analytics	• Data mining, text mining, or other analytics • Data warehouses or data marts • Transactional databases
Business services	• Customer Relationship Management (CRM) or sales force automation • E-mail • Enterprise Resource Planning (ERP) applications • Industry-specific applications
Collaboration	• Audio/video/Web conferencing • Unified communications • Voice over Internet Protocol (VoIP) infrastructure
Desktop and devices	• Desktop
Development and test	• Development environment • Test environment
Infrastructure	• Application servers • Application streaming • Business continuity/disaster recovery • Data archiving • Data backup • Data centre network capacity • Security • Servers • Storage • Training infrastructure • Wide Area Network (WAN) capacity

Source: IBM Market Insights, *Cloud Computing Strategy Research,* July 2009.

Table 1: Workloads. The study asked respondents to rate 25 different workloads they had already deployed or would consider deploying in a public or private cloud.

Cloud computing adoption and consideration factors

Organisations around the globe are drawn to cloud computing for its ability to speed service delivery and increase service and infrastructure availability while creating an elasticity that allows services to be expanded – or contracted – as demand changes. And because organisations can leverage economies of scale through a cloud environment, they can also reap a higher Return On investment (ROI) via greater staff efficiency and optimisation of IT resources. Cloud computing supports efforts to establish an SOA and to enhance information management and service management. With all these benefits in place, cloud computing can also help improve the perception of IT as being both flexible and responsive.

The study found that decision makers express openness to both public and private cloud, although the consideration and adoption rates for the private cloud delivery model were higher. Of those surveyed, 64 percent rated private cloud delivery 'very appealing or appealing,' compared to 38 percent for hybrid cloud and 30 percent for public cloud. What's more, at least 25 percent of decision makers report that they have already implemented an internal cloud.

Cost savings and time to value are the leading drivers

The survey reveals the primary drivers for cloud adoption in general and public cloud adoption in particular are cost savings and faster time to value. In fact, as shown in Figure 2, 77 percent of respondents chose cost savings as a key driver for public cloud adoption, citing anticipated savings in the areas of software licenses, hardware, labour, IT support and maintenance. One-third of respondents said they require a 20 to 29 percent cost savings to make a compelling case for a migration to cloud. In IBM's experience, actual savings in many cases exceed that 20 to 29 percent threshold. However, the level of savings achievable depends upon many factors, including the types of workloads being processed, the delivery method selected and the efficiency of the infrastructure to be replaced by cloud.

Factors that deliver faster time to value were identified as key drivers by 72 percent of respondents, including relieving pressure on internal resources, simplifying system updating or upgrading and being able to scale IT resources to meet needs. And half of respondents said they were motivated by the ability to improve system availability and reliability.

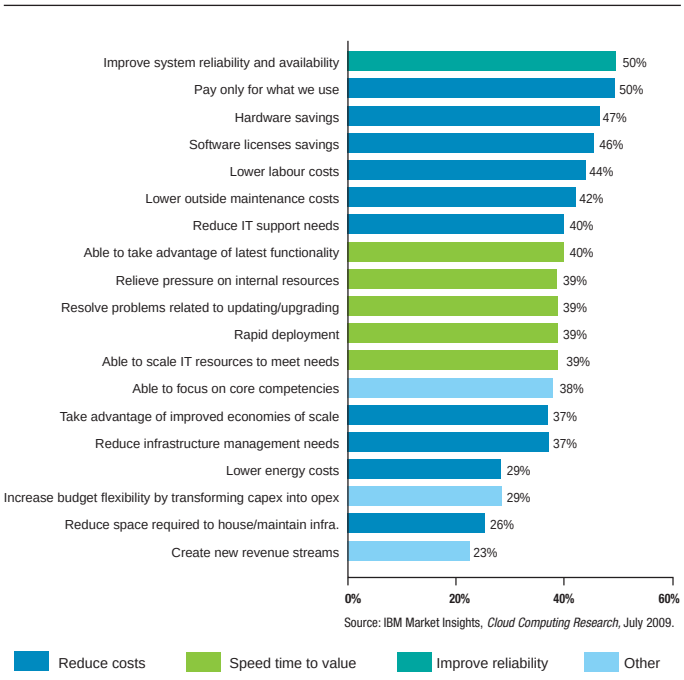


Figure 2. Public cloud drivers. Cost savings, time to value and improved availability are the leading attractions for using a public cloud service.

Data security concerns are a barrier to public cloud adoption

Sixty-nine percent of respondents said that concerns about data security and privacy were the primary barrier to public cloud adoption and more than half cited concerns about service quality and performance (54 percent), doubts about true cost savings (53 percent) and insufficient responsiveness over the network (52 percent) as hindrances to public cloud adoption. Workloads rated as the least favoured for public cloud, by far, were those related to security and databases. Despite those concerns, public cloud adoption is expected to gain momentum in coming years. Though private cloud is most favoured now, adoption of public clouds is expected to grow by 26 percent Compound Annual Growth Rate (CAGR) between now and 2013.[1]

Workload preferences for private and public cloud

Since workloads vary according to platform requirements, complexity, business criticality and data sensitivity, some are ideal for a public cloud, while others are more suitable for deployment in a private cloud. For this reason, a workload-based approach to cloud computing is essential in determining which delivery model is best for that workload – public, private or hybrid – and in understanding which workloads can realise the greatest benefits in a cloud environment.

In addition, some workloads, due to their characteristics (low risk and high potential for ROI) are better candidates for a cloud pilot project. An example of this is test environment infrastructure and provisioning, a type of IT infrastructure workload in which IT resources are allocated to test applications or systems management initiatives, such as server virtualisation, in a protected environment so that production activities are unaffected.

In the study, we found that workload types favored for public and private cloud deployment varied widely. Conferencing and CRM/sales force automation were among the highest ranked for usage consideration for public cloud, while they were among the lowest for private cloud. Within public cloud rankings, there was more than a 20 percent spread between the highest and lowest ranked workloads. For private cloud, consideration rates were much more consistent, varying by less than 10 percent for the top 15 workloads.

For this analysis, 'consideration' is defined by the percentage of respondents reporting that, for a particular workload, they:

- Had already implemented an internal or external delivery method
- Were planning an internal or external delivery method within the next 12 months
- Would consider implementing an internal or external delivery method in the next 12 months
- Would consider implementing an internal or external delivery method in more than 12 months.

Workload preferences for private cloud

Database and application-oriented workloads emerged as most appropriate for potential private cloud adopters. However, private cloud consideration was high across all workloads. As shown in Figure 3, the top five considered workloads included data mining, text mining, or other analytics, by 83 percent; application streaming, by 81 percent; service/help desk by 80 percent; industry-specific applications by 80 percent; and test and development environments tied at 80 percent.

Moreover, actual implementation rates for private cloud were high across all workloads, although not as consistent as consideration rates. Forty-six percent have implemented service/help desk. Other workloads that nearly half of respondents said they had already implemented in a private cloud include desktop (45 percent), e-mail and application server workloads (both 44 percent).

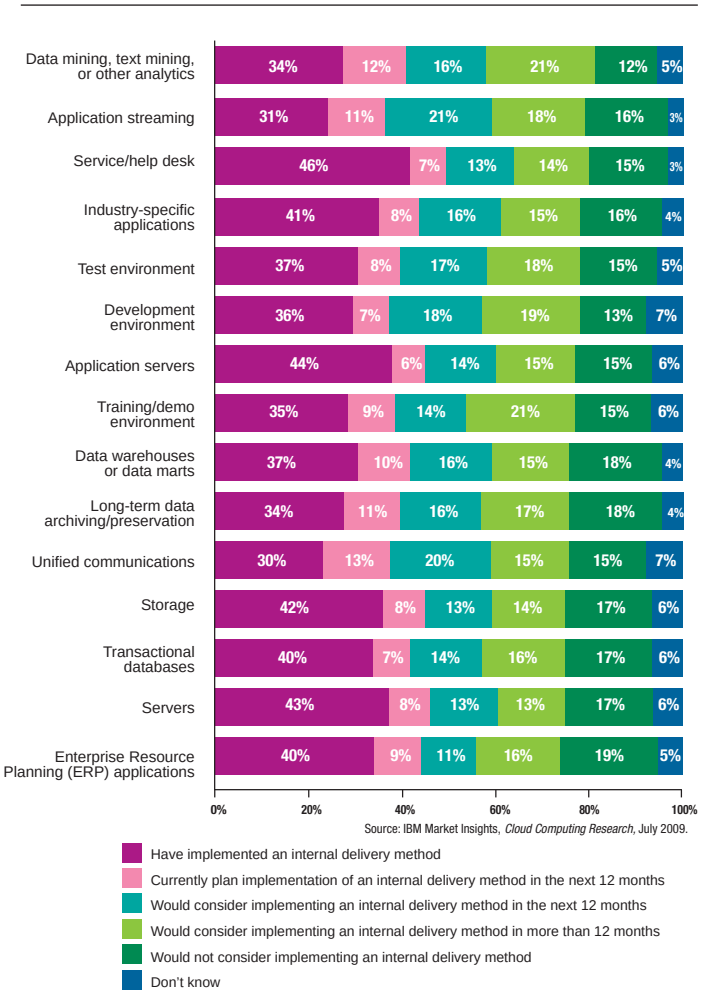


Figure 3. Preferred private cloud workloads. Analytics, application streaming, service/help desk, industry-specific applications and test and development environments were most favoured for a private cloud.

Workload preferences for public cloud

Overall, infrastructure workloads emerged as most favored by respondents for public clouds, but the most attractive usage was for CRM, an application workload. As shown in Figure 4, the top five favored workloads for public cloud deployment, based on those who said they were currently using, were planning to or would consider implementing them in a year or more, included: audio/video/Web conferencing, by 71 percent; CRM or sales force automation, by 61 percent; business continuity/disaster recovery, by 60 percent; data archiving, by 59 percent; and application streaming, by 58 percent. CRM and conferencing are already popular SaaS workloads, which makes them logical selections for public cloud implementation.

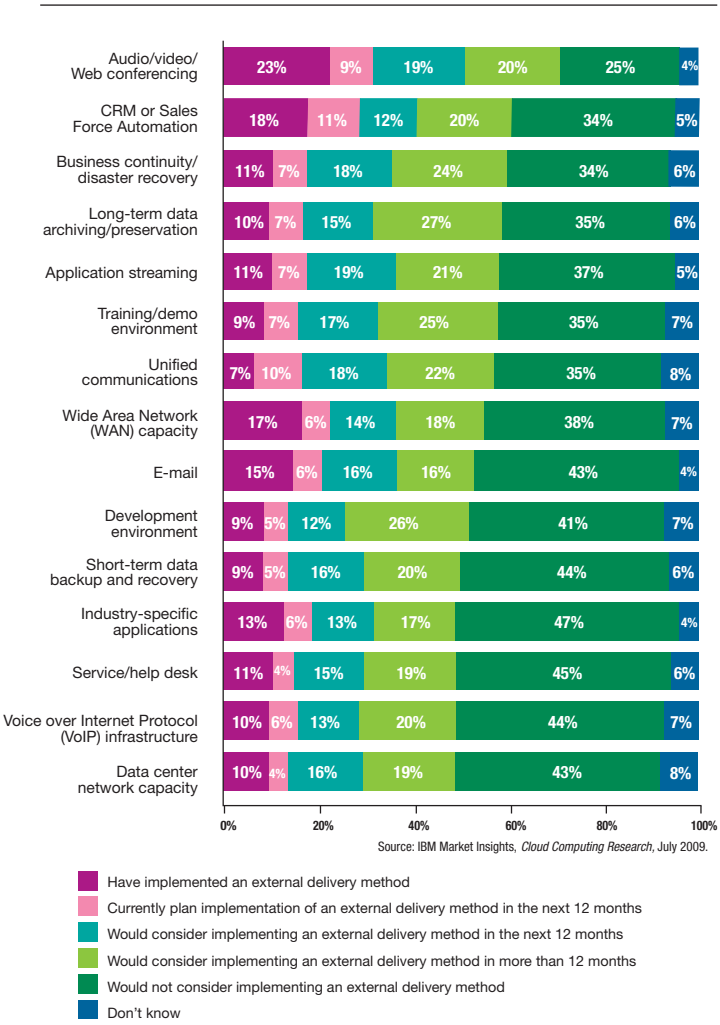


Figure 4. Preferred public cloud workloads. Conferencing and CRM or sales force automation topped the list of preferred public cloud workloads.

On the other hand, respondents have clearly indicated their position that not all workloads are good candidates for migration to a public cloud environment. Some examples include:

- Highly sensitive data workloads (e.g. employee and health care records)
- Multiple, codependent services (e.g. high throughput online transaction processing)
- Workloads requiring a high level of auditability and accountability (e.g. those subject to Sarbanes-Oxley)
- Third-party software that does not have a virtualisation or cloud-aware licensing strategy
- Workloads requiring detailed chargeback or utilisation measurement (e.g. capacity planning and department-level billing)
- Workloads requiring customisation (e.g. customised ERP applications).

Push factors versus barriers

As part of the survey, respondents were asked to identify the factors that would influence their deployment choices for each workload – either for or against public or private cloud adoption. 'Fluctuating demand' and 'unacceptably high costs for traditional IT delivery' emerged as 'push' factors for both public and private cloud. The factors that skewed preference in favour of public cloud (and against private) were whether or not the workloads are highly standardised, modular and independent. Conversely, concerns about data privacy, compliance with regulatory requirements and being able to maintain a high level of control over the environment were associated with a higher propensity to choose private over public cloud models.

IBM derived a public cloud adoption index and a private cloud adoption index for each workload by analysing:

- The implementation rankings for public versus private clouds
- The barriers against and push factors for private and public cloud adoption
- The relative budget expenditure.

As discussed above, the self-reported consideration rate for private cloud workloads was consistent, with between 40 and 50 percent reporting current or planned private cloud implementation across all workloads. However, a different picture emerged with the adoption index analysis, with a wider spread between the workloads with the highest push/lowest barrier factors and those with the lowest push/highest barrier profile.

Workload recommendations

Based on the adoption index analysis and IBM's own cloud implementation experience, both internally and with clients, IBM has identified the workloads that offer the most favourable entry points for public and for private cloud delivery models. For organisations interested in piloting a public cloud service, the infrastructure workloads listed in Table 2 will most likely be the projects that will pose the lowest risk and offer highest potential return. The same holds true for the workloads listed as top candidates for private cloud implementation.

Note that 'test environment infrastructure' appears in both lists. This is because it is a relatively low-risk workload in terms of the business and the overall IT operation. In addition, this workload has the potential for large ROI

through gains in speed and cost reduction. Therefore, IBM recommends that test environment infrastructure workloads should be considered a strong candidate for a pilot cloud project in either delivery model.

Public cloud entry points: infrastructure workloads are most appropriate

- Audio/video/Web conferencing
- Service help desk
- Infrastructure for training and demonstration
- WAN capacity
- VoIP Infrastructure
- Desktop
- Test environment infrastructure
- Storage
- Data centre network capacity
- Server

Private cloud entry points: database and application workloads are most appropriate

- Data mining, text mining, or other analytics
- Security
- Data warehouses or data marts
- Business continuity and disaster recovery
- Test environment infrastructure
- Long-term data archiving/preservation
- Transactional databases
- Industry-specific applications
- ERP applications

Table 2. Workload recommendations. Based on the analysis of study data and experience with actual cloud implementations, IBM has identified workloads that will most likely pose the lowest risk and offer highest potential return for cloud projects.

Some workloads are ideal for migration to a cloud environment, while others are not, so it is essential for organisations to understand workload infrastructure and business requirements to adopt the optimum cloud environment and to fully realise its benefits. IBM Research has developed a workload analysis tool that can help characterise and prioritise candidate workloads for delivery from the cloud.

Service management process criticality

The study also explored certain readiness factors for cloud implementation. Respondents were asked to rank 18 service management processes and functions based on how critical each is to the organisation. The ranking was on a scale from 1 to 5, where '1' was 'not critical at all' and '5' was 'extremely critical.' Figure 5 shows the percentage of respondents who rated each function either a 4 or 5: 'very critical' or 'extremely critical.'

As shown in Figure 5, the majority of respondents said they were focused on the traditional disciplines of systems management: security, networks, servers and applications. Ranked as less critical were the next layer of service management: availability, problem, capacity and change management.

The significant finding is the gap that the survey revealed between the rate of organisations that have deployed, or plan to deploy, a private cloud and the importance given to service management capabilities that are essential to the delivery of services via cloud. In a cloud environment, service management is key to automating self-service, automating

provisioning and managing access and security across the environment. Yet, as seen in Figure 5, these functions were rated as critical by fewer than 25 percent of respondents.

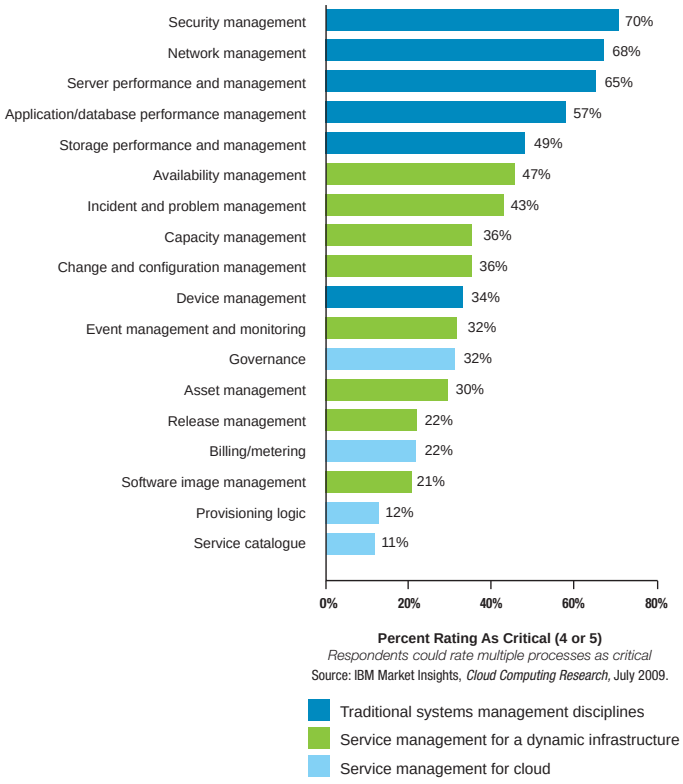


Figure 5. Service management process criticality. Responses showed a lack of importance given to service management capabilities that are essential to the delivery of services via cloud.

Cloud computing is the ultimate step in building a dynamic infrastructure, as discussed in the next section. In fact, the transformative steps between building a dynamic infrastructure and progressing to a cloud computing environment are defined as the addition of provisioning, usage accounting and self-service catalogue capabilities. For these reasons, IBM recommends prioritising the following service management processes, each of which is essential to successful service delivery in a private cloud. For organisations considering public cloud services, it will be important to verify that the service provider is able to provide these capabilities.

Service catalogue – Self-service is a key defining capability for cloud. The service catalogue is the interface that allows users/customers to select, size and order the services they want.

Governance – Governance is the discipline that helps minimise risk, maximise value and align IT and business objectives.

Provisioning logic – The provisioning function works with the service catalogue by translating the user's request for a service – for example, a test environment with 'x, y and z' characteristics – into a specific infrastructure configuration. Most importantly, this provisioning must take place automatically, without any hands-on intervention by the IT staff.

Usage/accounting – Also known as 'metering and billing,' this process tracks actual usage according to defined metrics and translates them into either an internal charge-back transaction or a bill for the public cloud customer.

Overall, the survey revealed that although respondents are more interested in private cloud, there are significant gaps in organisational and infrastructure readiness, with fewer than 25 percent addressing service management issues that are essential to deliver services within a private cloud.

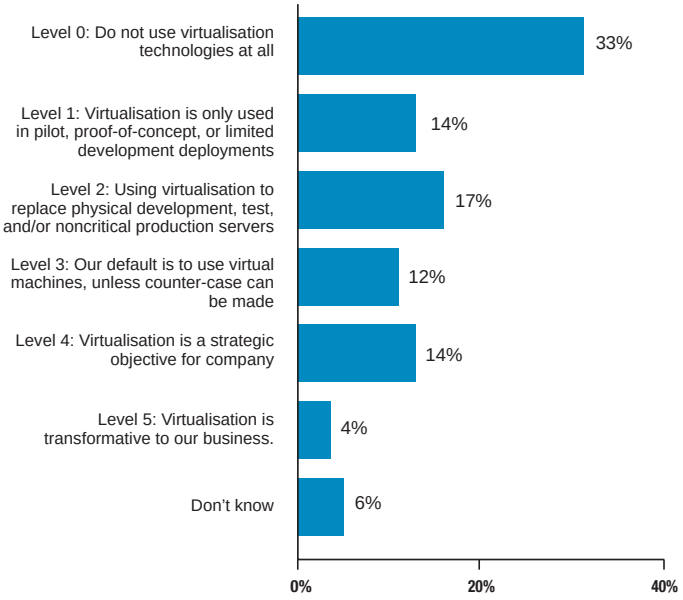
Key success factors

Just as service management considerations are critical to realising the benefits of a cloud computing environment, so is establishing a dynamic infrastructure, with capabilities for resource virtualisation, service standardisation and automated provisioning of IT resources (which delivers the greatest potential for cost savings). Implementation of private cloud is a best-practice evolution of a dynamic infrastructure, which has the characteristics necessary to improve the quality and speed – and reduce costs of – delivering IT services.

Specifically, an infrastructure that is 'cloud-ready' will have the following characteristics and capabilities:

- Open-standards-based and service-oriented
- Advanced virtualisation and automated management
- Common components and processes
- Advanced security and resiliency.

In addition to the gap in service management readiness, the survey also revealed that few respondents are far along in the virtualisation maturity continuum. In fact, as shown in Figure 6, only 18 percent indicated that virtualisation is considered a strategic objective or a transformative technology, while one-third reported that they are not currently using virtualisation technologies at all. If not already in place, organisations can look to IBM to help implement the capabilities needed for a cloud-ready infrastructure.



Source: IBM Market Insights, *Cloud Computing Research,* July 2009.

Figure 6. Use of virtualisation technology. Only 18 percent or respondents indicated that virtualisation is considered a strategic objective or a transformative technology for their organisations.

The steps toward cloud computing

Having a cloud adoption strategy and following the correct pathway to adoption are essential to success. This can be the most challenging phase of the adoption process, as was born out in this research and it is the stage at which most respondents said they would be prone to request outside assistance. With a strategy that prioritises workload types for consideration and maps them to the optimal delivery model, cloud computing presents a tremendous opportunity for IT organisations to increase business value and ROI.

In a world that is becoming more instrumented, interconnected and intelligent, cloud computing represents a smarter way to deliver services, use resources, control costs and maintain a competitive advantage. With an IT strategy that embraces cloud computing, CIOs can better satisfy their customers through improved visibility of IT resource use, better responsiveness, simplification and cost-effective service delivery. Some CIOs worry that cloud computing will be disruptive to IT operations, but properly implemented, cloud computing can help lower costs, increase IT responsiveness and optimise service delivery. Cloud computing can also increase the range of an organisation's services, applications and capabilities available to customers. To make the benefits of cloud computing a reality, CIOs must embrace the necessary changes.

Successful implementation requires an overall strategic vision combined with a pragmatic, evolutionary approach to deployment – one that IBM has developed through its many cloud engagements with customers around the world and within IBM. Today, IBM is helping organisations around the world get started on the journey toward cloud computing by following six strategic steps to cloud adoption.

1. Create the IT strategy and roadmap

Begin by determining the goals for the organisation regarding cloud service delivery and the platform requirements and complexity associated with each. Goals can include:

- Centralisation to reduce data centres and costs
- Consolidation of servers and storage to reduce the carbon footprint
- Virtualisation to increase hardware utilisation and standardise virtual images
- Automation of service management processes application migration
- Optimisation of resources and dynamic provisioning of services.

2. Assess and select workloads for cloud

Identifying and prioritising workloads that are candidates for cloud delivery is the next step. Workloads that are amenable to standardisation, are self-contained applications or have an SOA are more likely to be easily ported to a cloud environment. Conversely, workloads that will be more difficult, risky and costly to migrate to cloud computing are typically highly complex, require high amounts of data transfer or involve a high degree of customisation or are legacy systems that would require significant redesign to conform to cloud architecture.

3. Determine the cloud delivery model

Once you have identified candidate workloads, you can then establish which are more suited for delivery via a public cloud, a private cloud, or a hybrid of both. For public clouds, infrastructure and SaaS workloads pose the least risk and offer the highest potential ROI. These include audio, video and Web conferencing, help desk and training infrastructure, desktop environments and storage. For private clouds, data mining, text mining, analytics, security and business continuity workloads offer higher potential ROI and lower risk. Test and developer environments are considered good workload candidates for both public and private cloud.

4. Determine the value

Examine the ROI that cloud computing can bring, including time required for initial payback as well as projected ROI. In determining ROI, start by calculating the absolute savings that will be realised from all facets of IT operations related to the workload in question – including, for example, hardware costs, software licenses and upgrades, system administration, system support, end user support and provisioning. ROI calculations can also include business-related measures, such as increases in user productivity and resource utilisation; avoidance of capital expense; and reduction of risk due to higher availability.

In addition to looking at first-year savings, IBM recommends that clients project operating costs of both the legacy IT environment and the cloud environment over three years to calculate ROI over a longer term. Our research has shown that while all IT costs may increase over time, typically cloud computing costs will increase at a lower rate – resulting in increasing value.

5. Establish the architecture

The final step prior to implementation is to establish the architecture that will support your cloud initiatives, both public and private. A cloud architecture should address three 'domains:'

- **What are the services you will deliver or acquire?** These include infrastructure as a service ('raw' computing capacity); platform as a service (computing capacity plus middleware); or SaaS (computing capacity plus middleware plus applications)
- **How will you create and deliver the services?** This includes the tools, procedures and governance required to plan, define, catalogue, configure, deliver, monitor, measure, bill and report on cloud-delivered services
- **How will users access the services?** A service catalogue that enables end users to select, order and configure cloud-delivered services is an essential component of a cloud architecture. In addition, for private clouds, the architecture should address providing an operational console for service delivery and operational managers.

Underlying all three domains is the cloud platform – the architecture layer that defines the dynamic infrastructure for cloud delivery, as well as the service management disciplines that enable service delivery and end user access.

6. Implement the IT strategy, roadmap and cloud services

A key component of an IT strategy leading to cloud is conditioning your infrastructure for cloud delivery. This may include virtualising and automating existing systems, adding the service management capabilities requisite for cloud computing.

The roadmap for cloud implementation defines a pilot project or projects that will enable the IT organisation to gain experience with cloud computing delivery while end users gain experience with standardised applications and services delivered over the network. This pilot could be delivered from a private cloud platform, or it could be a pilot using trusted public cloud services. Either way, the pilot should deliver an isolated, low-risk workload.

Building on lessons learned, the next steps in the roadmap will be to enable additional workloads and extend cloud services to new users. Once fully implemented, the cloud environment will meet end-user needs through a single portal with a catalogue of services that are automatically provisioned through the cloud.

The Cloud Computing Adoption Framework, developed by IBM, can be a helpful tool in following these steps to implementation. The framework establishes common definitions for cloud computing delivery models and services, illustrates the key capabilities to consider in developing cloud computing strategies and identifies key aspects required to successfully execute that strategy.

The IBM cloud experience

In addition to numerous customer engagements, IBM has put cloud computing into practice in its own data centres around the world, and is able to draw on best practices to share in customer implementations. Here are some examples:

- ***Blue Insight.*** An internal IBM cloud computing implementation that provides information on demand (IOD) and analytics as a service to IBM employees to help them make better business decisions
- ***Cloud Sandbox.*** This internal version of IBM Smart Business Development and Test on the IBM Cloud (available in 106 countries as a free beta service at time of publication) provides users with self-service access to virtual computing environments as well as environments preconfigured with IBM developer and database software
- ***IBM Research Compute Cloud (RC2).*** RC2 is a self-service, on-demand IT delivery solution that enables IBM researchers to quickly and easily configure computing environments needed for research projects
- ***IBM Learning Centres, Europe.*** The internal cloud computing solution for IBM Learning Centres in Europe improved infrastructure utilisation by 80 percent and reduced staff by 30 percent
- ***IBM Computing on Demand.*** This service provides an enterprise-class public cloud computing solution that enables clients to tap into IBM computing resources by the hour, week or year.

For more information

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The IBM home page can be found at **ibm.com**

[1] IDC eXchange, IDC's New IT Cloud Services Forecast: 2009-2013, p=543, Oct 5, 2009.

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