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WHITE PAPER

The Business Value of Amazon Web Services Accelerates Over Time

Sponsored by: Amazon

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EXECUTIVE SUMMARY

In early 2012, IDC interviewed 11 organizations that deployed applications on Amazon cloud infrastructure services. The purpose of the IDC analysis was to understand the economic impact of Amazon cloud infrastructure services over time, beyond the well-documented benefits of reduction in capex and opex. Specifically, IDC set out to understand the long-term economic implications of moving workloads onto Amazon cloud infrastructure services, the impact of moving applications on developer productivity and business agility, and the new opportunities that businesses could address by moving resources onto Amazon cloud infrastructure services. The organizations interviewed ranged from small and medium-sized companies to companies with as many as 160,000 employees. Organizations in our study had been Amazon Web Services (AWS) customers for as few as seven months to as many as 5.3 years. Our interviews were designed to elicit both quantifiable information and anecdotes so that IDC could interpret the full return-on-investment (ROI) impact of Amazon cloud infrastructure services on these organizations. The study represents a broad range of experiences, with companies discussing applications ranging from a small internally developed application to a large commercial application with over 20 million customers. The use cases reviewed offered a variety of steady-state and variable-state workloads.

Business Value Highlights: Applications Running on AWS

- Five-year ROI: 626%
- Payback period: 7.1 months
- Software development productivity increase: 507%
- Average savings per application: $518,990
- Downtime reduction: 72%
- IT productivity increase: 52%
- Five-year TCO savings: 70%

From these interviews, IDC was able to measure the impact of Amazon cloud infrastructure services.

Overall, the organizations interviewed recognized annual financial benefits averaging over $518,000 per application. The most significant benefit comes from moving applications onto AWS infrastructure due to lower capital and operational costs. This reduction in capex and opex accounted for over 50% of the overall benefits found in the study. IDC observed significantly increased developer productivity on Amazon cloud infrastructure services compared with prior implementations. The companies interviewed experienced greater developer productivity across all of the key software

development life-cycle activities, which was a direct result of the extensive development and runtime services that are provided by Amazon cloud infrastructure services. Developer and IT staff productivity accounted for nearly 30% of overall financial benefits. The remaining benefits were driven by the flexibility and agility of Amazon cloud infrastructure services, which make it easier to trial new business models, support revenue-generating applications, and provide more reliable services to end users. These other benefits included:

- Benefits increase over time. There is a definite correlation between the length of time customers have been using Amazon cloud services infrastructure and their returns. At 36 months, the organizations are realizing $3.50 in benefits for every $1.00 invested in AWS; at 60 months, they are realizing $8.40 for every $1.00 invested. This relationship between length of time using Amazon cloud infrastructure services and the customers' accelerating returns is due to customers leveraging the more optimized environment to generate more applications along a learning curve.

- The five-year total cost of ownership (TCO) of developing, deploying, and managing critical applications in Amazon cloud infrastructure represents a 70% savings compared with deploying the same resources on-premise or in hosted environments. The findings showed a 626% ROI over five years.

- End users benefited from fewer service disruptions and quicker recovery on Amazon cloud infrastructure services, reducing downtime by 72% and improving application availability by an average of 3.9 hours per user per year.

- IT staff productivity increased by 52%. IT staff are thus able to improve support of mission-critical operations. Amazon cloud infrastructure services had significant impact on application development and deployment, reducing overall developer hours by 80%.

The five-year ROI analysis shows that on average, the companies saw a payback period of seven months and realized a five-year ROI of 626%.

SITUATION OVERVIEW

Introduction

For a company that was founded in 1994 and began delivering cloud computing in 2006, Amazon is a relative newcomer as a Fortune 100 company (Amazon.com first appeared in the Fortune 100 in 2010), and AWS is one of the oldest cloud computing providers in the industry (AWS started offering services in March 2006). Although entry into cloud computing was not an initial design point for Amazon, the demands of creating a reliable, secure, and scalable ecommerce presence, along with the desire to lower prices for its retail customers, led Amazon to focus on driving costs out of its IT infrastructure. Amazon's focus on creating a service-oriented architecture put the company on the as-a-service fast track.

Amazon's current services in support of application hosting, application management, security, data management, relational databases, nonrelational databases, payments, billing, storage, networking, content delivery, development, deployment, and workflow all come under the heading of AWS. This breadth and depth of AWS has enabled AWS to become the leader in cloud computing. While many enterprises initially thought of AWS as an infrastructure services provider, this perception has expanded in recent years in light of the array of runtime services that AWS provides as a platform for application deployment.

IT Challenges Today

The challenges and opportunities facing CIOs today have never been greater. As enterprises become more reliant on IT to improve efficiency while simultaneously differentiating services, IT has become a strategic asset in support of business, marketing, product development, and operations. This section identifies a number of the most pressing concerns that IT is tasked with addressing today. Confirmation of these challenges is readily available across the industry, and the issues have been widely reported on by IDC and many of the leading ISVs.

- **Better alignment of IT with the needs of the business.** IT has never been better positioned to address process automation and process improvement needs. Modern IT tools, techniques, and infrastructure are more effective than ever at supporting the needs of the business.

- **Focus on core business processes.** The opportunities for outsourcing, offshoring, and application hosting now provide enterprises with many options that allow them to concentrate on improving support of mission-critical operations. With maintenance of existing applications accounting for approximately 50% of IT resources, businesses must make hard decisions regarding where to spend their time.

- **Simplify, integrate, and automate.** Both IT demands and complexity are mushrooming. Enterprises must constantly look for ways to simplify and rationalize their approach to IT through the use of more highly abstracted development and deployment tools and policy- and configuration-based services.

- **Grow organizational profitability.** Although IT is not normally considered a profit center, it can contribute to profitability by enabling new business models and finding better ways to manage expenses.

- **Standardize and consolidate IT assets.** Consolidation has been on the IT agenda for years, and virtualization has helped decrease server sprawl while simultaneously increasing utilization. Standardization is especially important where lower-level architectural decisions, such as networking and authentication, are concerned, but it is rapidly moving up the stack into areas such as messaging and service enablement.

Key Cloud Computing Trends

The market for worldwide public IT cloud services encompasses packaged application software, platforms, and infrastructure that adhere to eight specific criteria — identified by IDC — that characterize a cloud service.

Software as a service (SaaS) includes collaborative applications (such as messaging, conferencing, and team collaboration software) and business applications (such as CRM, ERP, financial, HCM, PLM, and SCM) delivered via the cloud services model. Revenue in the SaaS market was about $13 billion in 2011 and is expected to increase at a compound annual growth rate (CAGR) of 21% through 2015.

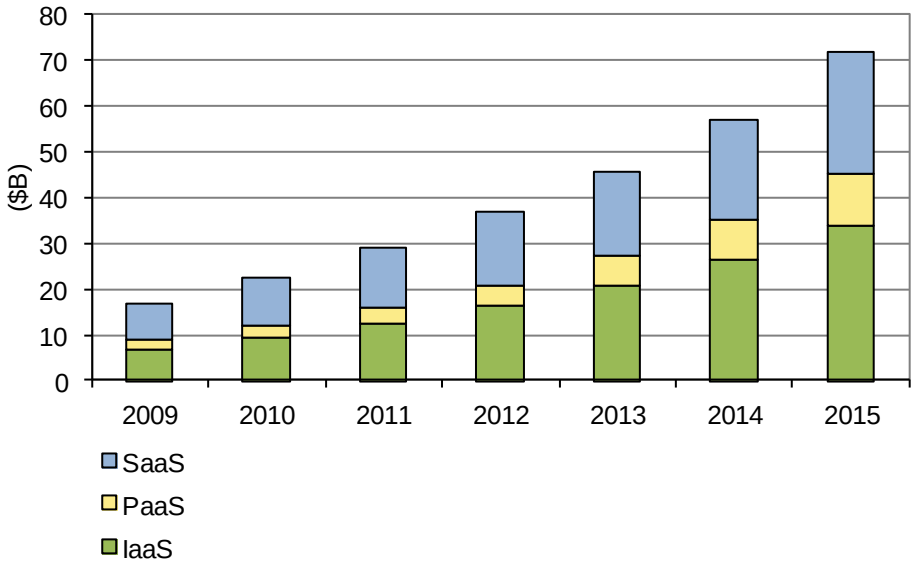
Platform as a service (PaaS) includes application development and deployment tools such as application development software, application life-cycle management software, enterprise mashup and portal software, information management and data integration software, and middleware and business process management software delivered via the cloud services model. Revenue in the PaaS market was about $3 billion in 2011 and is expected to increase at a CAGR of 34% through 2015.

Infrastructure as a service (IaaS) broadly includes compute resources, storage resources, and system infrastructure software delivered via the cloud services model. Revenue in the IaaS market was about $12 billion in 2011 and is expected to increase at a CAGR of 29% through 2015.

Figure 1 provides a graphical view of the worldwide public IT cloud services market segmented by primary market. Vendor revenues associated with IaaS and PaaS accounted for a 55% share of the overall market in 2011, which speaks to the immense value that organizations place on developing and deploying applications on public infrastructure.

FIGURE 1

Worldwide Public IT Cloud Services Segmented by Primary Market, 2009–2015



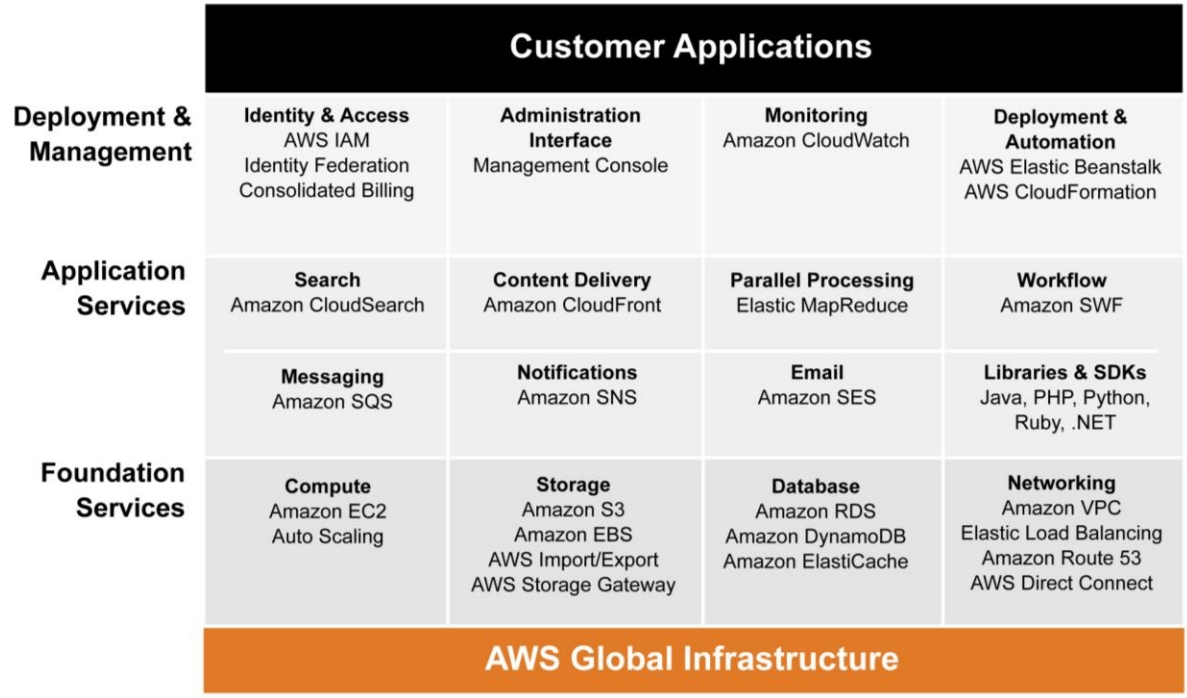
Source: IDC, 2012

AMAZON WEB SERVICES

During the late 1990s and early 2000s, as Amazon was emerging as the world's leading ecommerce company, internal business requirements necessitated that Amazon build out an application infrastructure that would support massive scale and reliability in the following areas: compute, parallel processing, storage, content management, data management (relational and nonrelational databases), transaction processing, messaging, queuing, payments, security, monitoring, and management. Competing IT objectives involving scalability and cost steered Amazon down the path of service orientation. The services created during this IT transformation process ultimately laid the foundation for AWS. Figure 2 identifies the key services provided by AWS.

FIGURE 2

Amazon Web Services



Source: Amazon, 2012

Amazon's focus on driving costs out of the company's large-scale ecommerce operations led Amazon to move toward service orientation and exposing all resources as scalable and consumable services. This movement also ensured that the development culture at Amazon would be aligned with modern development techniques and result in a platform that was flexible, agile, and extensible. This has resulted in a high degree of AWS API envy across the industry. From an AWS customer standpoint, this means it is easier to develop applications using AWS, easier to deploy preexisting applications on AWS, and easier to establish hybrid operations spanning AWS and private datacenters.

BUSINESS VALUE

Study Demographics

In early 2012, IDC interviewed 11 organizations that had deployed AWS. The organizations ranged from small and medium-sized companies to larger companies with as many as 160,000 employees. The organizations are based in North America, Europe, and Asia/Pacific and include representatives from real estate, banking, technology, media, sports, security, and management services industries. The interviews were designed to elicit both quantifiable information and anecdotes so that

IDC could interpret the full impact of AWS on these organizations. Table 1 summarizes the demographics of the study.

TABLE 1

Study Demographics

Category	Average
Employees	21,445
Virtual servers from AWS	1,232
Applications being implemented with AWS	9.7
Criticality rating of applications deployed on AWS — from 1 (low) to 5 (high)	4.5
End users of IT services — internal	1,372
End users of IT services — external application users	2,230,248
Industries	Real estate, banking, technology, media, management services, security, sports
Geographies	North America, Europe, Asia/Pacific

Source: IDC, 2012

The study base represents a broad range of experiences, with companies discussing applications ranging from a small internally developed application supporting eight users to a large commercial application with over 20 million customers. About half of the 11 companies are using AWS to deliver high-performance computing applications, one-third are supporting Web applications, and one-quarter have big data applications. The use cases reviewed offered a variety of steady-state and variable-state workloads.

FINANCIAL BENEFITS ANALYSIS

Benefits Summary

The organizations in the study selected AWS to develop, deploy, and manage their critical applications primarily because AWS offered the best scalability, time to market, and price. From the interviews, IDC was able to measure the impact of AWS. Overall, the organizations recognized annual financial benefits totaling over $5 million (over $518,000 per application) from the following areas:

- **Reduced IT infrastructure and services costs.** The most significant benefit comes from rehosting applications on AWS infrastructure due to lower capital and operational costs. This reduction in capex and opex accounted for a savings of nearly $276,000 per application per year. Companies were able to consolidate, integrate, and standardize their infrastructure.

- **Optimized IT staff productivity.** By accelerating the application development and deployment process, automating application management, and switching to IaaS, IT staff are now 52% more productive, saving nearly $150,000 per application per year. IT staff are thus able to improve support of mission-critical operations.

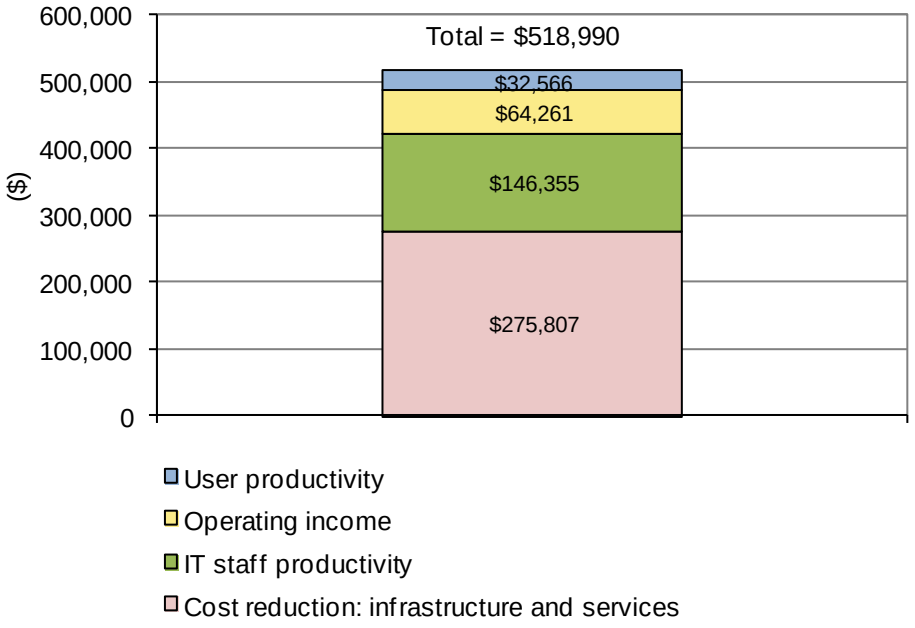
- **Enhanced end-user productivity.** End users benefited from fewer service disruptions and quicker recovery, reducing downtime by 72% and saving nearly $32,600 per application per year.

- **Increased business benefit.** Many of the companies are employing AWS to enable new business models and support revenue-generating applications and were able to increase annual revenue by over $1 million, which translates to more than $64,000 in annual operating income.

Figure 3 provides an aggregate view of these benefits.

FIGURE 3

Average Annual Benefits of Deploying Applications on AWS per Application



Source: IDC, 2012

Cost Reduction

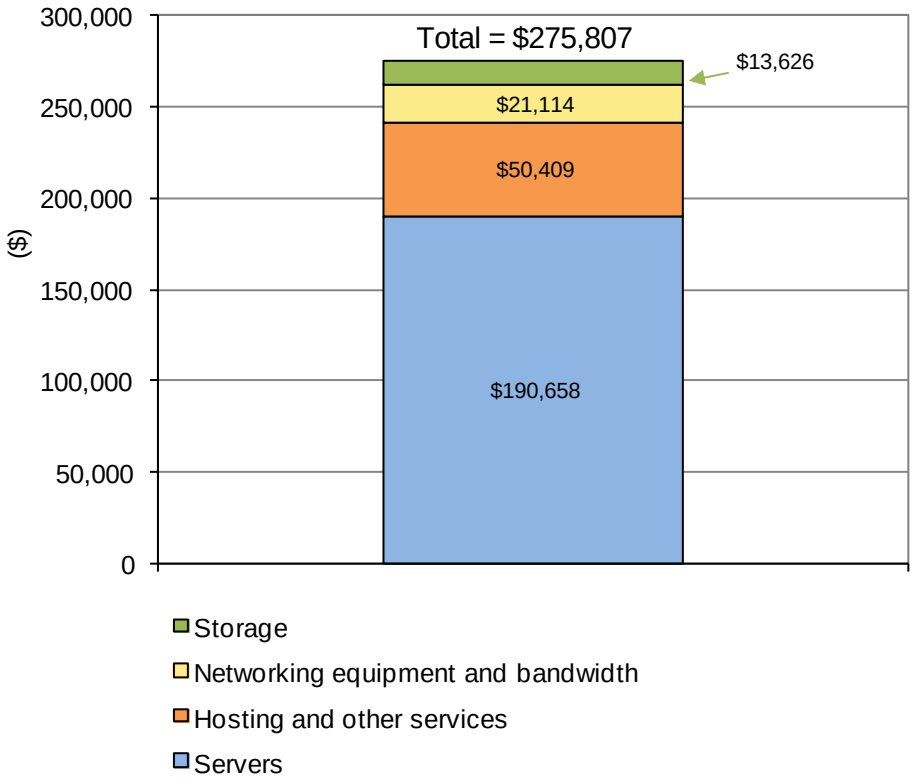
Companies today look to the cloud as a way to shift expenses from capital to operational budgets. All of the companies in the study not only shifted their budgets but also significantly reduced their costs and time to market for delivering these critical applications. In terms of annual budgets, they were able to replace $3.66 in capital costs with $1.00 in new operational costs, namely Amazon EC2 costs.

In this study, we assessed IT infrastructure savings resulting from migration to the cloud in the areas of server, storage, networking hardware and software, and server hosting services. On average, each company was able to reduce its annual infrastructure and services costs by nearly $276,000 per application in the following areas, as shown in Figure 4, as a result of the shift from capital costs to operational costs.

- **Servers (hardware and related software) —** includes the annual capex for the physical servers replaced by AWS (average 400 servers replaced per customer) as well as the operating system and related software efficiencies realized by moving to the cloud environment (security, management, etc.)
- **Hosting and other services —** includes savings in the areas of collocation services (four of the companies had collocation services) and/or managed services as a result of moving to the same level of services from AWS
- **Networking equipment and bandwidth —** includes WAN equipment and savings from more efficient use of bandwidth
- **Storage —** includes savings from moving storage to the cloud, resulting in more efficient utilization and redundancy of storage assets and a 25% reduction in the overall storage cost per terabyte (TB) in use

FIGURE 4

Annual Infrastructure and Services Cost Benefits of AWS per Application



Source: IDC, 2012

IT Staff Efficiency

Our analysis focused on tracking a critical application through the costs associated with development, deployment, ongoing management, infrastructure, and staff to support the infrastructure. As discussed earlier, AWS had a significant impact on application development and deployment, reducing overall developer hours by 80%. This increased productivity of developers means that organizations can deliver applications to market faster as well as increase the volume of applications being developed.

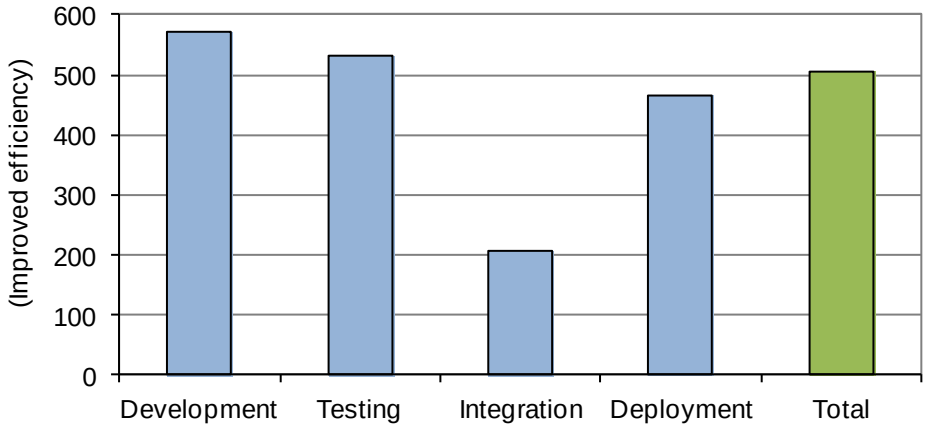
Development and Deployment Efficiency

An important area of consideration for this study was developer efficiency across the software development life cycle (SDLC). In our conversations with AWS customers for this study and the projects we evaluated, we found mostly hybrid approaches to the SDLC where tasks were split across in-house systems and AWS. Although some customers performed all aspects of their development project on AWS, this was not the norm and is explained by sunk costs on the part of customers, inertia, and caution due to the new technology and business models of cloud services.

Figure 5 shows the improvements that we observed in developer efficiency across the SDLC. These findings should be interpreted as follows: A 500% improvement in efficiency means that developers could perform tasks five times faster with AWS than with other in-house alternatives. A 200% improvement in efficiency means that AWS enables developers to perform tasks twice as fast as other in-house alternatives.

FIGURE 5

Comparison of Developer Efficiency with AWS and In-House Alternatives



Note: A 500% improvement in efficiency means that developers could perform tasks five times faster with AWS than with other in-house alternatives.

Source: IDC, 2012

The high scores received by AWS on development and testing were due to the availability, scope, and depth of AWS APIs. AWS APIs enabled developers to more effectively utilize services during application development, which reduced time spent writing additional custom code. The maturity of AWS also means that its services are well vetted and therefore lead to higher-quality applications with reduced defects and less time spent resolving defects. While many platform vendors will claim that such benefits stem simply from the adoption of platform technologies, we believe that these developer benefits are closely tied to the capabilities of the cloud infrastructure. For example, the automated provisioning, dynamic scalability, management, and monitoring that are part of AWS mean that the development of applications can be simplified because many key services that govern application behavior no longer have to be coded; instead, they can simply be configured as part of deployment. This approach also helps explain why deployment efficiency is commensurate with development and testing efficiency.

Integration efficiency received a lower score than other life-cycle tasks but still was twice as efficient as alternative approaches. Integration involves legacy assets and potentially hybrid datacenter interoperability, making integration challenging. While the improvements in integration were still significant, these gains were not as large as those for other SDLC activities, reflecting both the complexity of opening up and linking to applications not originally engineered for the Web and the low incidence of integration tasks that we were able to measure.

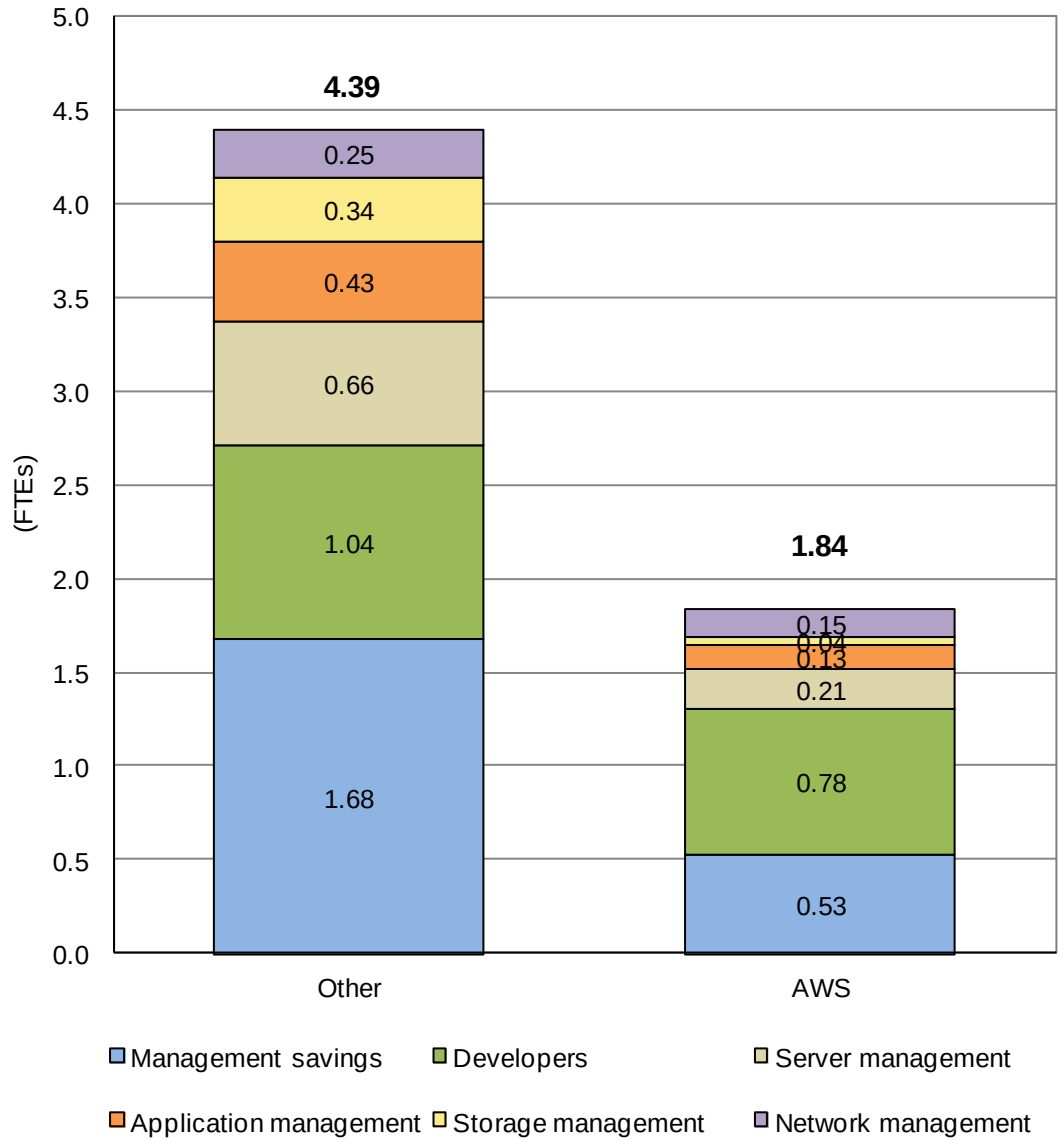
Post-Deployment Staff Productivity

As with most technology, if you make something easier, quicker, and cheaper to do, you will do more of it; so it goes, especially with application development. Because companies in the study could create applications with fewer staff hours, they tended to deliver more frequent upgrades or reallocate resources to create new applications that they had not previously planned. The net result was that they were able to generate more applications yet reduce the costs to develop and deploy by 25%.

Post-deployment IT staff productivity savings result primarily from the reduced infrastructure footprint, requiring less maintenance and support. The combined costs for server, storage, and network support are reduced by 68%, which includes the cost avoidance from not having to increase staff to meet new business requirements. In addition, AWS management services reduced application management costs by another 70%. Figure 6 shows the annual post-deployment IT staff productivity benefits per application in terms of FTEs.

FIGURE 6

Annual Post-Deployment IT Staff Productivity Benefits of AWS per Application



Source: IDC, 2012

Business Benefits

The most significant impact on the business operations of the organizations we interviewed was the enhanced agility delivered by AWS. This time-to-market benefit is often cited as the key reason for adopting cloud services. Seven of eleven companies reported significant improvements in agility. Not all contributed to revenue. Four of

these organizations were able to discuss how revenue-related agility improvements enabled new business models:

- "We can get transactions quicker in our accounting software now. Our people are more productive. It's really seamless to the end user in that regard. They physically have more time to do that work. Estimated additional annual revenue is $500,000+."
- "With AWS, we are able to launch some of the services instantaneously. It would take many months, if not a year or more, to build out that whole infrastructure from scratch. Estimated additional annual revenue is $2 million+."
- "In half a year that we've had this service on market…it's become almost our most popular service. I mean we're talking about millions of dollars in the last six months. Low millions so far. But we think that it's going to generate hundreds of millions over the life of this project. Estimated additional annual revenue is $3 million+."
- "Our ability to go to market with our new program. We would not have been able to get that out. Estimated additional annual revenue is $200,000 to $500,000."

User Productivity

Many companies opt for IaaS on an application-by-application basis and usually when faced with a new requirement. As businesses become more demanding and the stakes get higher, CIOs are concerned that their current resources cannot deliver on the agility, scalability, or robustness that the new application requires. The robustness or quality of service is often measured in unplanned downtime and is the number one reason companies switch providers. In this study, 80% of the organizations reported that Amazon EC2 had reduced downtime and that they were able to reduce their downtime by 72% per user, saving roughly four hours per user per year. In other words, the companies interviewed were able to improve availability from 99.495% in their on-premise/hosted implementations to 99.975% on AWS, increasing application availability by an average of 234 hours per user per year. Table 2 summarizes productivity improvements achieved with AWS.

TABLE 2

User Productivity — Performance KPIs (as Reported by Customers)

	Other	AWS	% Improvement
Downtime events per year	2.82	2.00	29
Hours per year	7.755	4.12	75
Downtime hours per user per year	5.40	1.50	72
Availability (%)	99.495	99.975	95

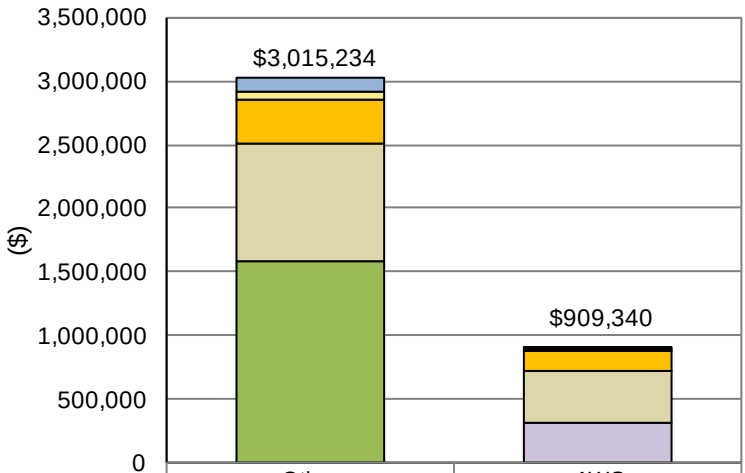
Source: IDC, 2012

Total Cost Comparison

By moving from on-premise or mixed on-premise and hosted solutions to AWS cloud services, organizations in our study were able to reduce the TCO for the average application by 70% over a five-year life cycle. TCO savings include reducing development and deployment costs (by 80%), application management costs (by 52%), and infrastructure support costs (by 56%) and replacing $1.6 million in infrastructure costs with $302,000 in AWS costs. The five-year TCO is shown in Figure 7.

FIGURE 7

Five-Year TCO of AWS per Application



	Other	AWS
Development	$109,638	$20,714
Deployment	$54,432	$11,664
Application management	$346,920	$166,208
Infrastructure management	$920,664	$408,962
Infrastructure	$1,583,579	$-
AWS costs	$-	$301,792

Source: IDC, 2012

Benefits Increase Over Time

Organizations in our study had been AWS customers for as few as seven months to as many as 5.3 years. While all customers had enjoyed positive returns on investment, there is a definite correlation between the length of time they have been AWS customers and their returns. This relationship between length of time using AWS and return is due to their leveraging the more optimized environment to generate more applications along a learning curve. At 36 months, the organizations are realizing $3.50 in benefits for every $1.00 invested in AWS; at 60 months, they are realizing $8.40 for every $1.00 invested.

ROI ANALYSIS

IDC uses a discounted cash flow methodology to calculate the ROI and payback period. ROI is the ratio of the net present value (NPV) and discounted investment. Payback period is the point at which cumulative benefits equal the initial investment.

IDC uses the NPV of the savings and increased revenue over five years in calculating the ROI and payback period for the deployment. The NPV of the savings is determined by subtracting the amount that would have been earned by investing the original sum in an instrument yielding a 12% return (to allow for the missed opportunity cost that could have been realized using that capital).

Table 4 presents IDC's ROI analysis for the deployment of AWS to replace on-premise or other hosting services. This ROI analysis constitutes a five-year view of the financial impact of AWS on a per-application basis. A detailed outline of IDC's standard ROI methodology is provided in the Appendix of this document.

The five-year ROI analysis shows that on average, the organizations in this study spent $286,000 per application on AWS and received $2.1 million per application in benefits for an NPV of $1.8 million. The companies saw a payback period of seven months and an ROI of 626%.

TABLE 3

Five-Year ROI Analysis

Benefit (discounted)	$2,078,626
Investment (discounted)	$286,357
Net present value (NPV)	$1,792,269
Return on investment (ROI)	626%
Payback	7.1 months
Discount rate	12%

Note: The discount rate refers to the missed opportunity cost that could have been realized using that capital related to the average cost of capital + risk factor.

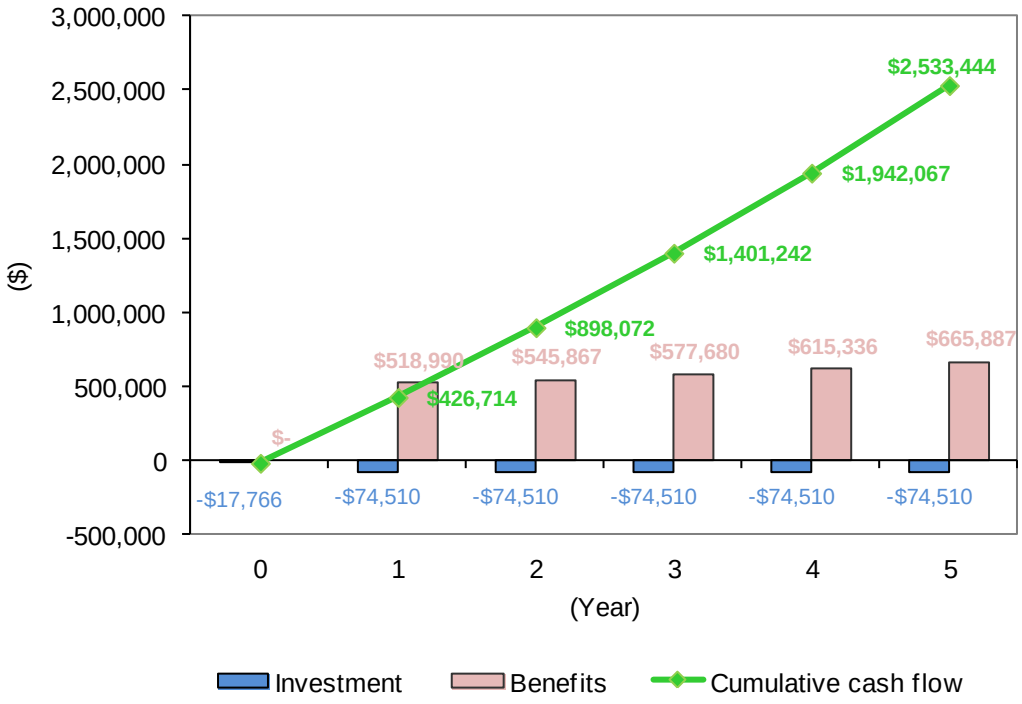
Source: IDC, 2012

The initial investment included the average total costs to purchase, deploy, and run services on AWS. Annual benefits include infrastructure savings, reduced IT labor support, added income, and improved productivity. Organizations in this study made an initial investment of $17,766 per application, which included the purchase and implementation costs for consulting services and the IT labor required for deployment. Based on that investment, the organizations realized average annual benefits of $584,752 per application. Over a five-year period, each company saw cumulative

savings of $2.5 million per application. Figure 8 presents the outcome of the ROI analysis in graphical form.

FIGURE 8

Cash Flow Analysis of AWS per Application



Source: IDC, 2012

CHALLENGES AND OPPORTUNITIES

Challenges

Legacy System Integration

Rehosting applications may require some reengineering, especially if the client side of the application requires a proprietary runtime and/or the application does not leverage Web services between the client and the server. Bridging to or integrating with server-side legacy systems is somewhat easier because the code can be more readily wrappered without having to rebuild parts of the application. Consequently, integration remains a challenge because the architecture and the modularity of legacy applications are highly variable.

Our analysis in this paper seems to bear this out. Figure 5 shows a 200% gain on developer productivity associated with integration, whereas development, testing, and deployment all showed productivity gains in the neighborhood of 500%. While we

have presented this issue as a challenge, the reality is that AWS still compares favorably with other alternatives in terms of integration and assembly due to the rich set of APIs, supported by AWS, that reduce the amount of code otherwise necessary to address most integration tasks.

Extending the Software Development Life Cycle

AWS has already instilled significant functionality across key areas of application development and deployment, including SDKs, application services, databases, networking, relational and nonrelational databases, identity and access, content delivery, and deployment. As AWS builds out its platform, enterprises will want to build and deploy more complex applications. This raises a question around how application life-cycle management (ALM) will be addressed. Application life-cycle management encompasses tools that support the full life cycle of an application, including requirements, team development, versioning, software quality assurance, project management, continuous integration, change management, build management, and defect tracking. While there are open source tools that support some of these activities and AWS' SDKs enable integration with some of today's leading ALM tools, providing and connecting these capabilities across hybrid environments remain challenges.

While we don't expect AWS to broach the many issues that characterize complex ALM implementations, we do believe that as AWS matures, customers will increasingly look to AWS to align with the leading life-cycle tools and provide APIs to better integrate development with deployment and ongoing operations with application development. Development complexity demands higher levels of ALM adoption. The need for a more comprehensive approach to ALM creates a significant opportunity for AWS and would elevate the stature of AWS among medium-sized and large enterprises as they increasingly seek to integrate their on-premise IT activities with public clouds.

Opportunities

Architecting Applications for the Cloud

Our findings show that AWS has an outstanding track record regarding availability. However, service interruptions are inevitable regardless of whether applications are deployed on-premise, on AWS, or elsewhere. To maximize the potential of cloud computing implementations, customers must evaluate the architecture of their applications. If availability is considered important, IDC recommends that organizations architect their applications across AWS Availability Zones in either active or passive ways that are commensurate with the level of availability required. These kind of architectural decisions are simply configuration based in AWS and easy to implement. Most IT shops fail to appreciate the level of sophistication that many cloud services, including AWS, provide and all too often approach deployment decisions without fully understanding how much more available and reliable their applications can be while still saving significantly on operational cost.

As organizations consider the choices that AWS provides around deploying applications, this is also the appropriate time to consider how applications should be scaled. Amazon Machine Images (AMIs) are available as on-demand instances, as reserved instances, and as spot instances. The choice of how to deploy and how to scale, therefore, has a significant impact on application availability and cost. IDC advises organizations to make sure they understand the full range of deployment alternatives before committing to any particular deployment architecture.

CONCLUSION

This ROI analysis effectively validates what end users expect from cloud services, improving savings over the long term. The key areas where this ROI analysis is aligned with user expectations are as follows:

- Enterprise-grade availability across worldwide infrastructure services for running any type of workload (transactional, MapReduce, high performance, Web, or developer)
- A highly cost-effective alternative to on-premise infrastructure solutions that delivers significantly reduced IT system and management costs
- Exceptional productivity and time-to-market advantages across the development, deployment, and management of applications due to the scope of AWS APIs
- High levels of datacenter security, service security, and data security, including the following: Service Organization Controls 1 (SOC 1) report, published under both the Statement on Standards for Attestation Engagements No.16 (SSAE 16) and the International Standards for Assurance Engagement No. 3402 (ISAE 3402) professional standards (this audit replaces the Standards on Auditing Standards No. 70 [SAS 70] Type II report); authorization from the U.S. General Services Administration to operate at the Federal Information Security Management Act (FISMA) Moderate level; the platform for applications with Authorities to Operate (ATOs) under the Defense Information Assurances Certification and Accreditation Program (DIACAP); ISO 27001 certification of AWS' Information Security Management System (ISMS) covering its infrastructure, datacenters, and services; successfully validated as a Level 1 service provider under the Payment Card Industry (PCI) Data Security Standard (DSS); International Traffic In Arms Compliance (ITAR) compliance (AWS GovCloud [US] Region); Federal Information Processing Standard (FIPS) Publication 140-2; HIPAA; and Cloud Security Appliance (CSA) Consensus Assessment Initiative Questionnaire (CAIQ)

Amazon's decision to develop AWS from the ground up to support Amazon's own massively complex IT needs as a Fortune 100 company provides a compelling reference model for how to architect cloud services. The size and scale of AWS also provide AWS with a high degree of market flexibility and ability to offer services at price points well beyond the reach of most very large enterprises or other cloud service providers. AWS has reduced its prices 20 times over the past six years, making AWS appealing to organizations of all sizes.

APPENDIX

IDC utilized its standard ROI methodology for this project. This methodology is based on gathering data from current users of the technology as the foundation for the model. Based on these interviews, IDC performs a three-step process to calculate the ROI and payback period:

1. Measure the savings from reduced IT costs (staff, hardware, software, maintenance, and IT support), increased user productivity, and improved revenue over the term of the deployment.
2. Ascertain the investment made in deploying the solution and the associated training and support costs.
3. Project the costs and savings over a five-year period and calculate the ROI and payback for the deployed solution.

IDC uses the NPV of the savings and increased revenue over five years in calculating the ROI and payback period for the deployment. The NPV of the savings is determined by subtracting the amount that would have been earned by investing the original sum in an instrument yielding a 12% return (to allow for the missed opportunity cost that could have been realized using that capital).

IDC bases the payback period and ROI calculations on a number of assumptions, which are summarized below:

1. Time values are multiplied by burdened salary (salary + 28% for benefits and overhead) to quantify efficiency and manager productivity savings.
2. Downtime values are a product of the number of hours of downtime multiplied by the number of users affected.
3. The impact of unplanned downtime is quantified in terms of impaired end-user productivity and lost revenue.
4. Lost productivity is a product of downtime multiplied by burdened salary.
5. Lost revenue is a product of downtime multiplied by the average revenue generated per hour.
6. The NPV of the five-year savings is calculated by subtracting the amount that would have been realized by investing the original sum in an instrument yielding a 12% return to allow for the missed opportunity cost. This accounts for both the assumed cost of money and the assumed rate of return.

Because every hour of downtime does not equate to a lost hour of productivity or revenue generation, IDC attributes only a fraction of the result to savings. As part of our assessment, we asked each company what fraction of downtime hours to use in calculating productivity savings and the reduction in lost revenue. IDC then taxes the revenue at that rate.

Further, because IT solutions require a deployment period, the full benefits of the solution are not available during deployment. To capture this reality, IDC prorates the

benefits on a monthly basis and then subtracts the deployment time from the first-year savings.

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