Cloud computing insights from 110 implementation projects

IBM Academy of Technology Survey

IBM

Contents

Executive summary

Over the past several years, IBM has gained valuable experience implementing cloud solutions within our clients' environments and within IBM. Now, as the cloud computing market matures, it is time to begin capturing the knowledge we have gained through these implementations. While cloud adoption frameworks were developed early on to predict what customers might do with cloud, we believe enough implementations exist to validate those predictions and to recalibrate where necessary. This white paper from the leadership of the IBM Academy of Technology represents the findings from 110 case studies of cloud computing implementations in a survey conducted in August 2010.

The case studies are mainly from mature markets and mainly from companies with more than 5,000 employees. With the exception of the chemical and petroleum industry and industrial products, virtually every industry is represented. The banking, government, telecom, insurance and financial markets industries represent over half of the case studies.

In brief, our survey findings show that:

- IT efficiencies, consumer interfaces featuring ease of use, and new charging models are the primary motivations for client cloud implementations.
- Conversely, security concerns, pricing strategies, system complexity, rapid technology advancements of cloud capabilities, gaps in standardization and a lack of clear value propositions are seen as the biggest inhibitors to cloud computing.
- Integrated vendor offerings combined with ongoing support (applying best practices) are in high demand.
- Service design is the most popular IT Infrastructure Library® (ITIL®) discipline, but other categories like image management and security management are expected to become critical.
- While noncritical workloads like development and test dominate cloud usage today, the survey participants believe that noncritical as well as critical production workloads will be implemented on cloud in two years' time.
- There is currently a 30 percent/70 percent split between public and private cloud engagements; however, over the next two years, respondents see the use of data and information produced by cloud customers more than doubling, with a corresponding decrease in exclusive internal use.

This paper examines our survey findings: where clients are with cloud computing, what challenges they face, how they are benefiting from their existing implementations and where they expect to be in two years' time.

Introduction and methodology

To obtain our results, the IBM Academy of Technology defined a series of questions and sent them to IBM technical employees with client-facing roles, most of whom are IT architects. The responders, who span the range of IBM business units, including services, software, systems technology, and research and development, then solicited feedback from their cloud computing clients. In most cases, the feedback is from primarily large clients. While private clouds offering
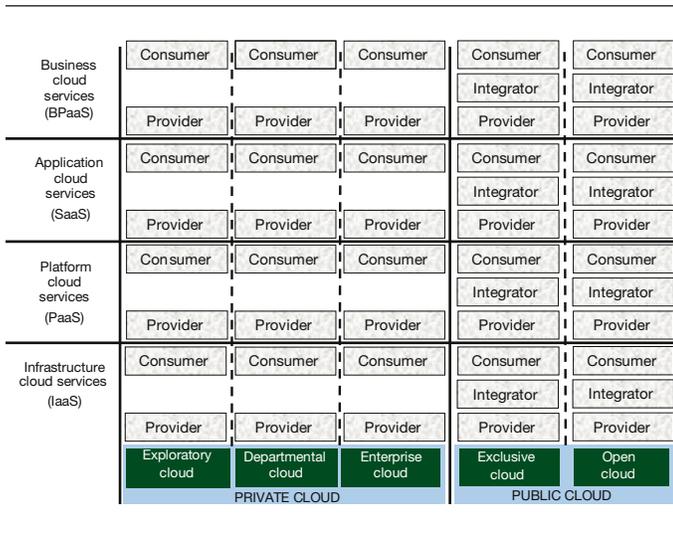
Business cloud services (BPaaS)	Consumer	Consumer	Consumer	Consumer	Consumer
				Integrator	Integrator
	Provider	Provider	Provider	Provider	Provider
Application cloud services (SaaS)	Consumer	Consumer	Consumer	Consumer	Consumer
				Integrator	Integrator
	Provider	Provider	Provider	Provider	Provider
Platform cloud services (PaaS)	Consumer	Consumer	Consumer	Consumer	Consumer
				Integrator	Integrator
	Provider	Provider	Provider	Provider	Provider
Infrastructure cloud services (IaaS)	Consumer	Consumer	Consumer	Consumer	Consumer
				Integrator	Integrator
	Provider	Provider	Provider	Provider	Provider
	Exploratory cloud	Departmental cloud	Enterprise cloud	Exclusive cloud	Open cloud
		PRIVATE CLOUD		PUBLIC CLOUD	

Figure 1: Cloud adoption framework.

infrastructure and platform services in large environments provided the majority of the input for this paper, it should be noted that the cloud adoption framework predicts a second large market segment at the other end of the spectrum, as shown in Figure 1.

We should therefore anticipate larger numbers of small clients purchasing business process as a service (BPaaS) and software as a service (SaaS) via public clouds.

With the exception of the chemical and petroleum industry and industrial products, virtually every industry is represented. As Figure 2 illustrates, banking, government, telecom, insurance and financial markets industries dominate with more than 50 percent of the sample.

Our survey questions focused on how our clients' existing cloud computing implementations are addressing specific areas. These included:

- Overall cloud scenarios
- Cloud consumption model
- Cloud infrastructure
- Cloud service management
- Organizational and skill requirements and gaps
- Cloud security
- Cloud information management

We then asked the clients what they expect their answer to be in two years. The next several sections of this paper discuss our survey results in detail.
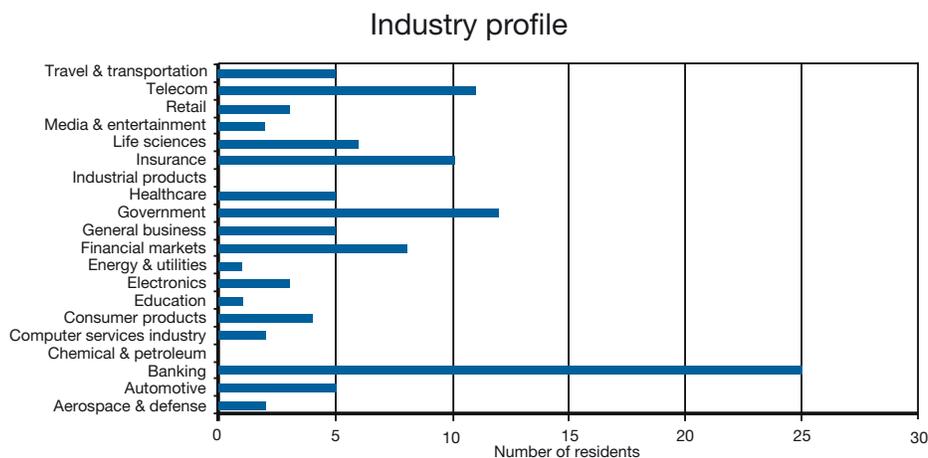
Industry profile

Figure 2: Industry profiles represented within the survey.

How are clouds used?

Organizations today are implementing three primary delivery models for cloud: private, public and hybrid. In private clouds, IT activities or functions are provided "as a service," over an intranet, within the enterprise and behind the organization's firewall. In public clouds, IT activities or functions are provided "as a service" over the Internet. For hybrid clouds, internal and external service delivery methods are integrated, with activities or functions based on security requirements, criticality architecture and other established policies. These implementations can be undertaken for any number of reasons, including a consumer interface featuring ease-of-use, IT efficiencies and new charging models.

Cloud usage is currently dominated by development and test as well as noncritical production workloads with 50 percent of usage being for local pilots while only 20 percent of usage is at the enterprise level. Clouds are mainly applied to loosely coupled workloads and support content-centric workloads focusing on internal IT infrastructure, application development and test scenarios, and web infrastructure. This usage is split between public and private cloud engagements with the vast majority in private clouds: Nearly 70 percent of engagements are private while only 30 percent are public with a minimal usage of hybrid clouds.[1] The 30/70 split between public and private cloud engagements running today is due primarily to two factors. First, the survey respondents reflect primarily large environments and are most interested in investigating the potential benefits of cloud computing. If smaller environments had been included, we believe the ratio would be different. Second, since one of the primary inhibitors to widespread adoption of cloud computing is security concerns, private clouds provide a means to experiment with cloud technology without exposing the firm to security concerns.

There are key differences in the services provided in the private and public clouds. Public clouds are dominated by SaaS followed by infrastructure as a service (IaaS). Private clouds are dominated by IaaS followed by platform as a service (PaaS), while BPaaS is only represented minimally in both.

Within our survey, the majority of clients began their cloud projects with infrastructure (74 percent) and/or development and test environments (69 percent), areas where they were able to minimize the risk associated with this new delivery method and optimize their return. Many clients (59 percent) were also focused on web infrastructure specifically. However, within two years, the picture changes dramatically, with the belief that they will have cloud projects significantly deployed across all workloads analyzed, including transaction processing, high-performance computing, decision support and analytics, business applications and collaborative computing. This finding, demonstrated in Figure 3, indicates confidence that anticipated values are being met, and, with experience developed from these early projects, rapid expansion will be possible.
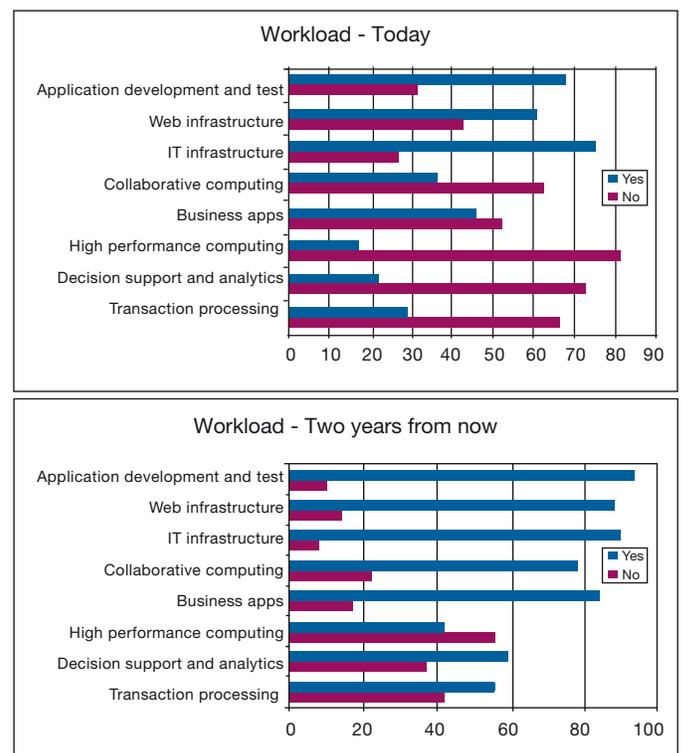

Figure 3: Current and anticipated cloud deployments across workloads.

How are clouds implemented?

Looking beyond motivation, the survey addressed clients' scope and plans for cloud computing, focusing on the chosen implementation approach, patterns and steps. The survey shows that 49 percent of clients have defined their cloud strategy, whereas the second half of our sample began cloud projects without having defined their target state and cloud road map. This finding is supported by the results of the "scale of implementation" question, where 50 percent of projects today cover a pilot scope. Only 20 percent are targeted at enterprisewide cloud deployment. A portion of our clients started pilot projects to extract learning and experiences for a cloud road map and strategy creation.

In parallel, the majority of the projects today are focused on development and test and noncritical production workloads. This step seems to be in preparation for testing management capabilities and tools for critical production workloads.

These findings are similar to our findings in service-oriented architecture (SOA) design and implementation, where best practices recommend testing design decisions in proof-of-concept and pilot implementations, as these decisions have large, long-term impacts on enterprise and IT architecture. A small, more affordable and quick test implementation can help provide the information necessary to make overarching strategic decisions.

Cloud service management implementation framework

The basis of a cloud implementation is a set of well-defined, proven processes, illustrated in Figure 4. Vital to being able to deliver, or even access, a cloud-based environment is service management. ITIL V3 defines service management as "a set of specialized organizational capabilities for providing value to customers in the form of (IT) services."[2] When examined at a greater level of detail than the ITIL V3 definition, service management comprises the whole of the governance, processes, roles and responsibility definitions, tools for automation, required information and best practices that integrate and operate available resources to produce valued services, and respond quickly to the needs of a business and its customers—for both legacy and cloud environments. The roles that execute the processes, the tool functions and the associated information are all based upon the process design.
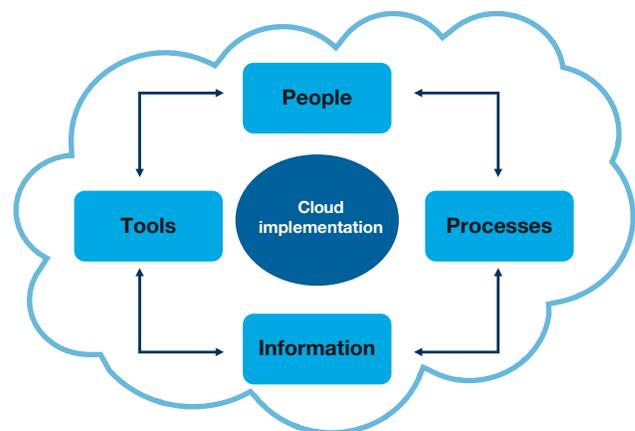

Figure 4: Cloud service management implementation framework.

The survey produced several key findings related to this framework:

Organizational change—Only 20 percent of projects report on organizational changes already implemented, although we can derive clear requirements for changes in IT organizations. Two areas seem significant: corporate IT organizations are not really managing the cloud implementation, operation of IT technologies and process management. Especially in larger organizations, organizations sourced their IT services through external service providers due to the lack of speed of their internal IT department to establish access to cloud services. Second, organizational silos can be a significant inhibitor to adoption, as silo thinking prevents overall process optimization and automation.

Processes and integration—About half of the projects started without service management integration, which relates to the nature of projects with regard to maturity, scale and criticality. Public cloud projects typically reported lower levels of service management integration compared to private cloud implementations. While with a public cloud, the assumption is that the solution is based on integrated service management by the cloud service provider, within private cloud environments, service management integration is even more critical to achieve cloud automation and cost targets. In addition, a level of integration between public and the customer's on-premises infrastructure is required. This leads into the domain of hybrid clouds, where application-level integration is required when running both public, private and traditional infrastructures as well.

On a weighted average rating, the majority of the respondents rated service design as the most important ITIL discipline followed closely by service operation, service strategy, service transition and service improvement.

Technology—Although standardization of technologies and software stacks is one of the main drivers of cloud benefits, 39 percent of the projects lack technology standardization. Approximately 53 percent of projects reported standardization for some technologies. This is a surprising result in our survey as the level of standardization for the services served by a public cloud is high and defined by the cloud service provider. For private cloud implementations, the level of standardization is one of the main success factors.

As an additional note, there were no significant differences across industries and geographies in the results from the survey questions for this section.

What are the challenges?

We found that for our surveyed clients, developing a strong value proposition, plus funding, security and managing complexity were the major barriers to getting started, as shown in Figure 5 below.
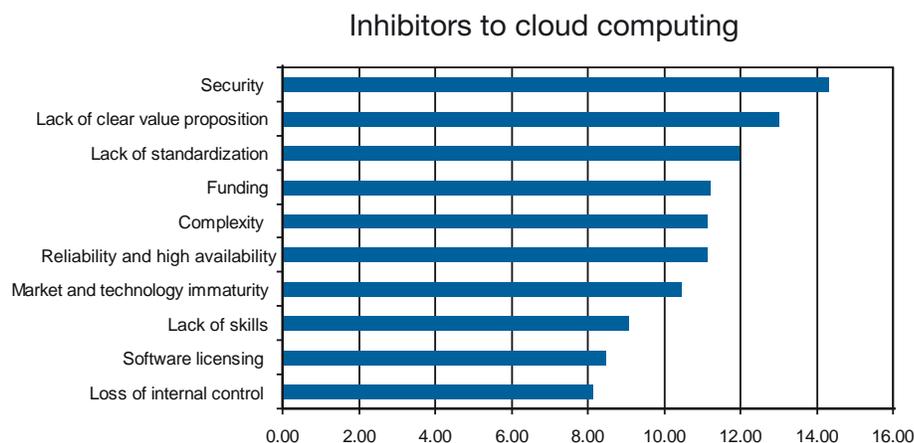

Inhibitors to cloud computing

Figure 5: Inhibitors to cloud computing.

Similar factors have been corroborated in many analyst reports. For example, IDC reports that security concerns are the most important fear among IT decision-makers for both public and private cloud, especially public cloud. Other factors, such as lack of technology, maturity, lack of personnel skill sets, organizational challenges and difficulty integrating with existing infrastructure will likely decrease over time as cloud success stories circulate.[3]

Security
Security is a critical issue largely in public or shared environments, where the cloud provider needs to make sure that data privacy and compliance is guaranteed. Secure and efficient data exchange across the enterprise and clouds, as well as secure application connectivity are the major security concerns. Image management is important both in private and public clouds, as images are fast becoming the core object for deployment in data centers as a way to bypass installation problems. In this context, organizations need a way to organize, secure, manage and deploy images to the various virtualized platforms in a scalable manner. Once deployed, organizations need a way to manage the virtual images, which includes monitoring, updating, tracking, change management and auditing.

The clients surveyed in our study are currently focused primarily on implementing technologies to enable cloud functionality in a private environment. By focusing first on private clouds, these clients were able to overcome their security concerns. As shown in Figure 6, the building blocks for a private cloud include consolidation, virtualization, standardization and automation, including self-service.
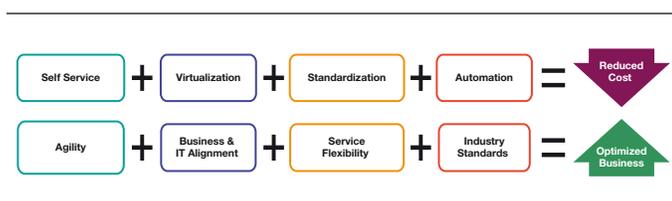

Figure 6: Building blocks for a private cloud.

Virtualization
While it was clear that virtualization was the first and largest component of cloud computing implemented, it is harder for clients to apply these technologies to other areas such as network (18 percent), applications (18 percent) and desktop (16 percent), and clients continue to see this as a challenge over the next two years. While automatic provisioning has been widely implemented in this client set, de-provisioning resources and reassigning those resources to other projects is more difficult, with other factors such as organization and culture coming into play.

Standardization
When discussing clouds, you also need to talk about the ability to reduce variations in implementation patterns on the cloud provider side, while at the same time keeping consumers happy with a right-sized offering. Standardization of both processes and all technical layers of the solution stack was identified in the surveyed projects as a major challenge. For example, despite the fact that a specific hypervisor often dominates the pilot/departmental installations today (start simple), clients anticipate a move toward a diverse set of virtual machine standards for enterprise-level clouds before being able to consolidate. On one hand, consumers expect their favorite hypervisor technology to be supported in a first production step; on the other hand, they want to migrate as quickly as possible to a standard when they have seen the benefits of cloud delivery and are looking for even higher efficiency and reduced costs.

There are gaps in both industry-specific and IT standards that make it more difficult to standardize and automate, which is needed in order to reduce the complexity involved. Just as the adoption of HTML as a standard language accelerated the adoption and expansion of the Internet, cloud standards will need to emerge to promote widespread adoption. In particular, the adoption of IT service level definition standards that can be dynamically negotiated between consumer and provider will be necessary before a true open cloud becomes reality.

In addition, the standardization of hardware and operating system/software stacks required in cloud environments needs to be driven from development and test into production environments.

Value proposition
The survey indicates that cloud computing value is best achieved with a specific business goal in mind and tools are available to assist with return on investment (ROI) and value assessments. Multiple clients shared that the job of justifying a cloud solution became much easier when focused on solving a business need versus the benefits of reducing the cost of IT.

Complexity and integration
Clients are looking for cloud providers to assist them with complexity and integration issues, as indicated when asked what they would like to see in cloud computing. Outside of price, almost all of the answers were in areas designed to reduce the complexity to implement cloud, such as providing additional pre-integrated offerings, improved functionality and decreased complexity for current offerings, and improved flexibility and integration techniques. The recognition is strong that implementing cloud computing is a complex task, and only 24 percent of current clients have implemented cloud in an integrated fashion today.

What are the benefits?

Cloud computing is offering a wide range of benefits—from high-resource utilization and flexibility to increased responsiveness. Approximately 80 percent of the clients are realizing significant sharing of IT resources through a highly virtualized infrastructure, and approximately 60 percent are achieving ease-of-use through self-service with rapid delivery. This is the case regardless of the industry or geography. For those clients using public clouds as opposed to private clouds, ease of use is higher at 85 percent, followed by 68 percent benefiting from pay-as-you-go charging and 63 percent benefiting from Internet/web-based clouds. Forty-seven percent of the public cloud clients are benefiting from a highly virtualized infrastructure. Figure 7 illustrates the results.
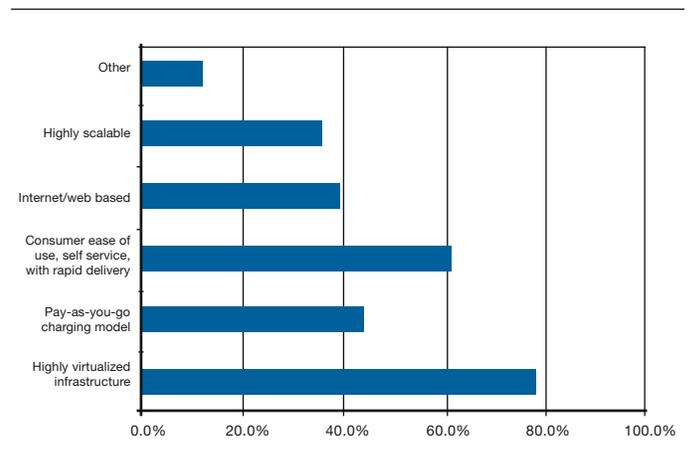

Figure 7: Benefits gained from cloud computing.

Several of the responders commented that their clients are realizing benefits in the area of flexibility, such as by enabling developers and testers to give up servers more readily when they are finished with them as compared to "manual" server builds, or through the ability to exploit services available on the public/Internet cloud more rapidly, either singularly or in combination.

Another group of clients is achieving benefits from cloud computing in the area of storage and data, by replacing existing on-premises storage or by providing storage and content management capabilities.

A promising benefit of cloud computing is in the area of analytics and sense-and-respond capabilities. A sense-and-respond organization is one that recognizes change early and is able to analyze and act in response to the change. An example of sense-and-respond from our case studies is the ability of clients to disrupt their competition by enabling a spectacular jump in the amount and accuracy of available business information, helping them to re-engineer their business and react to individual customer situations in new ways.

Outlook and trends

The experiences of these implementation projects confirmed commonly discussed challenges associated with cloud computing such as security, value proposition, funding and complexity. However, it is important to note that these organizations have found significant value as reflected in plans to expand their use of cloud computing. There is also strong optimism that within two years, the marketplace will have overcome many of the issues faced today.

It is always useful to understand what motivated a major endeavor in implementing new IT delivery methods in a large enterprise context. We have discussed specific findings based on today's market maturity, the technology and available best practices or methods, and the associated challenges. The next natural step is to leverage the insights from the implementation projects to determine how the area will evolve so that you might align it with specific planning horizons in your enterprise. The following section discusses survey questions based on future trends. As previously mentioned, these predictions are based on the assumption that security concerns, both real and imagined, can be adequately addressed.

As Figure 8 shows, clients strongly believe they will reverse the 80/20 ratio between departmental/pilot efforts today and enterprise/production readiness within two years. In other words, clouds will become mainstream.
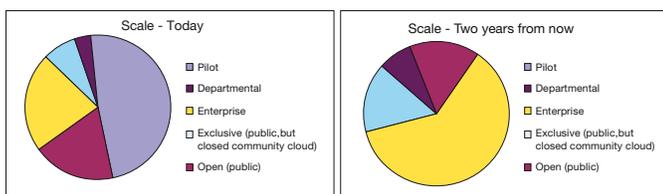
Figure 8: Overall cloud scenarios.

Charging models
Flexible pricing or charging models ranked lower compared to the typical market hype in cloud publications. We therefore analyzed the feedback we received on the importance of future pay-as-you-go capabilities, and we see a difference between private cloud implementations versus public cloud implementations. Public clouds appear to have already a good proportion of pay-as-you-go charging models compared to private clouds, but this will not always be the case. Participants strongly believe that pay-as-you-go models will also have to be implemented in private cloud settings between the IT organization and lines of business. This finding suggests that we will see an interesting challenge in integrating public and new private cloud charging schemes in hybrid cloud scenarios.

Another clear survey trend is based on the observation that we will see flexible charging concepts to address sustainable value-for-money relationships between cloud providers and consumers.

Data management
In terms of additional content provided by a cloud two years from now, we saw two major evolutions: (1) Decision support and analytics services had the highest jump in adoption, and (2) The estimate of the number of consumers contributing to the creation of new information through the cloud is doubling. Cloud becomes a new platform for data management and creation, especially in private cloud scenarios where our survey showed an even higher adoption of analytic cloud services (three times). Over the next two years, respondents see the use of data and information produced by cloud customers more than doubling with a corresponding decrease in exclusive internal use.

Service management

If cloud services become as critical as indicated in the next two years, we need to look at the maturity status and evolution of service management tools. While many clients consider their existing tool landscape as slightly better equipped to cope with the new challenges ahead, we see at least a doubling of the need to have better automation, control and visualization service management tooling implemented by 2012. Service security and the ability to control data/information access and usage is a must today and will be followed by an increased focus on identity management in 2012. (An exception to that general finding applies to public clouds, where compliance was ranked higher.)

Organizations from these cloud implementation projects have realized that significant advantages do take place with automation and self service, and most have started down this path. While today there is a focus on the traditional ITIL disciplines—with service design being the most popular— there is a growing need for new service management disciplines to address the challenges and opportunities in cloud computing, including image management and security. Both of these disciplines are included in IBM's extensions to ITIL, the IBM Process Reference Model for IT™ (PRM-IT) and the IBM Component Business Model™ for the business of IT (CBM-BoIT).

Implementing tools and processes associated with the service management disciplines does have the potential to reduce the complexity involved by a lot, and within two years, almost 75 percent of these clients plan to have new disciplines of service management integrated in their cloud solutions. These new disciplines will need to automate many of the tasks and processes involved in deploying IT resources, and they will need to be integrated into traditional service management tasks such as capacity planning and change management.

Summary

After evaluating the analysis of 110 implementation projects, we identified five key conclusions:
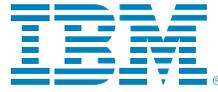
- Clients are finding value today either implementing characteristics of cloud or finding workloads that are best suited for public and private cloud, and in the process, they are gaining knowledge of what's needed for the future.
- Clients using cloud understand the importance of standardization and integration for a successful and more rapid adoption of cloud computing.
- Clients have also learned they will need to make organizational and process changes and reach a higher maturity level of integrated service management to get the full value of cloud computing.
- Clients believe many of today's current obstacles such as security, value and funding will be overcome within two years.
- Clients plan to increase dramatically their use of cloud computing, both to incorporate more mission-critical applications and to expand their use of public cloud services.

With the knowledge and insights captured through these implementations, IBM can offer a full spectrum of assistance, from business consulting to implementing an operational cloud computing environment. A deep understanding of requirements is key to creating lasting value, and IBM has extensive experience performing this type of analysis as part of our capability development process to drive new products and services.

For more information

IBM welcomes the opportunity to discuss your specific cloud computing needs. Please contact your IBM marketing representative, or visit the following website: **ibm.com**/cloud

For additional insights from the IBM Academy of Technology, please visit: **ibm.com**/ibm/academy/index.html

[1] IBM Market Insights, Cloud Computing research, July 2009

[2] IT Infrastructure Library, Version 3

[3] IDC Survey, Cloud Computing Attitudes, Doc.# 223077, Apr. 2010.

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