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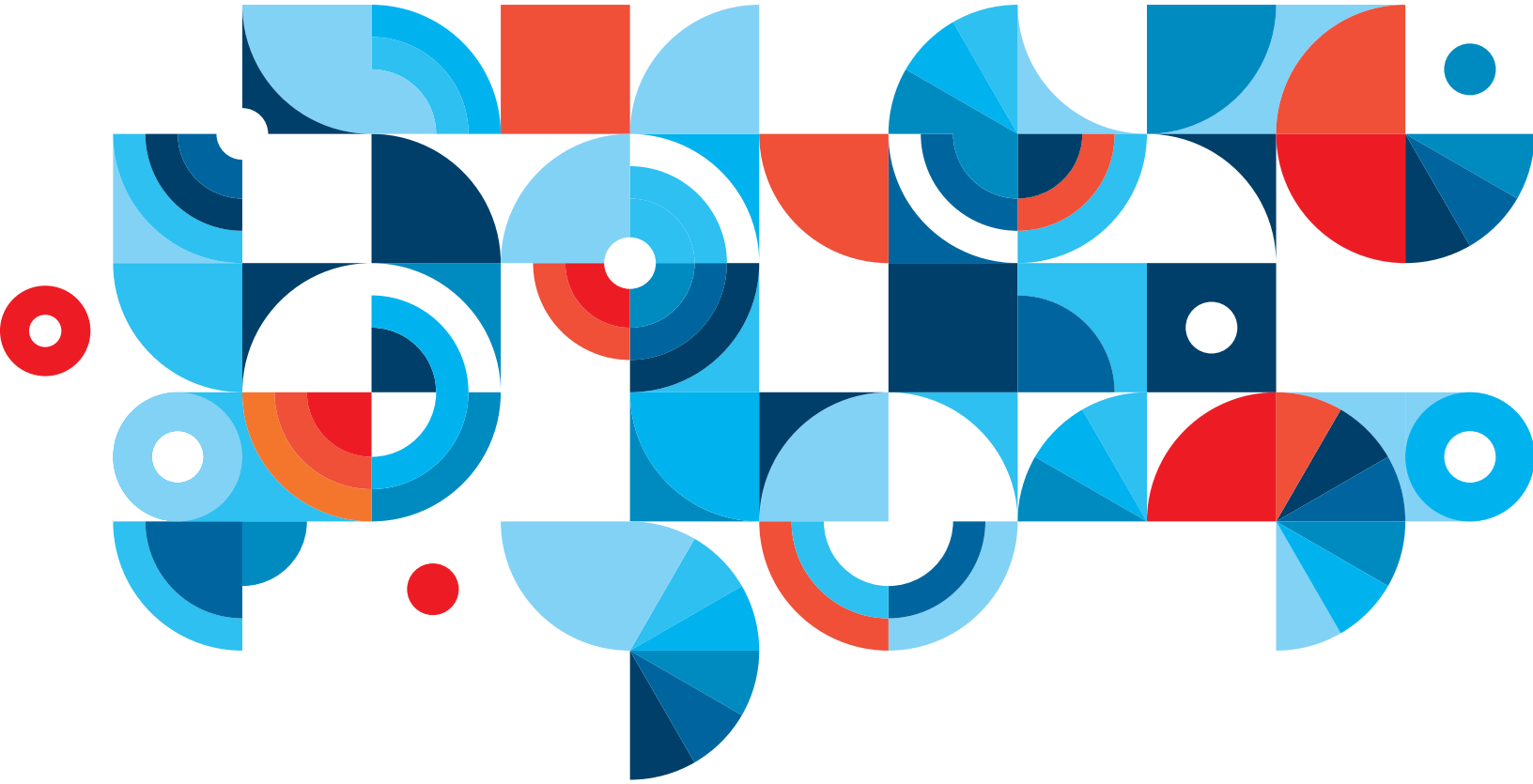
Success in the cloud: Why workload matters

Observations from IBM's own cloud transformation



IBM

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Executive summary

Like other performance-driven companies, IBM is continuously challenged by stakeholders to drive new revenue opportunities and efficiencies while lowering costs. As such, cloud computing with its widely-touted benefits made a convincing case for adoption. And the technology model has lived up to expectations. By providing a platform to standardize and automate key business applications, cloud has enabled dramatic reductions in IBM's IT support costs and major improvements in workplace efficiency and resource use. More than that, cloud computing has accelerated IBM's ability to innovate and do so in ways that improve how we deliver services and support. In short, it has become a catalyst for business transformation at IBM.

With the implementation of cloud computing internally, across six fundamental IT workloads—development and test, analytics, storage, collaboration, desktop and production application workloads—we have witnessed striking improvements in efficiency while capturing some impressive savings in capital and operations. Consider that:

- IBM development teams have seen server provisioning and configuration drop from five days or longer to as little as one hour. IBM's development and test cloud has virtually eliminated IBM's testing backlog, speeding new development and enabling applications to reach the market sooner.
- IBM's analytics cloud put an end to siloed business intelligence (BI) and the six-figure funding required for new BI projects. Organizations across IBM are tapping into a centralized analytics cloud for tools and intelligence aggregated from hundreds of information warehouses. The associated savings are expected to reach tens of millions over five years.
- IBM's block storage cloud cut the cost-per-byte of data stored by nearly 50 percent at one of the first IBM facilities in which it was implemented. This has allowed the facility to accommodate the explosive growth in storage demand—upwards of 25 percent annually—without increasing its total storage budget, and it is expected to do so for four straight years.

Through these and other internal cloud implementations, IBM is seeing firsthand the impact that cloud can have on the business. There is little question about cloud computing's potential to drive efficiency and lower costs. But the workloads a company selects for migration to the cloud and their affinity for the attributes inherent in the cloud model have a lot to do with cloud's success as a transformative tool for the business.

Introduction

IBM's IT leaders viewed cloud computing as an opportunity to radically simplify aspects of an IT operation that had grown complex and less productive. Based on our own cloud research and years experimenting with similar technology models, we understood the potential. Cloud could help IBM's development and testing teams provision their own server and storage capacity without week-long delays or involvement from system administrators. Cloud could help us move employees from a resource-straining traditional desktop environment to a virtual desktop environment, facilitating new deployments, upgrades and end-user support. Cloud could facilitate online collaboration among IBM's global workforce, making it easier for employees to interact, share ideas and innovate with clients, business partners and each other.

Cloud has succeeded in doing all of these things, but much has been learned along the way. As with any new technology, cloud is best deployed in the right circumstances and with the right workloads. One of the most significant determinants of success in moving to the cloud is the careful selection of those workloads. Some workloads are simply a better match for cloud computing, with more to gain from cloud's intrinsic features.

This paper shares IBM's observations and recommendations with respect to workload affinity for cloud computing. It describes the quantitative and qualitative value that IBM has achieved with six common IT workloads. And while each of these workloads has benefitted from the cloud, they have benefitted in different ways and to different degrees. Three workloads, development and test, analytics, and storage have produced the most stunning results to date. They have transformed the way whole groups of IBM users do their jobs, enabling them to speed new development and uncover new sources of revenue, among other things. The results achieved with the other workloads, though not as pronounced, have been very promising so far. As of this writing, they are still evolving and will continue to do so as their respective implementations mature.

IBM's impetus for adopting cloud

IBM's intent in adopting cloud was not unlike any other business. With its sizeable prospects for controlling IT costs, accelerating new capabilities and delivering as a service everything from infrastructure resources to business processes, cloud had the potential to radically change the economics of IT. It could drive up the value that IT provides to the business while lowering capital and operational costs. Cloud also offered the means to deliver on the increasing demands of IBM employees, business partners and customers who have come to expect a new standard of service.

More importantly, these cloud-enabled cost and operational efficiencies had the potential to transform IBM's business, not just in how IT resources and services were delivered, but in how IBM conducted business with clients and partners around the globe. Cloud provided the innovative and collaborative platform and the computing flexibility to reinvent business at IBM.

The importance of workload selection

Cloud computing has captured the attention of technology and business leaders alike, but the actual value it delivers to the organization varies with the application. When applied to the right workloads, cloud can deliver game-changing value. When applied to the wrong workloads, cloud's value over traditional delivery models can be diminished or lost altogether.

In selecting workloads for cloud, it is important to consider the soft, intangible benefits as well as the more visible and easily quantifiable benefits. After all, intangibles like customer satisfaction and quality of service are often significant elements of cloud value. For some workloads, they may represent the lion's share of the value delivered.

Clearly, some workloads have more to gain from a move to the cloud. This is often because they have a greater affinity for the attributes inherent in the cloud model. They align with the standardization, virtualization, automation and level of management

and hardware support that a cloud service provides. These workloads can operate easily in a virtualized, automated cloud environment, where the infrastructure makes it possible to dynamically request services from a virtualized pool of hardware and then automatically provision the required software stack and resource capacity.

Workloads with the greatest affinity for cloud may be those that are an excellent fit in terms of their potential gain and ease of deployment. These workloads require little to no customization because they can work with and benefit from the cloud's standard catalog services. Figure 1 illustrates how several common IT workloads fare on these two measures, based on IBM's research and experience with our own cloud implementations. In general, the workloads that appear in the upper right quadrant have proven to be the best fit for cloud computing.

Workloads must be carefully analyzed to weigh potential gains against how easily they can be deployed in the cloud, whether public, private or hybrid. The fact is not every workload is the same in terms of its importance and cost to the organization, and this can affect its outcome in the cloud. Some of the most critical workloads are so costly to the organization financially and operationally that a move to the cloud has the potential to provide considerable benefit. Other workloads may be so highly optimized already that there is little to be gained from such a move.

Workloads that are unusually complex may offer big potential for improvement, but they may require a high degree of customization or application redesign to conform to the cloud's architecture. These kinds of workloads can prove too difficult, risky or costly to move to the cloud. Certainly, the risk/reward profile of any workload should be clearly understood before it is deployed in the cloud. Consider complex ERP (enterprise resource planning) applications. The mission-critical nature of these production workloads raises the risk associated with cloud deployment, in some cases, far outweighing the potential gains.

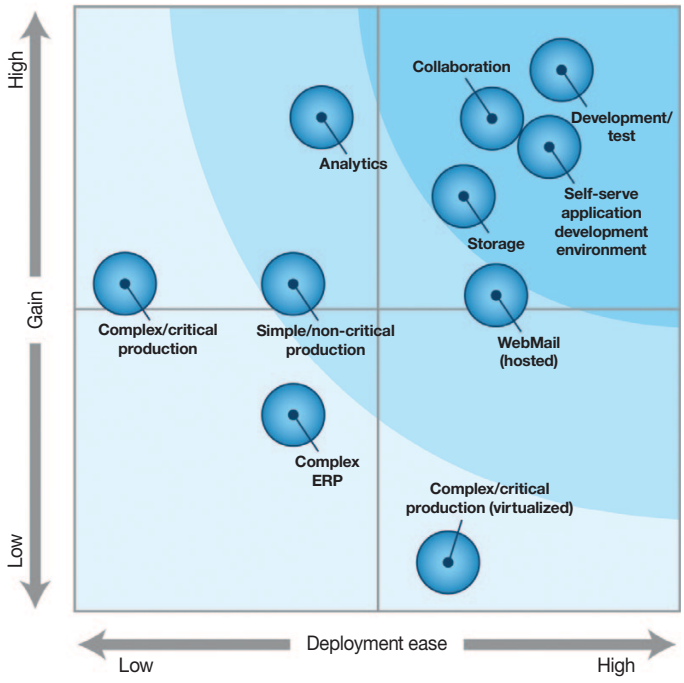

Figure 1. **Workload affinity for cloud computing**. Potential for gain and deployment ease are two key factors in the determination of a workload's affinity for and prospective success in the cloud.

Similarly, legacy and heterogeneous applications, and workloads that involve a high amount of data transfer, may be difficult to deploy in the cloud, relative to their anticipated gain.

By contrast, self-contained applications may be easy to deploy but only offer moderate gains. Other workloads may be viewed as a good fit for cloud deployment simply because they pose little risk to the organization from a security or other standpoint. This is the case with collaboration workloads, for which there is little to lose and much to be gained from a move to the cloud.

In IBM's own cloud experience, we have seen each of these risk/reward scenarios play out. But with cloud computing technologies and practices continuing to advance, the risk/reward profiles associated with most cloud workloads are likely to improve.

The remainder of this paper looks at the six internal IT workloads that IBM migrated to private IBM clouds, starting with the three that have had the greatest business impact to date — development and test, analytics and storage — followed by collaboration, desktop and production application workloads. For all six, the paper explains why IBM elected to move to the cloud and the benefits of doing so.

Cloud's biggest impact at IBM

IBM's greatest cloud computing gains to date have come from migrating workloads that impacted the efficiency of key groups of employees and ultimately IBM's ability to innovate. These workloads really stood to benefit from the change operationally, but also economically. On the one hand, they provided the most opportunity for transformative improvement. On the other, they were tailor-made for the elastic resource allocation, provisioning speed, extreme transaction processing and self-service automation that are synonymous with cloud.

Development and test workloads

IBM's IT organization knew that cloud offered a better way for internal development teams to build and manage their test environments. After all, 30 to 50 percent of all IBM servers were typically dedicated to test, and most were running at less than 10 percent utilization. When developers requested access to the servers, they could expect to wait up to a week. So it was not surprising that these teams would hold on to these resources when they were finally able to secure them, rather than releasing them for the gaps of time they weren't in use. The testing backlog created by this and other provisioning challenges had become the single biggest factor in the delay of IBM's new application deployments.

Implementing the development and test cloud enabled the IT organization to overcome these issues. It provided infrastructure-as-a-service (virtualized server, storage, operating system and middleware) capability in support of the teams that develop most of IBM's internal applications. It enabled IT to expand these resources on demand, making new server images available as provisioning requests were made.

With the cloud, development and test teams saw their server provisioning and setup time drop from five days to as little as one hour. Instead of tapping systems administrators to manually provision needed resources, they could provision resources automatically and independently using a cloud service catalog containing standard operating system and middleware images. The catalog is regularly updated with new images to meet user demand, and it simplifies chargeback with automated usage metering and billing.

The images provide the standard build for the test environment. Since developers are no longer responsible for the builds, the risk of defects resulting from incorrectly configured test environments (which stood at 30 percent prior to cloud) has lessened significantly. The cloud not only lifted the configuration burden from developers, it helped ensure the quality of their test environments.

IBM's hosting support team also benefitted from the development and test cloud. They were able to realize substantial cost savings resulting from the cloud's self-service and automation features, which lowered users' need for assistance. The cloud gave them considerably more time to focus on activities that would lead to growth, new clients and innovations in technology and services.

Following cloud deployment, the initial projection was for a 50/50 split between cloud-based self-provisioning and traditional manual provisioning requests. However, from the day the cloud-based option was introduced, it has been embraced by the IBM development community, with the large majority choosing

to go with the cloud. Today more than 95 percent of server provisioning and de-provisioning requests are made via the cloud, where it is available. This is a testament to the speed, ease of use and streamlined process made possible by the cloud.

Furthermore, de-provisioning requests are much higher with the cloud than they were with the manual provisioning process. Clearly this is a function of the cloud's ability to respond to provisioning requests in a matter of hours. Developers are now confident that capacity and resources can be acquired as needed, so they are more inclined to release these resources when they are not in use. Moreover, because resources become available sooner, the cloud can support more users with fewer physical resources than would be needed in a traditional hosted environment—a direct cost savings.

IBM Development and Test Cloud benefits summary
• Resource provisioning reduced to as little as 1 hour from 5 days or longer
• More efficient resource utilization through higher virtualization
• Increased availability of system resources as developers are more likely to de-provision images sooner
• Reduced labor spent building and supporting development and test environments and deploying associated middleware
• Standard builds, reducing defects and the costs of custom configurations

Analytics workloads

Knowing the extent to which critical business insight improves decision-making and provides significant competitive advantage, IBM was heavily invested in business intelligence (BI) projects enterprisewide. However, these BI applications were being built separately and autonomously by individual business units, creating silos of business intelligence. More than 100 different instances with multiproduct BI tools were being used across the company, each with over 100 users, and running across more than 300 data sources. In addition, an estimated 50 to 75 percent of new BI projects were not being co-located.

The lack of global data standards, systems and practices for IBM's BI projects resulted in massive duplication of effort and costly maintenance and support. And with the majority of BI tools deployed on individual desktops, it became difficult to share BI content effectively. Conflicting content also raised questions about the integrity of metrics and data sources. IBM estimated that each independent BI team and infrastructure required a minimum six-figure investment. This reduced the overall number of BI initiatives that could be funded.

As many as 50 new and sizeable BI installations were on the drawing board when IBM's internal business analytics cloud, Blue Insight, was deployed. Blue Insight offered a way to:

- Standardize IBM's BI tools, consolidating and centralizing current analytics capabilities to achieve greater economies of scale
- Deliver analytics as a utility-like service at a cost that would make the capability universally accessible, while eliminating capital and maintenance costs for participating business units
- Democratize data and insights for the purpose of making the intelligence available across the enterprise, while preserving individual business units' content ownership
- Provide the infrastructure elasticity to expand IBM's BI applications and users as rapidly as the business dictates.

Blue Insight's power comes from its ability to draw insights from hundreds of information warehouses and data stores across IBM and generate analytics on more than a petabyte (one million gigabytes) of data. By turning raw data into intelligence for our sales, marketing and development communities, IBM is able to deliver more value, more quickly and cost-effectively in the solutions and services we offer to clients.

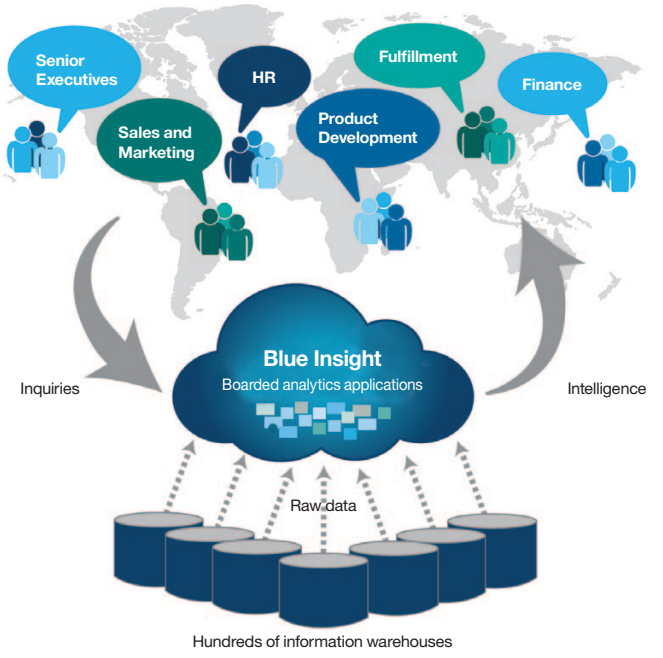

Figure 2: **Centralized business intelligence delivered as a service.** Blue Insight makes high-quality business intelligence easily consumable, splicing together and analyzing critical data from hundreds of sources while enabling IBM user groups to retain ownership of their BI applications.

IBM sales teams are using Blue Insight to gain a deeper understanding of each client's needs, not just for their own IBM product group or region, but for all IBM products and services worldwide. IBM's product development teams are using Blue Insight to analyze sales information, industry trends and customer perceptions more efficiently and to adjust their product planning and development specifications accordingly. Figure 2 illustrates how Blue Insight is used by these and other IBM groups.

IBM Blue Insight benefits summary

- Standardized business intelligence and analytics capabilities, delivered as a service
- Expected savings in the tens of millions over five years
- Elimination of duplicate applications and infrastructures for different analytics requirements
- Data and report ownership retained by participating business units
- Powerful, highly elastic infrastructure, enabling more rapid deployment of BI capabilities
- Ubiquitous user access to enterprise insights and intelligence
- Usage-based subscription model, stretching BI budgets farther and covering more users
- Greater flexibility of the BI skilled workforce
- Simpler enforcement of corporate and regulatory standards

Today 200,000 IBM employees access the analytics-based software-as-a-service capability for more than 500 boarded applications. The subscription-based pricing model enables participating IBM departments to stretch their BI budgets farther and cover more users. Managers can focus on using analytics to solve the day's business problems and do critical forecasting without worrying about affordability.

For IBM as a whole, the financial benefit continues to be dramatic. Over five years, Blue Insight is expected to save tens of millions of dollars through its multitenant infrastructure (including middleware and IBM Cognos® software); common operational support and management, service definitions and boarding process; standard security; automated provisioning and administration; reduction in custom BI applications and displacement of third-party analytics software licenses. While the immediate, tangible savings are important, the real value to IBM will continue to come from expense avoidance for new BI projects and from the business insights gained.

Blue Insight transforms IBM Treasury Operations

IBM Treasury Operations conducts business from multiple locations around the world. Prior to Blue Insight, bank-related data was gathered and analyzed independently at each location. There was no way for Treasury employees to access common global data, and their ability to perform ad hoc inquiries and reporting was limited.

Blue Insight enabled the deployment of Treasury Workstation, a single gateway for all banking communications via a common data warehouse. With centralized global treasury operations and a uniform source for data, IBM's financial teams can create the standard and ad hoc reports needed for global data analysis. They have the global visibility to understand counterparty limits and exposures and to perform cash forecasting and treasury position analysis—tasks that were too complex and time-consuming to perform before.

Storage workloads

Even with IBM's 10 petabytes of operational storage, skyrocketing data volumes are necessitating increased storage capacity, better utilization of storage resources and automated tools to manage it all. Like many of our clients, IBM is experiencing a 25 percent annual growth rate in internal storage. While it is not possible to stop the escalating demand for storage (due in large part to the rising use of mobile devices, social media and rich media like voice and video), storage clouds make it possible to lower the cost per unit, or byte, of storage appreciably. These clouds can significantly offset the increased cost associated with soaring data volume.

For IBM, it became increasingly apparent that traditional storage solutions lacked the crucial scalability needed to serve our large end-user communities. By moving internal storage capacity to the cloud, we have been able to virtualize storage resources to slow the demand for new storage and drive higher utilization rates. We have also lowered labor costs through the automation of storage management functions.

Today 75 percent of IBM's internal file storage (about 1 petabyte) is provided through a global storage architecture cloud, which acts as a general parallel file system, enabling employees to share data, make backups and manage their storage needs with self-service capabilities. The global file storage cloud was really IBM's first cloud, exuding the characteristics of cloud before the technology came to be defined. It provides elastic capacity, advanced virtualization and data replication for cost-effective business continuity and disaster recovery. It is currently accessed by more than 130,000 users and many of IBM's internal applications.

IBM's block storage cloud builds on the success of our global file storage cloud, leveraging similar storage automation functions to address demand while containing costs. With block storage representing 9 petabytes of IBM's internal storage inventory, it is our predominate class of operational storage. Understandably, cost-effective scalability is critical.

In 2010, we began work to transform IBM's Managed Storage Services, our on demand storage offering, into a block storage cloud with automated provisioning and storage tiering. The smarter information lifecycle management (SmarterILM) capabilities inherent in the block storage cloud automate the placement of data on drives in appropriate tiers—in many cases, lower cost tiers. Using an advanced block storage subsystem, SmarterILM dynamically assigns each type of data to its optimal storage tier based on established cost/benefit profiles. It enables IBM to achieve the best balance of storage cost and performance at any point in time and, in so doing, enables us to realize a much lower cost-per-byte of storage.

That lower rate is already a key factor in IBM's ability to handle the exploding growth in storage demand, as well as the total cost associated with that demand. Current projections indicate that even with 25 percent growth in storage volume each year, IBM's cost for block storage should remain flat through 2015, wherever SmarterILM-managed storage is used. Put another way, in 2015 IBM expects to pay the same amount that we paid for our storage inventory in 2011, but for approximately 2.5 times more storage volume than we had in 2011.

So far, where IBM's block storage cloud has been implemented, results have been striking in terms of savings, performance and deployment speed. By the end of 2011, 90 percent of the internal virtualized storage at one of IBM's major U.S. data centers was already leveraging the block storage cloud, exceeding expectations for deployment. What's more, the cost-per-byte of storage dropped nearly 50 percent, enabling IBM to mitigate the increasing costs of volume growth at that location.

IBM Storage Cloud benefits summary
• Overall savings of 30 to 40 percent for internal block storage
• Nearly 50 percent reduction in the cost-per-byte of block storage, offsetting the rising cost of volume growth
• Inherent scalability to accommodate skyrocketing capacity demands while controlling costs
• Automated storage tiering, dynamically moving data to alternate tiers to optimize cost and performance
• Better storage performance via elastic capacity, advanced virtualization and data replication for cost-effective business continuity and recovery

Overall, IBM's block storage cloud is projected to save 30 to 40 percent in storage infrastructure and management costs.

IBM's other successful workload migrations

IBM's IT organization is in various stages of migrating three other common workloads to the cloud. Like the storage, analytics, and development and test workloads, these workloads have a strong affinity for the cloud's attributes. As a result, they are proving to be a good fit for cloud, with very positive results so far.

Collaboration workloads

While IBM employees have used desktop-installed web conferencing capabilities for years, moving this function to the cloud simplified access, allowing our global workforce to collaborate securely regardless of device or location. Usage escalated drastically. In one year, the number of meeting minutes nearly doubled (from 145 million in 2009 to 275 million in 2010). Currently 85 percent of IBM's web conferencing minutes—over 300 million in 2011—are provided through IBM SmartCloud for Social Business, which has reduced costs and increased user productivity by providing cloud-based access to robust conferencing capabilities.

IBM has also moved online meeting and event support to the cloud. IBM SmartCloud Engage provides cloud-based access to a variety of business tools and services that facilitate online events, including meeting invitations, notifications, real-time meeting management and feedback surveys. The sharing feature allows tens of thousands of registered users to share select documents, applications and activities—or their entire desktop—with fellow employees or clients.

Desktop workloads

Desktop clouds centralize the administration and management of end user desktops, facilitating the virtualization of desktop applications and data using thin clients. IBM is in the early stages of desktop cloud deployment, with thousands of

production users accessing a private desktop cloud in IBM's China Development Lab and a considerable number of call center users accessing a desktop cloud in the U.S. and India.

While IBM's desktop clouds have simplified desktop administration and management and improved desktop security across the enterprise, IBM has learned that the key to deriving value from desktop cloud is choosing the right user population and pairing it with the right reference architecture. There is much to be gained, for example, from a desktop cloud that supports call center personnel who provide very basic help desk services because it allows a simple desktop cloud implementation and avoids having to support and pay for desktop image persistence. A desktop cloud also allows for increased security at a lower cost, so it is a good choice for user segments where unauthorized access and other vulnerabilities are of strong concern. Conversely, a desktop cloud may not be a good choice for user segments that require lots of custom software and device drivers and whose thin clients are not highly standardized.

By understanding end users' roles, usage patterns and business requirements, it is possible to segment users and to deploy desktop cloud where it will achieve the most success.

Production application workloads

IBM's production application cloud was implemented to reduce the cost of managing our internal application portfolio. Its initial implementation was designed to provide low-cost infrastructure-as-a-service capacity for IBM's non-critical applications, which have lesser service level requirements for availability and support, and as such, are deemed low-risk.

Potential applications were identified for the initial production cloud implementation, and the first of those have been migrated. Not unexpectedly, however, many of IBM's legacy applications have been found to be unsuitable for cloud. In some cases, these production workloads have already been sufficiently optimized for their current environments, reducing the need for optimization in the cloud. Others are encumbered by manually administered controls and compliance checks that limit what the cloud can do to improve current production speeds and outcomes.

Unlike new applications which are being designed to run in the cloud, older applications are often not flexible enough to derive meaningful benefits from the cloud. They can take advantage of cloud's rapid provisioning, for example, but cannot bypass current manually administered controls that slow production considerably. For that reason, many of IBM's legacy applications are being examined in the context of the cloud environment to determine what it will take to bring the two together cost-effectively. Similarly, IBM is looking at ways to automate the manual processes that are inhibiting applications' successful move to the cloud.

Broadening cloud use across the IBM ecosystem

IBM's Self Service Application Environment (SSAe) project is helping cloud computing take a giant leap forward among the IBM user community. Cloud-based SSAe leverages IBM's extensive collection of application assets, standardizes them and makes them available to employees across the enterprise at a predictable, affordable rate. In so doing, it encourages IBM's lines of business to tap into the cloud to easily create, alter and retire applications.

Instead of expending the time and resources to develop new applications, users can download desired applications from the cloud's self-service catalog and get them up and running without IT involvement. Support is available if it is needed, but no application development skills are required. SSAe provides the tools to simplify the building and dissemination of a variety of applications. And because these applications are complementary to IBM's cloud-based information access frameworks like Blue Insight, users can benefit from the analytics, innovative solutions and problem solving their fellow employees are working on globally.

In the near-term, IBM's goal is to migrate as many non-critical applications as possible from their traditional hosting environments to the production cloud, refining the platform as our maturity increases in this area. More critical production application workloads are expected to be migrated in the future, informed by our early experiences and the processes and tools developed as part of those experiences.

The value of IBM's production application cloud will be realized primarily through virtualized hosting and lower support costs enabled by increased automation and workload standardization.

Cloud's role in reinventing IBM's business

Over the last century, IBM has pursued a series of technological opportunities that have transformed our business and, in many cases, business at large. Cloud computing is proving to be another of those opportunities.

Cloud computing is creating a sea change, not just in how IT resources and services are delivered, but in how the business does business. And cloud has proven its potential to marry substantial cost savings and efficiency to business reinvention:

- Helping IBM integrate information across the operation to improve problem response and make smarter business decisions
- Enabling work teams to tap into enterprise know-how, resources and applications that were formerly unavailable to them economically, technically or geographically
- Putting powerful customer analytics in the hands of sellers and marketers to maximize results from new promotions and changing market dynamics
- Helping researchers accomplish in hours what used to take weeks: complex data calculations and comparisons, modeling and simulations
- Helping the business bring new and innovative solutions to market faster by facilitating experimentation and collaboration.

This transformative experience has been seminal to the development of the IBM SmartCloud portfolio of next-generation cloud technologies, services and solutions. The IBM SmartCloud portfolio leverages the same foundational technologies used in IBM's own cloud implementations as well as client implementations, and it leverages what we've learned in those implementations, namely the importance of workload affinity and service choice in the deployment of cloud computing. It combines the cost savings of a shared cloud environment with the service options more typical of a private environment: security, applications, service levels, management, support services and the like. For the first time, companies are able to tailor their cloud environments to match the requirements of their workloads.

Finally, it's important to point out that IBM's ongoing success with cloud computing has a lot to do with our culture. Organizations need to be willing to modify or even jettison their existing processes if they are to take advantage of new technologies like cloud. IBM has always thrived on technological change. Our IT organization is often the first testing ground — and proving ground — for new technologies, and cloud is no different. Today cloud is continuing to make its way across the IBM ecosystem. It has already had a profound impact on the IBM enterprise, but in our view, the transformation has only just begun.

Conclusion

Cloud computing has significantly altered the IT landscape at IBM, winning over early adopters with improved productivity and performance, and far exceeding initial expectations for usage. Its magnetic appeal speaks to the speed, flexibility and self-service capabilities of the cloud, especially for IBM users engaged in development and testing, storage and analytics activities. These user groups can really appreciate cloud's attributes in the context of their workloads' unique demands.

Clearly, the value that cloud brings to these workloads — and to the organization as a whole — will increase with the maturity of the model but also with the experience of those business units that take advantage of it. IBM recognizes cloud as a major enabler of IT's evolution and the future of IT service delivery. Towards that end, we are actively expanding the depth and capabilities of our cloud portfolio to help clients uncover new sources of revenue and capitalize on the potential for business transformation, but more fundamentally, to provide them with the necessary strategic guidance and tools to make the right cloud choices.

Understanding each workload's affinity for the cloud is essential, and it should be central to any cloud migration discussion. IBM's structured methodology for workload analysis is fueled by this belief and derived from our cloud experiences internally and with clients. Today that methodology is helping companies analyze and prioritize application workloads for cloud, factoring in potential cost and migration impacts. After all, choosing the right workloads can deliver extraordinary economic and operational value.

For more information

To learn how IBM is helping organizations migrate the right workloads to the cloud, please contact your IBM representative or IBM Business Partner, or visit the following website: **ibm.com**/smartcloud

You can also follow us on Twitter at: www.twitter.com/ibmcloud and on our cloud computing blog at: www.thoughtsoncloud.com

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