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What Is the Cloud?

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Chapter 1. What Is the Cloud?

The computing world has been marked by a series of eras or shifts, each heralded by major changes in underlying technology and business requirements. First, there was the mainframe era of the 1960s, then came the distributed computing or minicomputer era of the 1970s, the PC or highly distributed era of the 1980s, the client–server computing era of the 1990s, followed by the ubiquitous network or internet era of the early 2000s.

Currently we are in the era of *cloud computing*. It is enormous in size, broad in scope and importance, and is getting more so with each passing month.

To put cloud in some context, consider that as of January 2019, the two largest companies in the world by market valuation were Microsoft and Amazon. Each was valued at about $800 billion. That combined value of $1.6 trillion approximates the GDP of Canada and is more than the GDPs of Switzerland, Denmark, Belgium, and Portugal *combined*.

Microsoft started out making software for personal computers, whereas Amazon began as an online bookseller. But, today, what is powering the expansion of these two behemoths is a common growth engine: the cloud. The cloud services these two companies sell generated nearly $50 billion in sales last year, and that is expected to double by 2020—enormous growth even by computer industry standards. More than 55 cents of every dollar Amazon earns today comes from its cloud business, even though cloud revenues amounted to only 12%.

The future of the cloud continues to shine very brightly. In an annual survey of CIOs of major corporations, Goldman Sachs found that CIOs are planning on moving increasingly large computing workloads to the cloud services of Amazon, Microsoft, and other cloud providers. McKinsey believes that enterprise cloud strategies are the key to IT modernization and transformation today. Growth in private clouds, a form of the cloud favored by many big businesses (as we discuss later), is set to grow at a brisk 30% compound annual growth rate for the next eight years. Within three years,

nearly one in every three dollars spent by corporations on information technology will be spent on the cloud.

And, of course, the cloud has emerged as a key feature in consumer mobile applications. Who doesn't back up their smartphones, tablets, and laptops to the cloud these days?

The Cloud Is…

So exactly what is the cloud? Is it one thing or many? Is it a relatively new phenomenon or an outgrowth of the natural evolution and progression in computing? Why do data security questions pop up when the cloud is mentioned? Why should you care about it? And how did business and consumers ever live without it?

The very origin of the term "cloud" actually sheds light in an illustrative way as to what it is and what it does. Decades ago when hard-wired telephones were the chief means of one-to-one business communication, the public telephone network (think AT&T and subsequently the seven Bell companies when AT&T was broken up in 1984) was often represented as a cloud. It didn't matter where a user was located or who their carrier might have been. The key was that all users could access these phone networks and later other telecommunications and network services through this ephemeral "cloud" of communications resources. Then, they were billed for the services they consumed.

Today, there is no single definition of cloud computing. However, the different definitions have several key things in common. Think of cloud computing as the delivery of computing services on demand. What kind of services? Pretty much anything, from applications to data storage to networking or even more processing power. Users can access the cloud to get just about any computing service they need, when they want and need those services. They are delivered over a private network or, more commonly these days, over the internet, in many cases on a pay-as-you-go basis.

A basic premise of the cloud is that the actual location of the services provided is totally irrelevant to the end users. It doesn't matter what hardware is powering the applications or, for that matter, what operating system is dishing out application

information. The cloud is *computing-as-a-service*, a concept that has been around in computing for 60 years now. But, as we show in this report, there are major differences between old-school time sharing and today's cloud, so much so that the cloud is the dominant computing scheme today.

For consumers, common services like backing up voluminous smartphone photos and video files or accessing Gmail are tailor-made for the cloud. For the enterprise, the cloud can host literally all data and run all applications, including those deemed most mission critical. For Netflix, mission critical means flawless streaming of enormous video files to paying subscribers. And Netflix turns to the cloud for this vital service.

Something Old, Something New

This is all very different—and also very similar—to the way computing was handled in the earlier eras mentioned at the beginning of this report. In the mainframe era, users sat behind screens and keyboards known as *dumb terminals*—literally. They were attached to the mainframe via simple communications lines and lacked any ability to process anything on their own (hence, the term "dumb"). But through them, the users could get all the services and applications they needed to do their job, which is not dissimilar to today's cloud environment.

The distributed computing environment saw computing power migrate away from mainframes exclusively, initially down to smaller minicomputers, which were often found in discrete departments or in small businesses. They also served users tethered to dumb or mostly dumb terminals over somewhat faster networks. Later on, PCs made a big splash in businesses everywhere, performing many tasks on their own that previously involved minis or mainframes. These tasks included word processing, spreadsheets, schedulers, and other personal applications.

But there is a sharp difference between those early environments and today's cloud world. There was very little, if any, communication among these disparate systems. And the applications they powered had even less communication, not to mention the databases these systems generated. It was a computing free-for-all in many ways, with everyone doing their own thing. This proved to be not particularly productive in

business environments, for which information sharing and collaboration were beginning to be highly prized as enablers of competitive advantage.

Client–Server Era Ushers in More Resource Sharing

The client–server era changed all of this. In *client–server computing*, a server (big computer) takes requests for services from client computers (small computers or workstations). In other words, a shareable resource environment handles the client requests over a high-speed network. The tasks are assigned to the servers best designed to handle the tasks—say, high-level computations versus database queries versus engineering queries. This client–server model or computing architecture drew even closer to today's cloud model of services-on-demand. The pay-as-you-go features would come later.

Virtually all of these styles of computing occurred within the four walls of an organization, where protecting sensitive data was pretty straightforward. However, these styles of computing had many limitations and shortcomings. One was expense. Take, for example, a manufacturer that ran a seasonal business, like making lawn furniture, snow blowers, or pleasure boats. Or consider the retailers that sold these items to the public. At peak times of the year for each of these businesses, computing needs also would peak. That meant buying hardware, networking equipment, and software to insure optimal operations during those peak times, resulting in a lot of unused capacity for much of the rest of the year.

Or, consider a bank that advertised a series of new promotions designed to drive new depositors to open accounts or purchase mortgages. Business would peak sharply as the promotion campaign was running, only to return to normal rates of business when the campaign concluded. Building and maintaining computing infrastructure to accommodate such common business practices became very expensive and difficult to justify.

As we show in this report, cloud computing models can meet normal or minimum demand levels, while organizations can take advantage of cloud service providers to

meet peak service demands.

Along Comes the Internet and Cheap Networks

The rise of the internet and very high-speed, relatively cheap networks began to open up new possibilities. What if some of these services, such as increased processing power, more network capacity, bigger storage demands, or even the applications themselves were available, on an as-needed basis, from remote servers hosted on the internet? What if businesses of all sizes and in all vertical areas didn't necessarily need to build, maintain, and own all of the computing infrastructure they need to survive and grow? And for businesses that already had excess capacity of processors, networks, and storage capacity, what if they could rent this out to those in need of such services?

And so it was, with cloud starting in earnest about a decade ago. The cloud isn't any one thing when seen in this context. Rather, it was the confluence of many things, including the internet, rapidly shifting business requirements for speed and agility, and plummeting prices for mass storage. In addition, there arose the need to store and process very large volumes of so-called unstructured data, such as emails or social media photo and video files. The cloud was a perfect storm of technology innovation and business and personal demands.

All of this explains the extraordinarily rapid and continued growth of cloud computing by businesses as well as consumers. Today, there are literally thousands of viable, growing businesses that own little if any computing resources—other than their data. Their business is "in the cloud."

Different Kinds of Clouds

To this point, this ebook has "defined" the cloud largely by how it works, namely as a repository of computing resources available on demand—anything from raw compute power to storage to networking to applications. Users request these services and they are provided, for the most part, using advanced automation technology with little or no human intervention. Far and away the main feature or "calling card" of the cloud comes

down to one word: agility. In business, that translates to faster time-to-market and a definitive competitive advantage.

All that being said, there are three main cloud models in use today, each serving different needs and requirements for businesses and consumers.

What Is the Public Cloud?

When consumers think of the cloud, it is the public cloud they are considering, for the most part. And for businesses of all sizes, the public cloud is increasingly becoming the place where they spend the lion's share of their cloud spending and the place users access vast amounts of computing resources over the internet to get their jobs done.

These resources are often created, maintained, and distributed by very large private companies, which happen to have enormous stores of computing power. And, in the case of businesses, the sharing of that power with multiple customers is commonly referred to as a *multitenant architecture*. It is important to know that each tenant's data remains independent of the data of all other tenants, even though the tenants share resources.

Also, public cloud providers invest in considerable redundancy of certain resources, most notably storage, and operate multiple datacenters in different geographical areas. This gives the public cloud the desired business feature of reliability. And the bigger public cloud providers utilize very high-bandwidth, high-speed networks and connectivity to transport data and cloud services at virtually the same speeds that users in an enterprise network enjoy.

Because these public cloud providers have so much computing power relative to the computing needs of individual customers, they have no issue scaling up very quickly to meet sudden surges in demand. In the simplest terms, think of the public cloud as a large store of computing resources—if not limitless, certainly large enough to fill any customer's needs.

PAY AS-YOU-GO WITH PUBLIC CLOUD

These resources (processing power, storage, applications, networking) are all

available on a pay-as-you-go basis or on a subscription basis. The biggest public cloud providers are almost household names today. At the top is Amazon Web Services, or AWS. Amazon started out as an online bookseller and then morphed into the biggest online retailer in the world. Along the way, it acquired: massive numbers of high-performance big computers (mainframes); all the expensive operating systems that power them along with other key software; networks to interconnect these processors; and, of course, enormous volumes of storage capacity. Eventually the company figured it could make money essentially leasing out unused computing capacity.

Closely following AWS and growing rapidly is Microsoft's Azure cloud services. Being a major supplier of business applications and other business solutions, Microsoft was a "natural" for the public cloud market. Other public cloud leaders include Google and China's Alibaba.

ADVANTAGES OF THE PUBLIC CLOUD

The advantages of the public cloud include very rapid scalability, or ramping up of computer services. If a retail business suddenly needs more computing power to handle a big jump in web traffic following a product promotion, its IT department can get that from the public cloud almost instantly. Compare that to the prepublic cloud days when IT had to purchase a new computer after shopping around; install it; debug it; and then deploy it with new applications. The comparison is a day or less instead of weeks or even months.

Owing to redundancy and multiple geographic locations, the public cloud and cloud service providers have proven to be extraordinarily reliable. If an entire public cloud datacenter were to be wiped out in a natural disaster, others are ready elsewhere to take over. These are far higher levels of availability and reliability than most any company or organization can provide by itself.

Also, the public cloud can be quite cost effective. It is the scale of compute resources maintained by the public cloud vendors that gives them economies of scale in maintenance, mass buying, dealing with system failures, and even access to hiring top talent and experts in key areas like security. As a general rule, cloud services are not cost effective, if at all, for the delivery of unique services or those services consumed

in a long-term steady-state model. In addition, when relatively scarce IT staff are freed from the drudgery of operations maintenance, particularly with older systems, they are freed to focus on more business-essential tasks such as developing better customer-facing applications. Efficiencies such as these gained from the public cloud can lead to competitive advantage, increased revenue, and higher profits, as well.

SECURITY CONCERNS OF PUBLIC CLOUD

Nothing comes up all roses, including the public cloud, which has its share of drawbacks and valid concerns. The most serious and long-standing concern is security. Most of these concerns revolve around a core tenet of the public cloud, namely that public cloud servers are dedicated to multiple customers. Some feel that this multitenancy can make the public cloud a more attractive target for cyber criminals and data miners. As discussed in the next section, private cloud processors and resources are dedicated to just one customer.

However, several studies have shown there is a sound argument for the public cloud having as much if not more security than private clouds. The sheer volume of processing power and other computing resources the public cloud companies own and maintain make them far more capable of dealing with data threats, attacks, hacking, and so on. There is little they will encounter that they haven't seen before. And they can often afford to pay top IT security specialists to secure these vast resources. In addition, enterprises often fall short or fail in efforts to enforce technological and operational standardization within their datacenters. To profitably operate, cloud service providers (CSPs), by contrast, must establish and enforce a very high degree of standardization across their global infrastructure. This enables the broad deployment of automation within their datacenters and the employment of data security controls with real-time monitoring and alerting capability. This approach affords tremendous visibility across the security environment.

Additionally, with billions-upon-billions of dollars being spent by major businesses on the public cloud, there have been no major break-ins or successful attacks reported that resulted from an attack on a public cloud provider. It is important to understand that data security is a joint responsibility between the CSP and enterprise. Some organizations fail to implement effective data management policies and processes

(especially in the area of data classification), which leads to an inability to select and employ proper data security controls. Only the cloud service customer is capable of properly classifying the data, selecting and enforcing the use of needed data security controls, establishing appropriate role-based access control (RBAC) procedures, and fulfilling identity provider functions.

Finally, even though most big public cloud providers offer customers various tools for estimating what a package of cloud services will cost, there are a number of oftentimes unseen considerations that can surprise customers with "hidden" costs. TechTarget provides an excellent article describing how these can raise a cloud bill.

What Is the Private Cloud?

Private cloud, usually used by mid- to large-sized (enterprise) organizations, allows these organizations to get many of the same advantages of the public cloud. The difference is that with the private cloud they never shift responsibility for their data and know at all times exactly where that data is located. These are important if not business-essential considerations for organizations working with so-called "sensitive" data. This can be data that is considered essential to the competitive position of the organization; highly sensitive personal information that is often the target of hackers and data criminals; and data subject to high levels of regulation and compliance, often from government entities. For example, in Europe there exists since May 2018 a new set of data privacy laws called the *General Data Protection Regulation*, or GDPR. It specifies certain requirements that companies know exactly where consumer data is located, how it is transported, protected, and so on. At this time, the public cloud does not necessarily meet all of these requirements, though that could change as things progress.

The private cloud allows companies to build an infrastructure and deploy computer resources precisely as they want. They can then deliver the information and resources that internal developers want without putting vital data security at risk or, in theory, with less risk than that associated with the public cloud. But this comes at a cost, potentially a steep one, in terms of the expense of infrastructure to provide the same resiliency and redundancy as the public cloud offers.

A private cloud might be physically located at a company's headquarters or at a remote datacenter. And some organizations will pay third-party partners to host their private cloud. Regardless, all private cloud services are hosted on servers and processors that are not shared with other businesses and are maintained on a 100% private network. Also, as with the public cloud, private cloud users or departments can pick and choose whatever services they want to have provisioned (e.g., to build, test, and run new applications). They are then metered internally so that the department is charged for these services. High-level software, most notably VMware's Software Defined Data Center, automates just about all of these private cloud functions. Also, Cisco offers its Unified Computing System. And increasingly, OpenStack, the popular and growing open source project, is being configured for effectively the same purposes as vendor-specific products.

It is important to note that this approach can negate the economic advantages normally associated with cloud computing in favor of providing freedom of choice to internal customers with respect to technology, services, and operations.

What Is a Hybrid Cloud?

The cloud is seldom an all-or-nothing proposition, with businesses rarely going all-in for public or private cloud architectures. Instead, the most common cloud environment in business today is a *hybrid cloud*—a mix of public and private cloud services. This integration of public and private clouds usually involves creating parallel environments to allow for the free movement of applications and data from one to the other. So, for example, sensitive corporate data can remain on site in a private cloud, but certain workloads, such as application testing, might well migrate offsite to a public cloud where it is cheaper.

For most businesses, a hybrid cloud offers optimal flexibility and more deployment options while at the same time optimizing the expensive infrastructure the business already owns. And a hybrid cloud works well to insure compliance with various data security regulations, such as HIPAA in the medical community, Sarbanes-Oxley and others in the financial services area, and PCI-DSS in the retail space.

The Community Cloud Model

Lesser known and therefore less prevalent than the other three cloud models, the *community cloud* is a variation of the private cloud offering a comprehensive cloud solution for a specific business community. The community model caters to multiple organizations that want to collaborate and pool resources to establish cloud services under which all the organizations operate, using a common information technology governance model. Examples of a community cloud include the US Federal Government Community Cloud, which operates under the Federal Risk Authorization and Management Program (FedRAMP) IT governance model. Healthcare's Optum of the UnitedHealth Group and the IGT Cloud for online gaming companies are two commercial community cloud examples.

What Are Cloud Services?

As mentioned, cloud services are pretty much any computing-related feature that can be provided through a typical datacenter. These include network services, database services, applications of all kinds, raw computing horsepower (e.g., to crunch through a pile of scientific or engineering data), storage, application testing services for developers, security services, and so on. Cloud services are usually scalable on demand and available on some sort of fee or pay-as-you-go basis.

The usual alphabet soup of acronyms of which the computer industry is so fond represents the most common of these services.

IaaS

Infrastructure-as-a-service (IaaS; pronounced "eye-az" [depending on whom you ask]) is generally thought of as the top layer of the dominant cloud computing models, although it is far from the largest—that distinction falls to Software-as-a-Service, which we look at momentarily. True to its name, IaaS refers to the infrastructure that can be leased or rented by organizations. This includes processors, servers (both physical and virtual), and storage resources (including common hard drives, optical drives, network-attached storage [NAS], solid-state drives, and flash storage arrays).

IaaS has gained significant traction in recent years, particularly with startups and fast-growing independent divisions of larger companies seeking to build their own business-critical applications but eschewing the investment and maintenance that infrastructure requires. Also, these are companies often looking for immediate scalability fostered by fast growth. With IaaS, they can "spin up" a new virtual server in a tiny fraction of the time it takes to get that extra capacity by buying and installing it on their own.

There are many questions that continue to swirl around the matter of just how secure IaaS really is for the most sensitive and critical of applications that will run on IaaS infrastructure. That is an ongoing debate, with some IaaS advocates feeling that the tremendous experience IaaS providers gain from dealing with so many customers in so many different verticals actually can make IaaS *more* secure than home-built infrastructure. Many of these questions are primarily driven by the customer organization's inability to properly classify data and apply appropriate data security controls. Nonetheless, in one recent survey, half of the senior IT respondents felt IaaS isn't secure enough for applications involving critical or sensitive data. That same survey also found the following:

- Fear of change might be at work against a more aggressive use of IaaS, with half of survey respondents saying misconceptions around IaaS have been a strong barrier to adoption.
- Yet, 75% of organizations will have infrastructure in the cloud within two years.
- Half of the organizations polled say IaaS boosts key performance metrics.
- As time passes, IaaS benefits will trump the many challenges cited today.

Leading providers of IaaS today include (in order):

1. AWS
2. Microsoft
3. Alibaba Cloud
4. Google Cloud Platform
5. IBM

6. Oracle

Although market forecasts of the global size of IaaS vary, they are united in the belief that growth will be in double digits annually for the next several years. In fact, IaaS growth will outpace the much larger Software-as-a-Service segment. Reliable estimates peg annual growth in IaaS in the 28% range for the next six years. IaaS global sales in 2017 were about $24 billion, up from just $18 billion the year before.

PaaS

Platform-as-a-Service (PaaS; pronounced “paz”) is the smallest of the main cloud models, by annual revenue. However, many experts and analysts expect PaaS to become one of the most important and fastest growing segments in the enterprise technology stack. PaaS generally includes the underlying storage, networking, and virtual servers available on a pay-as-you-go basis, but it also provides the many tools and other software that developers require while building applications. This includes middleware, database management, operating systems, and application-specific development tools. In other words, PaaS offers the same simplicity and flexibility of IaaS but extends support to the entire development community.

Leading examples of PaaS solutions include the following:

- AWS Elastic Beanstalk
- Windows Azure
- Heroku
- Force.com
- Google App Engine
- Apache Stratos

Global PaaS sales last year of nearly $18 billion are expected to rise to $22.6 billion this year, a 20% increase.

SaaS

Software-as-a-Service (SaaS; pronounced “sass”) is far and away the most prevalent

and dominant of all cloud computing models and is likely to remain that way for the foreseeable future. SaaS is essentially the delivery of applications directly from the cloud to individual users. The hardware processing the applications and data as well as the underlying operating system matter not one bit to end users, who access these applications via a familiar web browser such as Chrome, FireFox, or Safari. Companies purchase SaaS offerings generally on a per-user or per-seat basis.

Organizations of all sizes have flocked in huge numbers to SaaS. And why not? They don't need to invest in a lot of expensive hardware and operating systems. Plus, they don't need to pay IT staff to maintain the infrastructure or troubleshoot the applications either. The SaaS vendor provides all that. If not using a SaaS vendor, businesses need to buy a perpetual license to run a software application on company systems, on top of which is added a 10 to 20% (or higher) annual maintenance fee. It's a great deal for software companies, a sort of annuity or gift that keeps on giving. For the buyers, not so much.

Not all applications are suitable for a SaaS deployment. For example, a maker of, say, components of nuclear reactors or other highly customized products may well find that in-house systems are best adapted and more functional for such specialized purposes. For more generalized applications, however, SaaS is proving to be the go-to software solution. Also, SaaS solutions over time are becoming more and more customizable, broadening the potential market for SaaS.

The enthusiasm for SaaS is reflected in ambitious projections for its ongoing growth. The market for SaaS solutions is expected to reach $186 billion within six years, growing annually at about 22% to reach that figure. Last year, SaaS accounted for two of every three dollars spent on the public cloud. Leading the charge into SaaS are customers buying customer relationship management (CRM) solutions, such as Salesforce, as well as enterprise resource management (ERM) solutions. In addition to Salesforce, other well-known SaaS solutions include Microsoft's Office 365; Workday (financial and capital management software); NetSuite (enterprise resource planning or ERP solutions); ServiceNow (IT service management or ITSM); and Athena Health (medical records management)

Case Study: Airbnb Books Room in the Cloud

Airbnb, perhaps the best known of companies allowing property owners and travelers to connect with one another, is barely 10 years old. At an estimated market value of $31 billion, it is second in size as a startup only to Uber. Growing a company from zero to $31 billion—twice the market valuation of American Airlines—in just 10 years would have meant very heavy capital spending on information technology and heavy operational spending on IT staff to run such an infrastructure. Instead, Airbnb increasingly has gone to the cloud to essentially rent infrastructure and services, specifically from AWS. The company had made a decision a year after its founding to deal with AWS exclusively for all of its cloud computing functions, seeking greater ease of management of IT resources. AWS quickly found that it was simple to ramp up more servers and compute power without having to contact anyone and without having to make large service usage commitments, according to company cofounder and CTO Nathan Blecharczyk.

Airbnb even moved one of its most prized data assets, its relational database, to AWS in hopes of simplifying many of the time-consuming and costly administrative tasks often associated with relational databases. What's more, Airbnb completed the entire migration of this key data repository to AWS with only 15 minutes of system downtime. This was vital to Airbnb, because shutting out users from its community marketplace for any extended period of time could drive repeat users into the eager clutches of competitors.

Ultimately, the cloud benefits for Airbnb include optimal flexibility and responsiveness to enable greater growth in this red-hot market. Airbnb also lauds the cloud's relatively low costs and simplicity of bringing new computing services on stream with maximum speed and minimum effort.

Case Study: Heineken, James Bond, and the Cloud

One of the most recognizable brands on earth owing to its distinctive green bottle, Heineken is always on the prowl for joint marketing deals to extend its global reach. Such efforts included teaming up with James Bond and the release of the smash hit movie *Skyfall*, which racked up more than $1.1 billion in box office sales.

Where did Heineken fit into this success? The company's marketing department hatched plans for a worldwide joint campaign, an unusual gesture for a company used to highly decentralized and localized advertising efforts. This meant the *Skyfall* promotional 100 MB movie segment had to play absolutely flawlessly for potentially millions of viewers around the globe.

As this was a one-time event, it was unfeasible for Heineken to invest in the computing resources needed to pull this off. Besides, the people pushing this campaign were marketers, not IT professionals. Thus Heineken turned to Microsoft and its Azure cloud services to drive the campaign's success. In particular, Heineken took advantage of a Microsoft service called Azure Content Delivery Network to make a very large block of video available with very high reliability to more than 10 million viewers around the world.

Case Study: American Airlines Reroutes to the Cloud

As any business or leisure flyer knows, the quality of airlines is gauged largely by customer service. In today's hyper-connected world, that quality of service in an airline often relates to the level and ease of use of self-service and instant information the airline can provide. To that end American Airlines moved several of its critical applications to the IBM cloud, using new cloud technology to create innovative customer-facing applications to boost the overall customer experience.

American had been using a variety of "legacy" applications to power its customer self-services. Legacy in computing is often synonymous with slow, inflexible, user-unfriendly, and expensive. With IBM Cloud, American replaced these apps with cloud services available instantly to customers worldwide on a 24/7 basis.

One notable example of the benefits of cloud relates to the usual tedium and frustration customers feel when rebooking a flight due to weather issues, which every flyer has experienced. Precloud, American passengers had to call a reservation desk (good luck with that during a major outage!) or find an available agent at the airport. American sought to put customers in control by allowing them to see the alternate flights available

and then rebook themselves on smartphones or at self-service kiosks. Working with IBM, American developed its Dynamic Rebooking application, which was deployed in the cloud in less than half the time American anticipated.

Global deployment of that app coincided with a major hurricane striking the US mainland and the resulting mega-mess to the flight system. Customers using the app found that it walked them through the rebooking process and the reissuing of tickets while serving up an e-boarding pass and sending other messages to reroute checked luggage. All this was accomplished without any intervention by American agents. Looking ahead, American will further utilize cloud services to foresee delays and cancellations based on weather predictions, allowing customers to decide for themselves on rebooking in advance.

Case Study: Colgate-Palmolive Cloud Supercharges Collaboration

With one of the most ubiquitous brands in the world, Colgate-Palmolive sought to boost collaboration among its 38,000 global employees to drive greater efficiency. With these workers spread across offices and facilities in 130 countries, collaboration is key to smoother operations. Greater collaboration translates into better information on local market conditions, the competition, and insights into new opportunities. This means engaging cross-functional, often far-flung teams to get important work done.

Colgate felt this would be an ideal task for the cloud, given the universal access to data and communications that the cloud provides. IT leaders set about finding an employee-friendly, cloud-based toolset to support innovation and boost productivity across the board. For Colgate, the solution is Google GSuite, a highly integrated toolset with the convenience of single sign-on (SSO). The solution also works independently of Colgate's legacy systems. More important, Colgate was able to adopt GSuite while avoiding any large upfront investments in hardware, software, and the expense of managing it all.

Employees reacted enthusiastically to the new toolset, with 28,000 of them migrating to GSuite within just six months. In the first month alone, employees logged some 57,000

hours in Google Hangouts Meet sessions, collaborating on myriad business-related topics. As one Colgate manager noted, employees using GSuite applications on mobile devices are able to create, manage, and accept meetings easier than ever before, often with a single click.

Case Study: Schneider Uses the Cloud to Bring Electricity to the Masses

With instant communications and ubiquitous connectivity, it can be difficult to grasp the reality that some two billion of the world's people lack electricity or reliable sources of energy. Schneider Electric, a global specialist in energy management and automation, holds as a central part of its mission statement the belief that access to energy is a basic human right. To that end the company constantly strives to find pathways to safe, sustainable, and affordable energy for everyone.

To achieve its lofty goals, Schneider partnered with SalesForce, the world's biggest supplier of SaaS apps, to link employees and partners globally and transform how they share information and conduct their daily business.

Schneider's rapid growth since the turn of the millennium put great pressure on IT and IT resources to make better sense out of scores of disparate systems and databases throughout the company, some of which resulted from Schneider's many acquisitions. And with 120,000 internet-connected employees worldwide, the company needed to insure seamless communications among them as well as seamless access to the data they needed to perform. That simply wasn't feasible with the mélange of legacy systems the company operated.

Working with Salesforce, Schneider sought to replace this slew of disparate systems from multiple vendors—more than 100 in all—with a single solution easily shared by all 120,000 employees, and partners, as well. The goal was to give Schneider's sales team the coveted "360-degree view" of their customers while helping individuals and teams collaborate optimally across geographies and departments. After a slow start (users can be notoriously sluggish when confronted with new technology solutions), Schneider now boasts more than 43,000 Salesforce cloud users and an additional

400,000 users at partner organizations. As one Schneider executive noted, the cloud solution has "completely transformed the way we manage our customer base…with one version of the truth to rally the company behind."

Summary

The rapid growth of the cloud is well documented, as are the lofty projections of continued growth at least for the next five years. There are several reasons for this cloud growth optimism, all based on the steady stream of benefits that the cloud delivers. In today's world, perhaps the two most prized attributes of business operations—and for all organizations, for that matter—are flexibility and agility. These attributes allow organizations to respond quickly to the very rapid changes in the global business environment.

In addition, there are significant potential economic benefits from using the cloud. Many, if not most, organizations do not accurately document, monitor or measure the total cost of delivering their internal IT services. Costs like datacenter real estate, property taxes, electricity, and environment management are covered under non-IT budgets. In some organizations that have an accurate read of the total costs of owning and operating their own IT infrastructure, switching to public cloud for standardized services can yield immediate cost savings. Even greater savings can accrue from efficiencies gained via the cloud. When relatively scarce IT staff are freed from the drudgery of maintaining infrastructure, a task that can consume up to three-quarters of their time, their efforts can be redirected on more strategic tasks. This often includes developing better customer-facing applications, which can lead to specific competitive advantages, increased revenues, and increased profits.

Interestingly, research shows that some concerns about cloud security persist, even though major CSPs have excellent security records. The reality might be that security issues are primarily driven by the customer organization's inability to properly classify data and apply appropriate data security controls, not by the cloud providers themselves. Whatever the case, organizations obviously feel that perceived risks of the cloud are outweighed by the benefits, given the continued growth in cloud usage.