MH0008
0077645065

KONSTANTINOS GRIGORIOU
GERMAN RETANA
FRANK T. ROTHAERMEL

IBM (in 2010) and the Emerging Cloud-Computing Industry

THE TEAM SAT SILENTLY in the conference room. Sam Palmisano, IBM's Chairman, President, and CEO, had just finished a presentation to Bruce Harreld, Senior Vice President of Strategy, and his team, comprised of several VPs, directors, mid-level managers, and some summer interns. Mr. Palmisano's words still rang in their ears: "Cloud computing is coming on strong, and is here to stay. The economics and the structure of the IT industry will change forever. We have to leverage it. I don't want a repeat of the PC disaster. Understood?"

The weather was changing; clouds were emerging on IBM's horizon and the company had no time to lose. Pressing questions needed urgent but effective strategic answers. IBM had been through many ups and downs following previous platform, technological, market, and strategic shifts in the IT industry. It remained to be seen if IBM had learned anything from the lessons of the past that would help it survive the coming cloud-computing storm.

The question facing Harreld and his team was what kind of reference point it should use with respect to cloud computing. IBM had numerous strategic options to consider, the first being how far to venture into this new uncharted "cloud" territory. With mainframes, IBM excelled at vertically integrating all related activities in-house: hardware, software, sales, and service were all part of the "Big Iron" (a term referring to business involving large mainframes or supercomputers). While that business model had not proven successful in the PC market, it could provide a means of establishing a dominant position in cloud computing if executed in a smart and timely manner. Alternatively, the company could choose to focus on specific value chain activities—for example, supply the hardware needed by cloud service providers, develop and sell the systems-management software needed to grow the distributed and scalable infrastructures, or become a cloud service provider (to firms that did not want to implement cloud services by themselves). Yet another option was to pursue two or more of these activities in combination.

Then there was the question of whether to work with a partner, acquire existing businesses, or go it alone. Partnerships could ease the burden of doing everything in-house and secure a critical mass of famous players (like Amazon or Google) that could potentially dominate the cloud market. However, IBM would have to share some (or perhaps even most) of the value created. The attraction of acquiring smaller players that were already active in the cloud market was that it could infuse IBM with relevant and essential talent. Between 2000 and 2009, IBM consummated over 100 such technology acquisitions to strengthen its portfolio of businesses.[1] Yet, acquisitions could also delay IBM's response because of the time needed for integration and coordination procedures. Going it alone would keep the bulk of value created in-house, but it would not be easy to do everything in-house in such a competitive multilayer industry, nor could things be done very quickly. Going it alone would also be the most resource-intensive of all the options.

PhD candidates Konstantinos Grigoriou, German Retana, and Professor Frank T. Rothaermel prepared this case from public sources. This case is developed for the purpose of class discussion. It is not intended to be used for any kind of endorsement, source of data, or depiction of efficient or inefficient management.

Another issue was market segmentation. Should IBM target individual consumers, or should they focus on small and medium-sized companies, or large enterprises, or even whole nations? Would it be better off serving public, private, or hybrid clouds? Traditionally, IBM's strength had been at the enterprise level, which would seem to indicate a focus on private clouds.[2] However, the real question was: What would be the most profitable market segment(s) in the cloud-computing business?

Mr. Palmisano had tasked the group with formulating a strategy for responding to the challenges posed by cloud computing. He also wanted step-by-step recommendations for how to implement their ideas. Bruce Harreld and his team began to discuss how to tackle the problem. . . .

Background on Cloud Computing and the IT Industry

Cloud computing is an emerging, web-based form of information technology (IT), defined as "a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that [could] be rapidly provisioned and released with minimal management effort or service provider interaction."[3] (See **Exhibit 1** for a full definition and further explanation of cloud computing.) It was made possible by cheap and powerful processors combined with high-bandwidth availability across networks.[4] The cloud was radically changing the distribution of value across the entire IT industry. Traditional "big fish" in the IT industry sold hardware (e.g., Intel, Dell, IBM), operating systems (e.g., Microsoft), database engines (e.g., Oracle, IBM), office applications (e.g., Microsoft), or business applications such as enterprise resource planning (e.g., SAP, Oracle) or customer relationship management tools (e.g., SAP, Oracle, Microsoft). But through the cloud, these components could all be accessed as an online service by users whenever needed. The IT industry was undergoing a platform shift from product- to service-oriented strategies, and companies that did not adapt to this new reality might not survive.

The industry's first big platform shift in the early 1990s—the move from mainframes to smaller machines, first so-called minicomputers, and then personal computers (PCs)—had nearly done in IBM. After first dismissing the PC as a toy, IBM made a belated effort to shape its development by introducing the IBM PC in 1981. Although it set the (open) standard for the industry, IBM made multiple strategic blunders that nearly bankrupted the company. In order to accelerate time-to-market, IBM chose not to build the operating system and microprocessor internally; instead, it sourced these vital components from Microsoft and Intel, respectively. This decision effectively passed IBM's historic source of monopolistic power (operating system and processor architecture) to Microsoft and Intel, exporting hundreds of billions of dollars of value to its major competitors. At the same time, the PC completely disrupted IBM's business model. PC users had no need for IBM's expertise in mainframe computing systems, data processing centers, or sales and service support, but IBM persisted in these activities long after their decline in value. On January 19, 1993, IBM announced the largest single-year corporate loss in U.S. history. Since then, IBM had chosen to actively engage in everything new in the IT sector (see **Exhibit 2** for a history of the IT industry), in order to maintain its reputation as a "reference point" in the industry.

The Rise of a Giant

IBM's ("Big Blue's") history dated back to long before electronic computers. It originated as the Tabulating Machine Company in 1896 and specialized in the development of punch-card data-processing

equipment. Thomas J. Watson, Sr. became General Manager of the company in 1914 and in 1924 changed its name to International Business Machines Corporation, or IBM. During the next 20 years, IBM grew rapidly. Despite the Great Depression of the 1930s, IBM continued to manufacture new products, and after passage of the Social Security Act of 1935, IBM secured a major government contract to maintain employment data for 26 million people. This was described as "the biggest accounting operation of all time,"[5] and it opened the door for a variety of other government contracts. After the United States entered World War II, all IBM facilities were placed at the disposal of the federal government and IBM's product line expanded to include bombsights, rifles, and engine parts.[6]

In the 1950s, IBM became a chief contractor for developing computers for the U.S. Air Force's automated defense systems, a product that generated tremendous profits. More importantly, the company gained access to cutting-edge research on digital computers being done under military auspices. However, IBM failed to dominate the emerging industry by letting RAND Corporation take over the job of programming the new computers. According to one project participant, Robert P. Crago, "we couldn't imagine where we could absorb two thousand programmers at IBM when this job would be over some day, which shows how well we were understanding the future at that time."[7]

IBM was the largest of the eight major computer companies through most of the 1960s. (Others were UNIVAC, Burroughs, NCR, Control Data Corporation, General Electric, RCA, and Honeywell.) People in the industry talked about "IBM and the seven dwarfs," as IBM dominated its competitors with a 70 percent market share. In the 1970s, a number of mergers and acquisitions resulted in an increasingly concentrated market, with IBM still firmly in the lead. Many companies chose to focus on niche areas, in order to avoid competing directly with IBM. The IBM mainframe that earned the company its dominant position during this period was actually still part of IBM's product line. Originally dubbed the IBM System/360, it was now known as the IBM System z10.

The Decline of Mainframe Computing

Up through the 1970s, IBM relied on a vertically integrated strategy, building most key components of its systems itself, including processors, operating systems, peripherals, and databases. IBM preferred to do things in-house, and the prevailing attitude was that no one could do things better anyway. The company was able to capture high margins capitalizing on its reputation for technical prowess, reliability, and outstanding service, even when the technology was not cutting-edge. IBM's strategy was virtually flawless, routinely out-competing its rivals. In 1976, however, IBM faced a life-threatening discontinuity that was not the result of a traditional competitor's action. It started in a California garage far from IBM's New York headquarters, when college dropouts Steve Jobs and Steve Wozniak put together the Apple I personal computer kit. On April Fools' Day of the same year, they founded Apple Computer, Inc.

Once among its greatest assets, IBM's size and industry dominance caused it to underestimate the power and speed of the computer revolution that was taking place. Instead, IBM's disdain toward Apple and other emerging competitors gave the new companies five unchallenged years during which to perfect their new technology. IBM did not introduce its own version of the PC until 1981, and though it set the (open) standard for the industry, IBM's delayed response meant that it had already forfeited the opportunity to dominate this new market. To add insult to injury, IBM then chose to outsource the operating system and microprocessors for its new machines from Microsoft and Intel, respectively, creating the Wintel standard in the PC industry. In yet another misjudgment, IBM sold its 20 percent equity stake in Intel in the mid-1980s.

Meanwhile, IBM held on tight to other activities in the computing value chain, only to find that its vertically integrated business model had no advantage in the evolving computer industry. PCs could be sold in a variety of retail outlets, eliminating the need for a highly trained sales force. Data-processing centers were no longer essential, as PCs had their own memory and processing systems inside. Nor was there a need for IBM to maintain these machines, as businesses increasingly internalized the service function and hired their own computer technicians.

As the computer value chain disintegrated, different companies took the lead in specific segments. Intel was the leader in microprocessors, Microsoft in operational systems, Novell in networking, HP in printers, Seagate in disk drives, and Oracle in databases. Even in personal computers, cost-efficient competitors like Compaq and Dell easily outpaced IBM. Many dedicated software developers and vendors also popped up. Thus, in 1992, IBM's CEO John Akers began to split IBM into business units (e.g., for processors, storage, software, services, printers, and so on) to compete more effectively with the focused niche players.

The growth of local area networking capabilities and the subsequent decline of mainframe sales led to the inevitable outcome: On January 19, 1993, IBM announced the largest single-year corporate loss in U.S. history ($8.1 bn). The "Big Iron" business divisions had not recognized the need for the company to adapt in time. As a result, 250,000 workers departed, and a decade of radical transformation followed. Louis Gerstner was the first non-IBMer to take over, inheriting the daunting task of saving Big Blue.

The Louis Gerstner Era

When Louis V. Gerstner, Jr., became chairman and chief executive in 1993, the question was whether IBM would survive. Mr. Gerstner was not a lifetime IBMer. Even worse, he had no particular understanding of the computer-technology industry. He came with a background in consumer products, financial services, and consulting. The IBM board had decided that IBM needed a leader, a strategist, and a manager—and Mr. Gerstner's portfolio of skills fit the bill.

Mr. Gerstner received a bachelor's degree in engineering from Dartmouth College in 1963 and an MBA from Harvard Business School in 1965. He worked as a McKinsey consultant and later became president of American Express and then CEO of NJR Nabisco. He was not the obvious choice for the fallen icon of American technology. Nevertheless, he brought to the table a strong vision and a passion for change. As soon as he took the reins at IBM, he began traveling to meet customers to get a sense of the market. His verdict was bold: "We were going to build this company from the customer back, not from the company out."[8]

One major decision Mr. Gerstner made was to reverse Akers's plan to split IBM into 13 "Baby Blues." In theory, dividing the company into multiple strategic business units addressed IBM's fundamental trouble—that as an integrated company, IBM was not flexible. Mr. Gerstner, however, liked the concept of "integrated solutions," recalling his days as an IBM customer. IBM could provide one-stop shopping and service to tackle tough business problems without forcing its customers to deal with different vendors. He heard similar sentiments from customers. Within three months, Gerstner decided to keep the company together. "I knew it was a big risk, but I never doubted that it was the right thing to do at IBM," he said.[9]

Mr. Gerstner developed three strategic pillars that were "the fundamental underpinnings of building an integrated company," as he later wrote in his best-selling book, *Who Says Elephants Can't Dance?*, describing IBM's legendary comeback.[10] First, he initiated a broad computer services unit that sold bundles of hardware, software, consulting, and maintenance to manage business processes. His decision to move into services set off "an incredible bomb in the company," Mr. Gerstner recalled, adding, "here was a part of IBM that was going to work closely with Oracle, Sun Microsystems and, god forbid, Microsoft." Ultimately, IBM Global Services became the company's biggest business, because it was able to "look at technology through the eyes of the customer."[11]

The second pillar of Gerstner's turnaround strategy targeted another IBM tradition: that of relying exclusively on its own homegrown technology (see **Exhibits 3a and 3b** for IBM's patent history). Earlier when the company had gone outside—giving programming to RAND, processors to Intel, and software to Microsoft—the move had been regarded as a grave mistake. But now, there was a conscious decision to move to "open systems." Mr. Gerstner wanted all of IBM's software to run on competitors' hardware, and all of IBM's hardware to support competitors' software. For many IBMers, this was tough medicine to swallow.

Gerstner's third pillar was to fully embrace the Internet and the "networked world" model of computing. The move to open systems facilitated this transition. The networked model of computing suited IBM's strengths—as the Internet shift made big data-serving computers essential again and took the interest away from PCs. Along with big computers, the Internet brought with it a host of complexity and compatibility issues, since heterogeneous software and hardware had to be connected and work together. IBM's breadth and its services were big advantages in this environment. "Here was a chance for IBM to lead again," Mr. Gerstner declared. "We were able to articulate a role for IBM in the networked world that spoke of the value of all we did."[12] Needless to say, Gerstner's Internet strategy was quite visionary in 1993.

IBM's new strategy evolved quite rapidly. In late 1995, the firm formed an Internet division to make sure the entire company was focused on the Internet. Then, beginning in 1997, IBM started a massive advertising and marketing campaign to push "e-business," a term coined by IBM. Many observed that the notion of e-business served as a wake-up call to Wall Street about the upcoming shift in business models.[13] While experts and competitors were slow to comprehend the full value of e-business, IBM's corporate customers loved the new focus. The dot-com boom in 1999 was an opportunity for Gerstner to say that he regarded the hot Internet startups as "fireflies before the storm," suggesting that there was much more to come. At the time, that was hardly conventional wisdom.

At the conclusion of Gerstner's tenure, his three strategic pillars had come together in a sound strategic vision. This fundamental strategic shift guaranteed real change in IBM's stiff corporate culture. In addition, the buildup of the services business led to increased hiring, bringing in a new sea of faces and fresh ideas. In 2008, IBM Global Services employed 150,000 people, up from 7,600 in 1992. More than half of these employees had worked for the company five years or less, in stark contrast to the company's heritage of long-term staff retention. Gerstner's success as CEO clearly demonstrated the dynamism of the IT industry, and the fact that even if one misses a turn of the innovation cycle, there is still hope to survive and get back in the game.

The Sam Palmisano Era

On January 1, 2003, Sam J. Palmisano took the helm at IBM. "Sam," as the IBMers knew him, pushed the e-business strategy even farther. However, Mr. Palmisano had a very different leadership style when compared with Gerstner, differences that ranged from body language to conversation style. He was tall, beefy, and relaxed, looking every inch the former college football lineman he was, and he spoke to people with trademark informality.[14]

Palmisano was a life-long IBMer, having joined the company as a 22-year-old salesman in 1973. Since then, Sam had held a series of leadership positions, including Senior Vice President for the Enterprise Systems and Personal Systems groups. He had played an instrumental role in creating and leading IBM's Global Services (rising to Senior Vice President) and building the largest IT services organization in the industry. He also served as Senior Managing Director of Operations for IBM Japan. Palmisano was appointed IBM's President and Chief Operating Officer in 2000.

The strategic moves Palmisano had made since becoming CEO were bold, some would even argue risky. His strategy promised to redefine what it meant to be a computer company—making IBM a valuable complement to all business value chain activities and supporting functions, thus expanding its role well beyond that of equipment supplier. Consulting and software were the cornerstones of his strategy, so Palmisano invested in solution-driven consulting, services, and software, keeping only the high-margin components of hardware. (See **Exhibit 4** for IBM's offerings and market segments.) In 2002, he acquired PricewaterhouseCoopers Consulting for $3.5 billion and Rational Software for $2.1 billion. Also in that same year, IBM announced a $10 billion program to develop infrastructure technology to provide supercomputer-level resources "on demand" to all businesses.[15]

When the market appeared to flatten in 2005 (see **Exhibits 5 through 7** for IBM financial data), Palmisano pushed the shift to services even faster, selling IBM's PC division to China's largest computer maker, Lenovo. "Software had to play a bigger role," Palmisano explained. "Then we could offset the transition in services." In software, IBM built expertise mainly with acquisitions of small companies in fields like security, data management, and web commerce. From 2003 until 2007, IBM spent $11.8 billion on 54 acquisitions—36 software and 18 services companies—in order to facilitate the transformation process.[16] In addition, IBM encouraged universities and other technology companies to promote education for an emerging field that within IBM was called "service science."[17]

Palmisano's strategy represented an aggressive effort to increase profit margins in response to intense price competition in hardware and software. Under his leadership, IBM transformed itself from a multinational company with worldwide operations to a more seamless global enterprise with centers of expertise, each of which was a hub in a global service network. The corresponding change in IBM's corporate mindset was illustrated by employees' responses to a 2003 survey regarding the company's future values. Three strategic thrusts emerged: "Dedication to every client's success," "Innovation that matters—for our company and for the world," and "Trust and personal responsibility in all relationships." It was a case of a company successfully responding to the challenges of globalization and rapid technological change. (See IBM's stock-performance chart in **Exhibit 8**.) IBM now had 400,000 employees worldwide and an annual R&D budget of $5 billion. In 2009, some 284,000 employees (71 percent) were from outside the United States, up from about 65 percent in 2006.[18]

IBM still faced daunting long-term challenges—particularly in services, which contributed 57 percent of the company's 2009 revenues (**Exhibit 9**). New entrants from India enjoyed a significant cost advantage in the technology-services business, given their access to a cheap educated workforce. Companies like Infosys, Tata Consulting Services, and Wipro had average operating profit margins of

more than 20 percent, twice as much as IBM's margins.[19] In response, IBM announced the cut of 5,000 jobs from its U.S. global services unit in March 2009, transferring them to India to take advantage of cheaper Asian engineering work.[20] At the same time, IBM continued to climb the economic ladder and take on more complicated work, competing on the basis of specialized expertise (**Exhibit 10**). Although Palmisano had yet to declare victory, he thought the future looked quite promising (**Exhibits 11 and 12**). "The encouraging thing is that we've made progress," he said, " . . . but there's still a lot to be done."[21] The challenge of cloud computing loomed large on the horizon.

Cloud Computing as a Harbinger of Change

"The cloud" was a significant threat to the IT industry because it had the potential to change all the layers of the IT stack (**Exhibit 13**).

CHANGING THE IT STACK

At the infrastructure level, cloud computing allowed data centers to achieve higher utilization rates by providing services to a larger and more dispersed client base, resulting in enormous economies of scale. Servers depreciated whether they were powered on or off.[22] The cloud provided a means by which a data center could use as much of its installed capacity as possible, rather than shutting down servers to save power. Organizations, and particularly system administrators, were starting to adopt public clouds from *Infrastructure-as-a-Service* (*IaaS*) providers or building their own private clouds to capture a share of these benefits. The call for greater business efficiency was likely to speed up this trend.[23]

At a higher level in the IT stack, developers were looking at *Platform-as-a-Service* (*PaaS*) offerings. These services allowed developers to launch applications online, without knowledge of, or interest in, the underlying hardware. This was particularly useful for software development teams in organizations, as they no longer needed to deploy full infrastructures to test, show, and perhaps later deploy their prototypes, proof of concepts, or applications.

At the highest level of the stack, *Software-as-a-Service* (*SaaS*) offerings were radically changing the way end-users perceived and used software applications. Through the cloud, software was provided as a combination of digital services and did not have to be installed on local servers or computers. Users would no longer need standalone software packages. Google Docs was an early example of distributed computing for popular applications like word processing, spreadsheets, and presentations. Microsoft's Office 2010 was also meant to be run off a web browser. Yet another example of this shift toward Software-as-a-Service was Salesforce.com, a firm founded in 1999 by former Oracle executive Marc Benioff. Salesforce.com offered an online CRM (customer relationship management) system that users accessed over the web, instead of through the traditional boxed license. By 2008, Salesforce.com was already third in terms of revenue market share, and SaaS offerings comprised 20 percent of the CRM market.[24]

CHANGING COMPUTING DEVICES

Since applications were increasingly run off web servers, the requirements of end-users' devices were also changing. The cloud could be accessed through a greater variety of user interfaces, such as low-priced netbooks, tablets, or smart mobile phones with web access. Freed from the need to house

applications that required large amounts of internal memory, these devices were smaller, more portable, and provided a more interactive computing experience.

CHANGING THE IT INDUSTRY

As the cloud increased in prevalence, hardware-makers would have to choose between supplying servers to cloud service providers and becoming service providers themselves. Doing both would not be easy, because the hardware suppliers would be competing with their biggest customers. Software-makers faced a greater challenge in that they would have to develop a means of metering application usage, either by charging a computing utility rate (much as is currently done for electricity) or a periodic subscription fee.[25] The cloud was also a hospitable environment for open-source programming, which would increase the competition and decrease overall prices for proprietary software.

At the same time, cloud computing was already blurring such traditional distinctions among industry participants,[26] placing giant companies that used to be partners on a direct collision course. Cisco was moving into servers, which had previously been HP and IBM's domain. Dell had introduced data-center software and was likewise starting to compete with HP and IBM. Sun, before being acquired by Oracle, took on Oracle's database dominance by introducing its own database offerings. HP purchased EDS and thus initiated an intense rivalry with IBM on IT services. Similarly, Dell bought Perot Systems to move upstream into value-added IT services.

Consequently, boundaries between competitors were far from clear in the cloud. Winners and losers in this game would be determined by their respective capabilities to understand where value was created and how to capture it along the newly emerging industry value chain. Intense competition, along with *Moore's law* (which states that the number of transistors placed on an integrated circuit doubles roughly every 18 months), was likely to drive down prices and margins for all cloud providers.

CHANGING THE WAY PEOPLE DO BUSINESS

Just as with the emergence of the personal computer, the cloud was changing how people worked and companies operated. The cloud was expected to make businesses more adaptable, interconnected, and specialized—and often smaller. Its main advantage was that it turned capital expenditures into operational expenditures, making it attractive in a period of cutting IT budgets. Instead of each company building and maintaining its own IT infrastructure, it could procure those services from a third party. This was particularly significant for firms with uncertain demand for computing resources, as the cloud would allow them to scale upward or downward and consume exactly what they needed. Currently, companies had to buy the equipment necessary to cope with peak demand, which then sat unutilized in off-peak periods. Software applications could also be maintained at a centralized location, meaning that technicians no longer had to update individual PCs each time an upgrade or patch was issued.

Not surprisingly, cloud services were hugely successful with startups, which could now enjoy an infrastructure of the same quality as larger companies. As a Microsoft executive commented, "Even if the entrepreneurs were smarter, large firms [had] a competitive advantage because they [had] the hardware. Now that the hardware is available to all, entrepreneurs can win because they can ask more interesting questions—being smart now matters more."[27] In other words, cloud computing negated any scale advantages. At the same time, large companies stood to benefit as the cloud's service-oriented IT architecture freed their business processes from more restrictive ERP (enterprise resource planning)

systems. Companies of all sizes were likely to find it easier to adapt through combinatorial innovation (innovating by combining one or more existing technologies), given that the cloud was basically a huge collection of digital services.

A possible side-effect of the migration toward cloud computing was that businesses might engage in even further specialization and expansion of outsourcing, keeping only their core strengths in-house. This would mean increased dependence on services provided by others, leading to the development of "process networks" and higher levels of virtual integration. Ultimately, the cloud could change not just computing, but business and economic reality as organizations became increasingly interdependent. The cloud was not constrained by physical, geographic, or political boundaries.

An Emerging Ecosystem of Cloud Competitors

Thomas Watson allegedly once said that there was a world market for maybe only five computers. Despite the fact that he was probably referring to mainframes, this statement had been widely used to illustrate IBM's failure to see the future and understand the upcoming dominance of personal computers. Ironically, it could prove to be most true in the cloud world. Technically, all that was needed was a cloud for consumer applications, a cloud for enterprise applications, two clouds to provide the necessary infrastructure, and one to act as a content provider to make the four other clouds work together.[28]

Thinking this way, a clearer picture of the industry emerged. (See **Exhibits 14 and 15** for lists of current and potential industry contenders, respectively.) With respect to consumer applications, Google's App Engine and Force.com (provided by Salesforce.com) were the footholds of the platform as a service market. Salesforce.com was also active in the Software-as-a-Service segment, though the market was still quite dispersed without any dominant players. At the same time, there was an increasingly wide variety of enterprise applications (including ERPs and office suites) offered as cloud-based services. Estimates of the cloud-services market size in 2012 ranged all the way from $42 billion (IDC) on the low end to $160 billion (Merrill Lynch) on the high end.[29]

The public cloud–infrastructure segment was largely dominated by Amazon, with Rackspace a distant second. Companies that offered complementary technologies were also starting to emerge. Early examples included RightScale, CloudKick, and enStratus, which offered tools to manage public cloud infrastructures. Meanwhile, traditional web-hosting companies were using tools like Enomaly's ECP to utilize their existing infrastructures to provide cloud services. Even content-delivery networks like Limelight were partnering with infrastructure providers to further expand their services. Players outside of the traditional IT industry (e.g., telecommunications, big retailers) could also enter the market, capitalizing on their infrastructures, brand names, and scale and cost capabilities. For example, telecom companies like AT&T controlled bandwidth, which was a key cost driver in cloud technologies.

The private cloud–infrastructure segment was still largely a no-man's land. One possible reason for this was that private clouds required firms to make significant investments in and reconfigure their own data centers. Any firm with a preinstalled base would therefore be cautious in implementing changes, and private cloud providers had thus far been unable to accelerate the adoption process.

Finally, the integration of cloud-based services was still in its infancy. An early first-mover, Grand Central, had tried to serve as a "bus in the cloud" and connect SaaS providers, but it went under in 2005. OpSource had recently introduced its Services Bus (based on technology from a company named Boomi), while Workday acquired the enterprise service bus, CapeClear. An article published in

InfoWorld commented that such little integration was present that perhaps the cloud was best termed "sky computing," where IT customers plugged into multiple isolated clouds floating on the horizon.[30]

IBM's Cloud Strategy

Cloud computing fit with the notion of rapid business innovation, which was the driving force behind IBM's cloud strategy.

EARLY INITIATIVES

IBM made its first foray into the cloud in 2007. The "Blue Cloud" was a combination of software and hardware components through which IBM sought to provide customized, cloud-based services for each of its client organizations, a so-called "private cloud." Some analysts viewed IBM's efforts critically, claiming that Blue Cloud was just "Web computing by another name."[31] IBM responded that Blue Cloud was never intended as a full-fledged cloud service; rather, it was an initiative crafted by IBM to experiment with the emerging technology.

In 2008, IBM started offering integrated Cloud Computing Centers. Their purpose was to enable IBM's clients to transition to virtualized data centers and to provide them the freedom to innovate in a controlled and secure computing environment. According to IBM, the Cloud Centers could deliver standardized services through IT automation, resulting in reduced system and application management costs. They were targeted at clients in emerging markets, to facilitate growth as well as to acquaint them with the benefits of the new delivery model. The first Cloud Center opened in February 2008 in Wuxi, China. After that, IBM built centers in Vietnam, Japan, Brazil, India, Korea, Ireland, Poland, and South Africa, and was continuing to expand this program.[32]

Later that same year (2008), IBM started to extend its consulting and technology services to the cloud, building on knowledge gained from its earlier Blue Cloud project. IBM envisioned helping its customers in three main ways. First, IBM would communicate the message of the cloud to help its customers understand its full potential. Second, it would help them assess the cost of their own cloud initiative and plan accordingly. Finally, IBM would be in a position to provide expertise in the installation, configuration, and usage of a "private" cloud in its customers' data centers.

At the same time, IBM moved even further into the cloud revolution by developing a certification program covering the resiliency of cloud-based applications or services delivered by its partners. Companies hoping to gain IBM's seal of approval had to work with IBM's cloud consulting practice, making IBM a "reference point" in the cloud market.[33] The idea behind the certification program was to help create some standards around security and interoperability in the rapidly emerging world of cloud computing. Generally, the program seemed to have attained its goal, as smaller companies were utilizing it as a signal of expertise in the cloud arena.

ALLIANCE WITH GOOGLE

Apart from these independent moves, IBM formed an important alliance with Google. Though the companies initially stated that the purpose of their relationship was to facilitate university research by providing Internet-scale computing to academic institutions, many suspected this was not just an educational initiative. Sure enough, the CEOs of Google (Eric Schmidt) and IBM (Sam Palmisano) appeared

onstage together at a conference in Los Angeles just a few months later, in May 2008, declaring their joint intention to promote commercial cloud-based services.[34] "Cloud computing is the story of our lifetime," stated Eric Schmidt (Google). "Eventually all devices will be on the network."

The two companies hoped to capitalize on each other's strengths to help get the job done. IBM's reputation could help drive sales of Google Apps (Google's cloud offering), while IBM would provide the infrastructure and services to offer an integrated solution for customers around the globe. Sam Palmisano declared: "This project combines IBM's historic strengths in scientific, business, and secure-transaction computing with Google's complementary expertise in Web computing and massively scaled clusters."[35] Less-tangible benefits of this partnership included the development of a "dominant design"—a cloud-like platform backed by the brand values of both the Google and IBM names.

Microsoft and other competitors were watching this relationship very closely, fearing that Google would try to monopolize key parts of the cloud with the advertising market. According to Nicholas Carr, a technology writer and blogger, there was some basis for this concern. What Google did—building huge data centers, fighting copyright restrictions, digitizing the world's libraries, and launching its new web browser (Chrome)—was aimed at increasing the use of the Internet. "Google wants information to be free," Carr recently wrote in his blog, "because as the cost of information falls it makes more money."[36]

RECENT EFFORTS

In March 2009, IBM initiated negotiations to buy Sun, which would have been the largest acquisition in IBM's history.[37] Analysts saw this purchase as a questionable strategic move, arguing that it made sense only as a financial opportunity since Sun could be bought at a sharp discount.[38] Sun was later bought by Oracle, whose CEO, Larry Ellison, believed the cloud was not distinct from what enterprise-IT had already been doing[39] and promptly shut down Sun's weak cloud-oriented steps. The question remains: What would IBM have done with Sun's cloud infrastructure initiatives?

Undaunted by its failure to capture Sun, IBM went on to introduce new offerings at every level of the cloud infrastructure later that same year. For Software-as-a-Service, IBM promoted Lotus Live as the "Facebook for enterprises." For Platform-as-a-Service, IBM made some bold moves: All product groups within IBM learned that they should align their offerings to work in the cloud, including some of IBM's most successful product lines (Rational, Tivoli, Websphere, and others). A couple of Tivoli-branded offerings showed great promise as easy-to-use automation tools to help managers set up private and hybrid clouds. Another sign of IBM's increasing commitment to the cloud was its focus on developing middleware, defined as "in-the-cloud integration services between as-a-service offerings."[40] In terms of infrastructure, IBM publicized several success stories on building private or hybrid clouds for its clients, showing signs of something big to come. Finally, to combine this surge with IBM's overall strategy of expanding services, IBM's consulting arm announced that it would start helping clients determine the right cloud formation for them.

Industry analysts expected 2010 to be a breakout year for IBM's cloud agenda, with accelerated efforts to increase cloud computing offerings and to compete directly with its major competitors (Google, Microsoft, and others). IBM Fellows and other distinguished IBM-affiliated individuals had spent nearly three years experimenting with the cloud and brainstorming on a wide range of cloud-related issues: early signs of cloud adoption; security in the cloud; the potential of the cloud; business strategy and models for cloud providers; benefits of cloud computing for clients; and so on. This commitment to the development of the cloud started to pay off in January 2010 when IBM announced the largest

enterprise cloud deployment yet, as Panasonic moved from Microsoft Exchange to IBM's LotusLive cloud service.[41] In February, IBM announced that it had started a 10-month project to develop a cloud network infrastructure for the U.S. Air Force—representing a major vote of confidence in IBM's cloud security.

Meanwhile, IBM continued to offer highly successful private clouds for its clients to run behind their firewalls. It planned to keep growing its cloud-integration capabilities through acquisitions of smaller companies offering the necessary middleware. At the same time, IBM invited application vendors to address specific business processes that would align with IBM's offerings. The final objective was an ecosystem of partners in which every vendor addressed a specific business need and all were working in unison to provide integrated business solutions that IBM could offer to its clients.

IBM had its sights on the public sphere as well, announcing its plans for a public cloud facility in Raleigh, North Carolina, to go live in summer 2010. IBM insisted that the company's ultimate goal was a hybrid model, where clients could integrate their private clouds with public infrastructure. This new effort fit well with the "green revolution." Initial evidence suggested that the new data center was so efficient it saved 15 percent in annual energy costs.

Globally, IBM's recent efforts were no less impressive. The company continued to build cloud-computing centers in emerging markets, entering through alliances with local, leading small enterprises. It also recently announced an agreement with the European Union to collaborate with universities to develop new cloud-related computer science models.

A SMARTER PLANET

Finally, IBM initiated a massive advertising campaign—much as it did with "e-business"—to promote the idea of building a "smarter" planet. Many believed this push was directly related to the company's cloud strategy. According to IBM, the world was already "instrumented" (transistors, mobile phones, RFID tags, and sensors were the dominant building blocks of the digital age) and interconnected (2 billion people on the Internet, immense information exchanges, and smart interacting devices). The next step was to make our planet "intelligent." What IBM meant with the slogan "smarter planet" was that we could use integrated technology to tackle most of today's pressing environmental and social issues—in other words, make the world smart enough to be sustainable.

IBM cited a number of examples that illustrated the urgent need for a smarter planet: inefficiencies in energy supply systems; over- and undersupply of water in different geographic regions; congested highways and their impact on air quality; the waste of money in inefficient supply chains; the climbing costs of inefficient health care systems; and the 2008–2010 financial crisis. All of these incidents were evidence of a trajectory that needed to be stopped—by investing in intelligent infrastructure.[42]

IBM also cited a number of applications that had proved successful. Coincidentally, many of them were already part of the company's expanding portfolio in smart infrastructures. Stockholm's traffic had been reduced by 20 percent using a smart traffic system; oil extraction technologies could exploit more than the current 20 percent of the available reserves; smart food systems could trace everything back to the farm level; and smart health care networks were envisioned to lower the cost of therapy by 90 percent.

Outsiders characterized IBM's proposal as a "technology-fueled economic recovery plan," noting that its reach extended well beyond the company's own capabilities. IBM's message was far too comprehensive and holistic to be taken as a mere advertising campaign. Palmisano even gave a speech to the Council on Foreign Relations in which he called for increased public and private investment in efficient system infrastructures to fuel future growth. In IBM's vision, the move to a smarter planet would involve cities, regions, and even nations. It was a period of radical discontinuity in the systems we used, and therefore provided an opportunity for visionary leaders and companies to make a profound contribution to societies all around the world. Of course, the cloud, and IBM's investment in cloud computing, would be a key resource in achieving that reality.

Decision Time

Bruce Harreld's strategy team had a lot of data to review and little time to complete its report. The IT industry had always been full of turmoil and frequent technological changes, but cloud computing represented a radical paradigm shift that paralleled the introduction of the PC and the Internet. IBM was adamant (if not paranoid) about not being left behind. It had staged a successful comeback once before, but there was no guarantee it could rise from the ashes a second time if it made similar mistakes again.

Indeed, in its efforts to maintain its reputation as a "reference point" in the industry, IBM had staked some kind of initial claim on almost every emerging cloud front: Software-as-a-Service, Platform-as-a-Service, Infrastructure-as-a-Service, and middleware. It had established private, hybrid, and public clouds for a variety of clients, both in the United States and abroad. Through its certification program, the company was building a network of interconnected providers, and it had just announced a key strategic alliance with Google. IBM's client base currently included national governments, business enterprises, and end-use consumers. Perhaps the real question facing Harreld's team was whether and how long IBM could continue to do it all.

Harreld believed that IBM had been smart to hedge its bets in the early days of the cloud, but that tough choices loomed ahead as the cloud grew increasingly more complex. IBM would have to become more selective regarding which segments to specialize in, which companies to acquire, which ones to partner with, and when it made more strategic sense to go it alone. Trying to do all things for all types of clients was not an efficient business strategy for the long term, and would ultimately spread IBM's resources too thin. Those were the difficult decisions that Palmisano wanted his team to make. Harreld sighed, knowing they had better get to work. . . .

EXHIBIT 1 Working Definition of Cloud Computing

Note 1: Cloud computing is still an evolving paradigm. Its definitions, use cases, underlying technologies, issues, risks, and benefits will be refined in a spirited debate by the public and private sectors. These definitions, attributes, and characteristics will evolve and change over time.

Note 2: The cloud-computing industry represents a large ecosystem of many models, vendors, and market niches. This definition attempts to encompass all of the various cloud approaches.

Definition of Cloud Computing:

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model promotes availability and is composed of five **essential characteristics,** three **service models,** and four **deployment models.**

Essential Characteristics:

On-demand self-service. A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service's provider.

Broad network access. Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, laptops, and PDAs).

Resource pooling. The provider's computing resources are pooled to serve multiple consumers using a multitenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, network bandwidth, and virtual machines.

Rapid elasticity. Capabilities can be rapidly and elastically provisioned, in some cases automatically, to quickly scale out and can be rapidly released to quickly scale in. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be purchased in any quantity at any time.

Measured service. Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service.

Service Models:

Cloud Software-as-a-Service (SaaS). The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through a thin client interface such as a web browser (e.g., web-based e-mail). The consumer does not manage or control the underlying cloud infrastructure, including the network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.

Cloud Platform-as-a-Service (PaaS). The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure, including the network, servers, operating systems, or storage, but has control over the deployed applications and possibly application hosting environment configurations.

Cloud Infrastructure-as-a-Service (IaaS). The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, and deployed applications, and possibly limited control of select networking components (e.g., host firewalls).

(continued)

Deployment Models:

Private cloud. The cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third party and may exist on-premises or off-premises.

Community cloud. The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be managed by the organizations or a third party and may exist on-premises or off-premises.

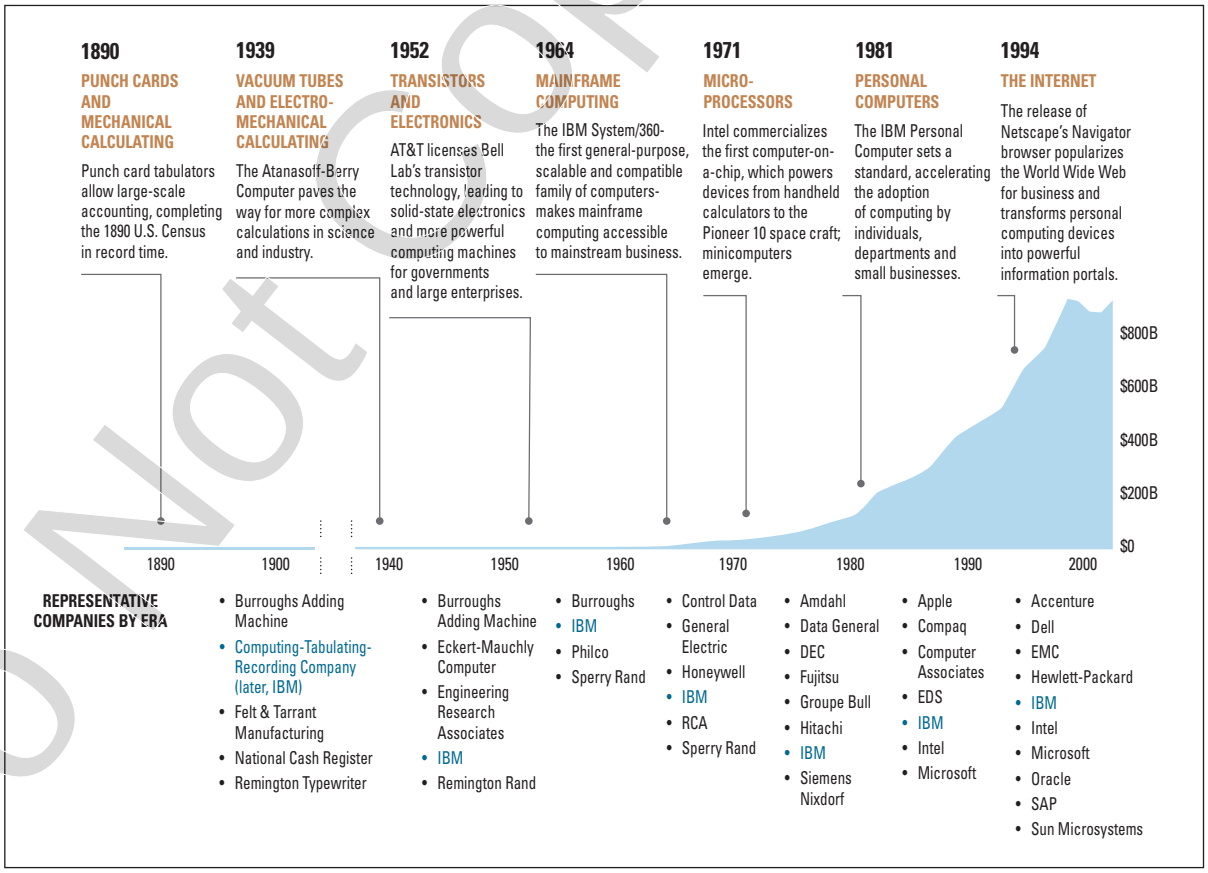
Public cloud. The cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services

Hybrid cloud. The cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load-balancing between clouds).

Note: Cloud software takes full advantage of the cloud paradigm by being service-oriented with a focus on statelessness, low coupling, modularity, and semantic interoperability.

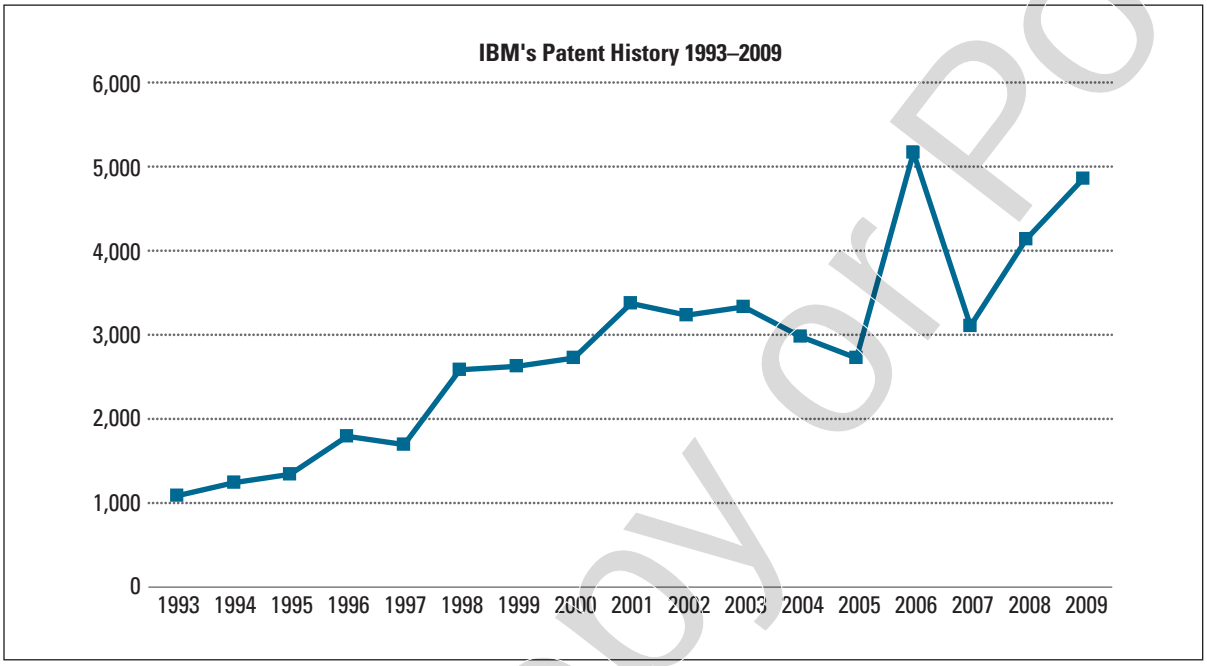
Source: National Institute of Standards and Technology, Information Technology (NIST), Laboratory Authors: Peter Mell and Tim Grance, Version 15, October 7, 2009, http://csrc.nist.gov/groups/SNS/cloud-computing/.

EXHIBIT 2 Technological Discontinuities in the Computing Industry, 1890–2000



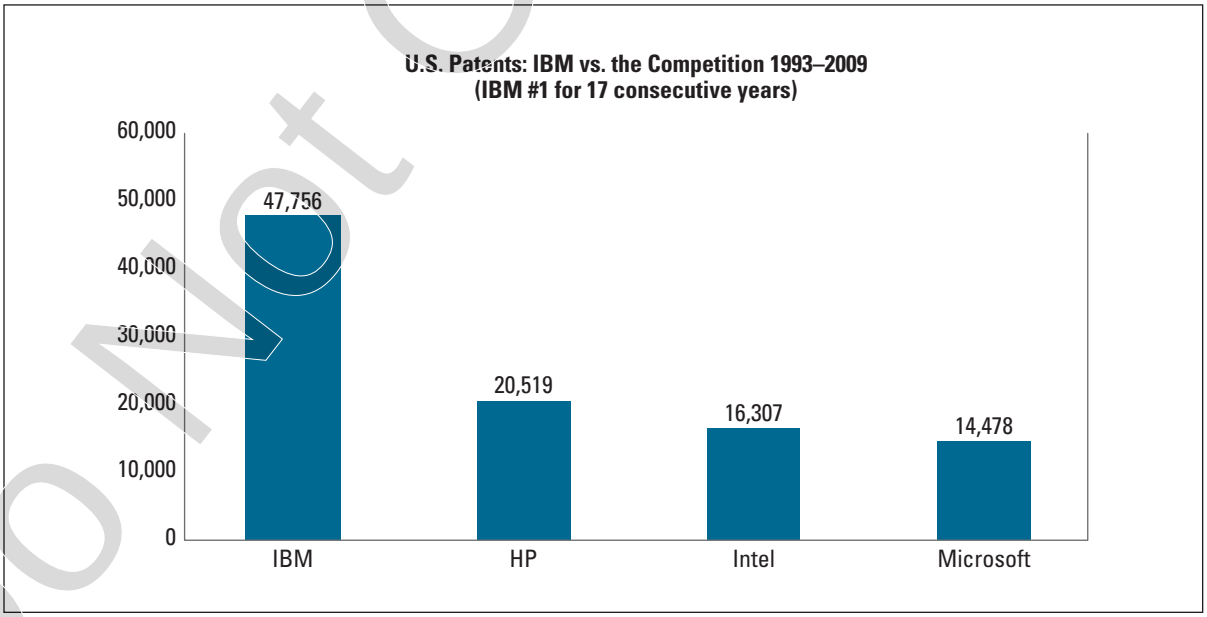
Source: IBM Prospectus (2004), "Understanding our company." Vertical axis shows total industry revenues.

EXHIBIT 3A IBM's Patenting over Time, 1993–2009



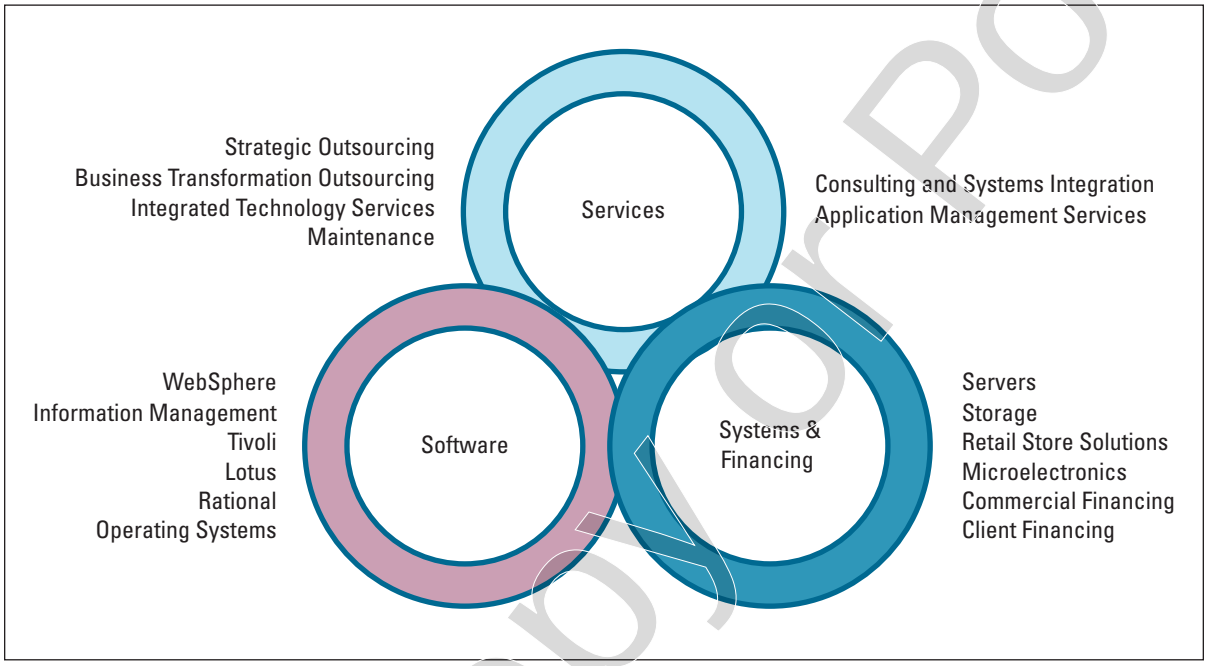
Source: Data obtained from U.S. PTO.

EXHIBIT 3B Total Number of Patents, IBM vs. Selected Competitors, 1993–2009



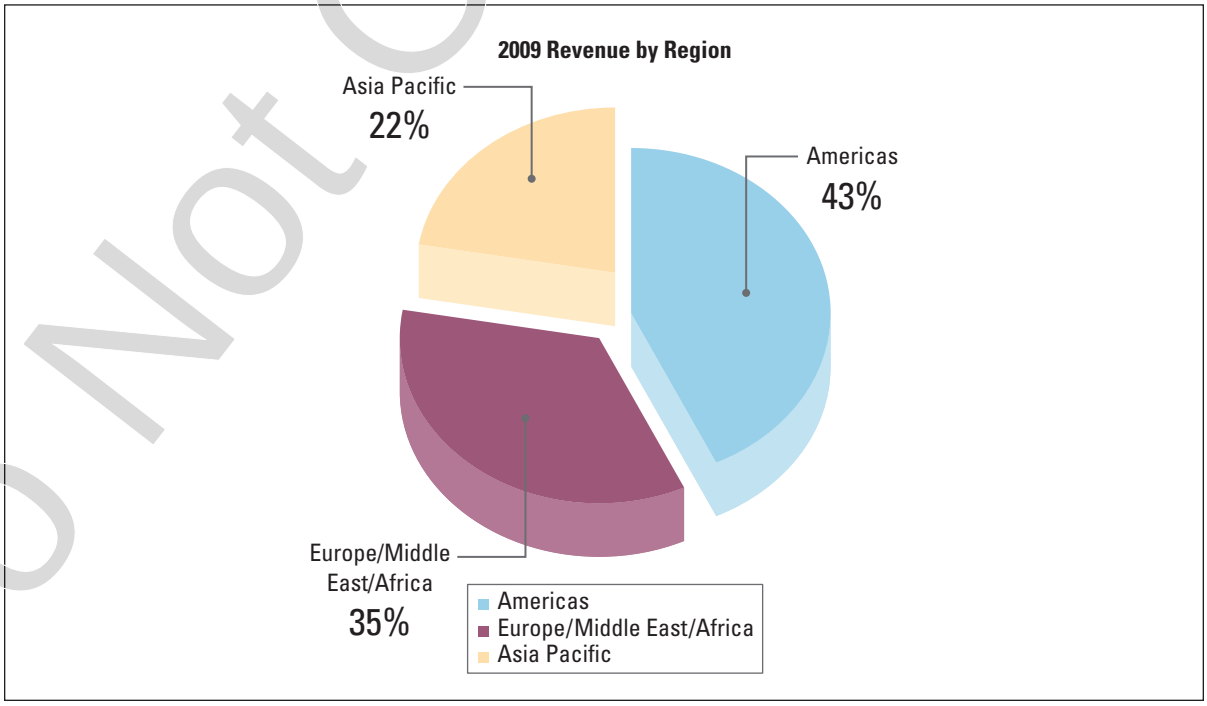
Source: Data obtained from U.S. PTO.

EXHIBIT 4 IBM's Offerings and Market Segments



Source: IBM 2007 Annual Report.

EXHIBIT 5 IBM Revenue by Geographic Region, 2009



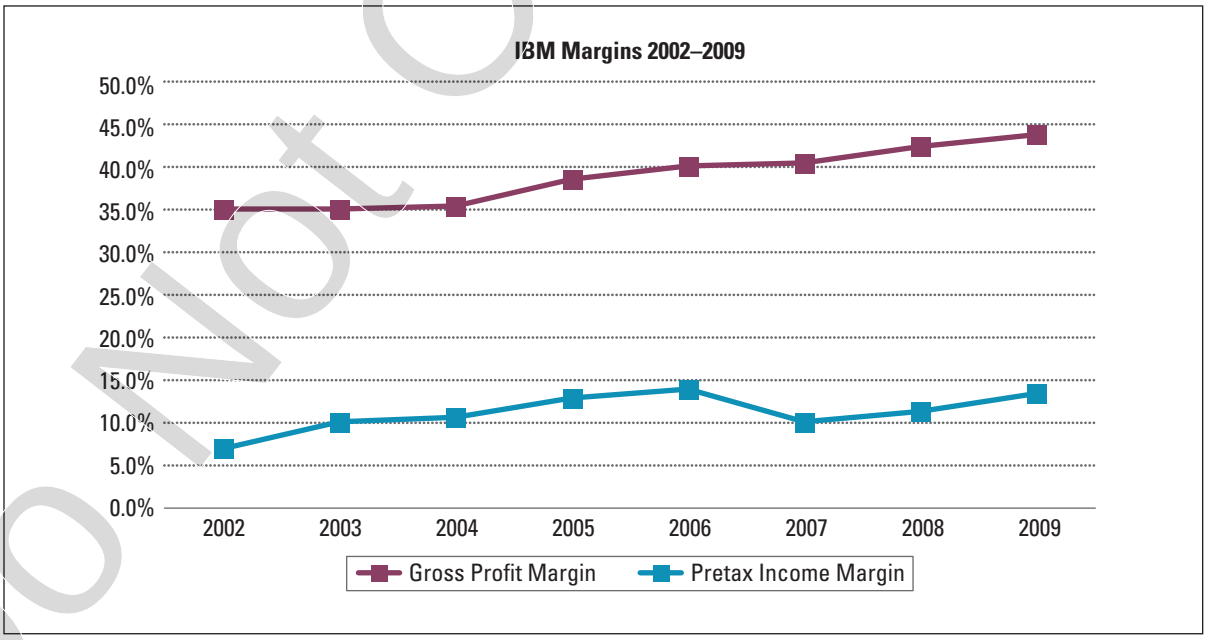
Source: IBM 2009 Annual Report.

EXHIBIT 6 IBM Financial Information by Segment, 2007–2009 (in $ millions)

	2009	2008	2007
Global Technology Services	**37,347**	**39,264**	**36,103**
Gross Margin	35.00%	32.60%	29.90%
Global Business Services	**17,653**	**19,628**	**18,041**
Gross Margin	28.20%	26.70%	23.50%
Software	**21,396**	**22,089**	**19,982**
Gross Margin	86.00%	85.40%	85.20%
Systems and Technology	**16,190**	**19,287**	**21,317**
Gross Margin	37.80%	38.10%	39.70%
Global Financing	**2,302**	**2,559**	**2,502**
Gross Margin	47.50%	51.30%	46.70%
Other	**869**	**803**	**842**
Gross Margin	11.60%	13.40%	4.40%
Total Revenue	**95,758**	**103,630**	**98,786**

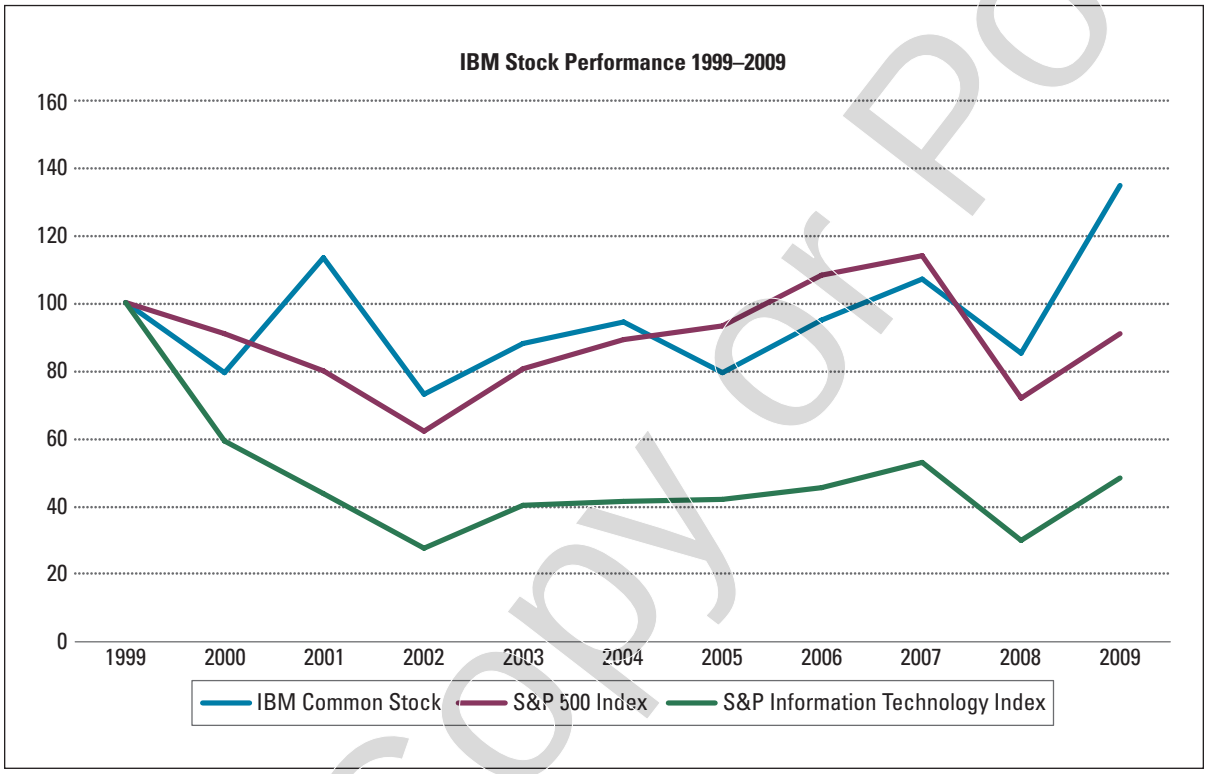
Source: IBM Annual Reports.

EXHIBIT 7 IBM Margins, 2002–2009



Source: IBM Annual Reports.

EXHIBIT 8 IBM Stock Performance vs. S&P 500 and S&P IT Index, 1999–2009



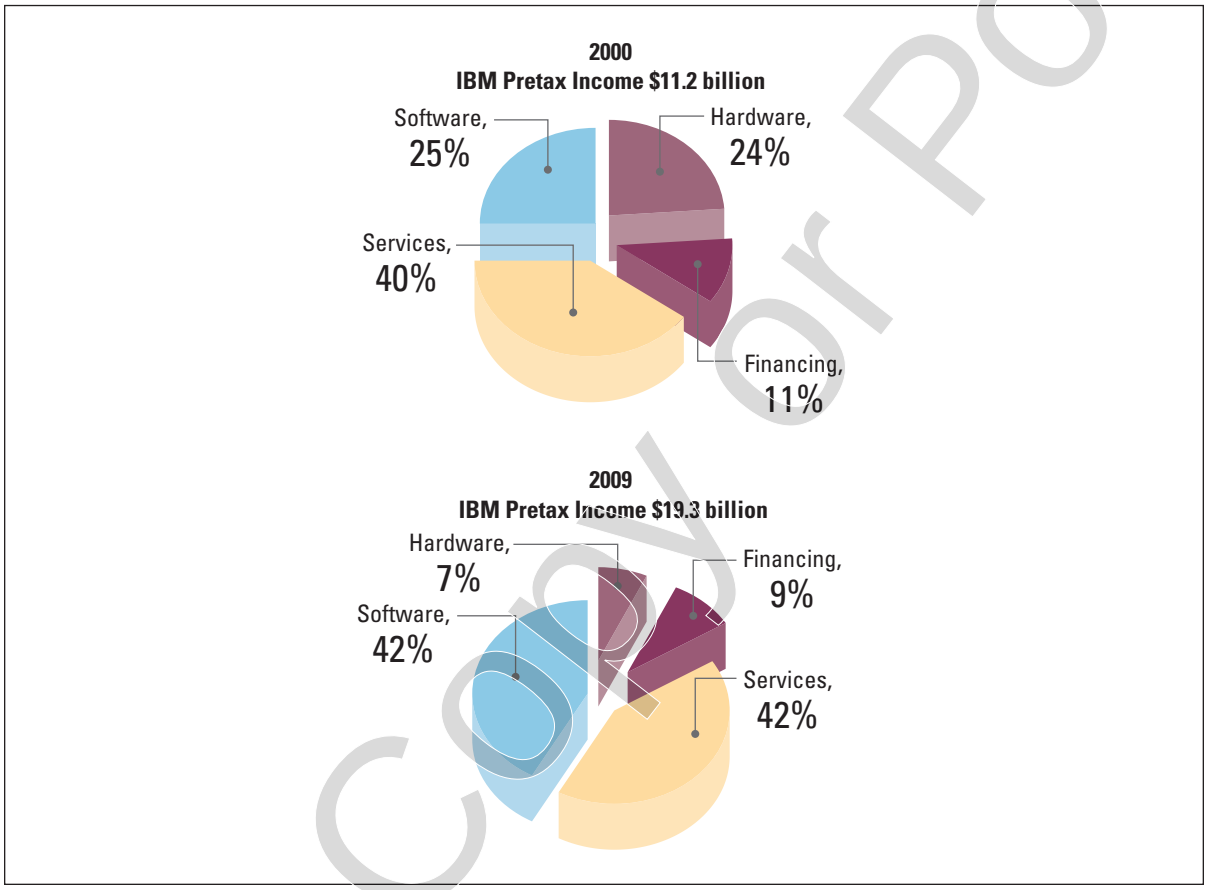
Source: IBM 2009 Annual Report.

EXHIBIT 9 IBM Financial Data, 1999–2009 (numbers in $ millions except per-share amounts)

Year Fiscal	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Revenue	83,334	85,089	83,067	81,186	89,131	96,293	91,134	91,424	98,786	103,630	95,758
Net Income	7,712	8,093	6,484	2,376	6,558	7,479	7,934	9,492	10,418	12,334	13,425
EPS (Basic)	4.25	4.58	3.74	1.4	3.81	4.47	4.96	6.18	7.27	9.02	10.12
EPS (Diluted)	4.12	4.44	3.69	1.39	3.74	4.38	4.86	6.11	7.15	8.89	10.01
Cash Dividends Paid on Common Stock	859	909	956	1,005	1,085	1,174	1,250	1,683	2,147	2,585	2,860
Per Share of Common Stock	0.47	0.51	0.55	0.59	0.63	0.7	0.78	1.1	1.5	1.9	2.15
Investments in Plants, Rental Machines, and Other Property	5,959	5,616	5,660	5,022	4,398	4,368	3,842	4,362	4,630	4,171	3,447
Return on Stockholders' Equity	39.10%	40.00%	28.50%	9.80%	24.50%	25.60%	25.80%	29.30%	42.60%	48.70%	80.40%
Total Assets	89,571	90,412	91,207	97,814	106,021	111,003	105,748	103,234	120,431	109,524	109,022
Net Investments	17,590	16,714	16,504	14,440	14,689	15,175	13,756	14,440	15,081	14,305	14,165
Working Capital	3,577	7,474	7,483	6,927	7,205	7,357	10,509	4,569	8,867	6,568	12,933
Total Debt	28,354	28,576	27,151	26,017	23,632	22,927	22,641	22,682	35,274	33,926	26,099
Stockholders' Equity	20,426	20,550	24,352	24,112	29,531	31,688	33,209	28,635	28,615	13,584	22,755

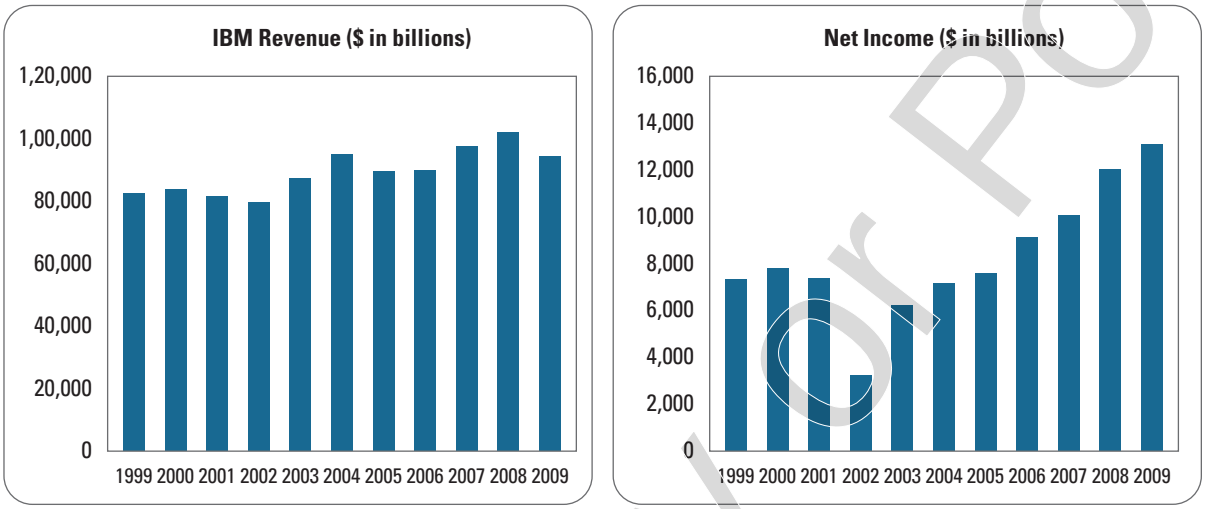
Source: IBM Annual Reports, 1999–2009.

EXHIBIT 10 IBM Pretax Income Mix, 2000 and 2009



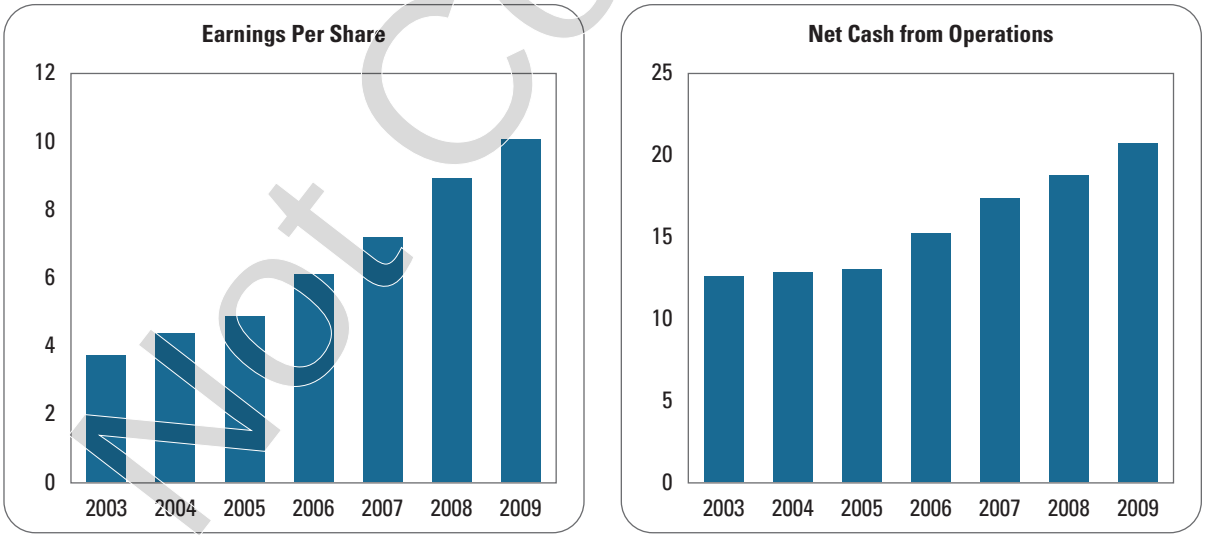
Source: IBM 2009 Annual Report.Source: Data adapted from www.jdpower.com/autos/ratings/quality-ratings-by-brand/sort-column-0/ascending/page-1/#page-anchor, and www.jdpower.com/autos/ratings/dependability-ratings-by-brand/.

EXHIBIT 11 IBM Revenue and Income, 1999–2009



Source: IBM 2009 Annual Report.

EXHIBIT 12 IBM Earnings per Share and Net Cash, 2003–2009



Source: IBM 2009 Annual Report.

EXHIBIT 13 Examples of Providers of Different Cloud Service Models

Service Model	Intended Users	Level of IT Stack	Examples of Providers
Infrastructure-as-a-Service (IaaS)	System administrators	Lowest. Closest to hardware.	Public Cloud: Amazon, Rackspace, GoGrid, Joyent Private Clouds: VMware, Enomaly
Platform-as-a-Service (PaaS)	Developers	Moderate. Developers care only about application code.	Google App Engine, Force.com, Engine Yard, Heroku
Software-as-a-Service (SaaS)	End-users	Highest. Users only access application.	Google Docs & Gmail (office apps), Microsoft Software Plus Services (office apps), Salesforce.com (CRM), NetSuite (ERP)

EXHIBIT 14 Current Cloud Providers

Amazon. A retailing company founded in 1994, Amazon initially launched its Web Services in 2002 as an integration tool for its marketplace, only to relaunch it in 2006 as a suite of cloud services. Amazon is by far the leader in the public infrastructure cloud segment, offering a wide variety of tools that complement their own infrastructure service. Amazon has a vast ecosystem of firms that offer services based on its infrastructure platform. The ecosystem includes traditional software vendors such as IBM and Oracle, who make their software available on Amazon's infrastructure through Amazon Machine Images (AMIs), which are preconfigured server images that can be launched by users. Amazon leverages its knowledge on how to manage distributed and scalable systems, and is recognized as the company that made the cloud model as known as it is today.

Rackspace. Founded in 1998 and traditionally focused on enterprise-level web hosting services, Rackspace launched its cloud in March 2009. It attained the capability to use its data centers to offer cloud services by acquiring smaller players (Slicehost and Jungledisk) and by developing its own private ventures (Mosso). Rackspace's enterprise-level personalized technical support distinguishes it from Amazon, where support is limited to a community forum. The firm's reported consumer base grew from 43,000 users in the first quarter of 2009 to 80,000 in the first quarter of 2010.

Google. Google is a point of reference in the PaaS segment with its Google App Engine, and in the SaaS segment with its suite of online applications, particularly Google Docs and Gmail. The App Engine has attracted a vast amount of Java and Python developers. Free versions of Google Docs and Gmail have been widely adopted by individual end users as well as academic institutions. The enterprise version of these applications has been adopted by governments (including parts of the federal government in Washington, D.C.) and small firms, but not so much by businesses.

Salesforce.com. This CRM vendor was founded in 1999 by former Oracle executive Marc Benioff. Its SaaS offering has disrupted the traditional CRM market. Managers in marketing departments of firms of all sizes have preferred to opt for Salesforce.com's online offerings instead of going through traditional software-procurement processes with their IT departments. In addition to its CRM application, Salesforce.com offers Force.com, a Java-based PaaS that integrates with its SaaS offering.

Enomaly. This startup, founded in 2004, deployed its Elastic Compute Platform (ECP) to thousands of web-hosting firms, who have used it to adapt their preexisting infrastructures to offer cloud services. The firm's sales have been particularly important in countries like China and Japan. Enomaly has already established important alliances with Intel and HP to provide cloud solutions in China.

EXHIBIT 15 Firms Likely to Become Strong Cloud Players

Microsoft. The IT-industry giant has been slow in moving into the cloud but is coming on strong. Microsoft is starting to address the PaaS segment with its Windows Azure offering, which is particularly appealing to .NET developers. It has also started offering the MS cash cow, Microsoft Office, as a web service in its 2010 version. Microsoft's Software Plus Services suite is a set of web applications that include mail (based on Exchange) and collaboration tools (founded on Share Point) targeted for enterprise consumers. It also offers Live@Edu as a free e-mail and collaboration platform for academic institutions.

AT&T. Even though its initial on-demand server offering called Synaptic Hosting was not picked up by consumers, AT&T's control and understanding of the telecommunication networks puts it in a favorable position. The consumption of bandwidth is a key cost driver in cloud services.

Savvis and Terremark. These two firms are primarily enterprise-level web-hosting firms. Both have engaged in alliances with other enterprise-level firms such as VMware to start offering cloud services from their existing data centers. The fact that they use VMware, which is among the most popular virtualization tools used by enterprises, may make it easier for enterprise consumers to adopt them over other public cloud providers.

VMware. VMware has been pushing its vSphere solution into its established enterprise market. It has struggled in distinguishing its traditional virtualization solutions from its new cloud, scalable solutions. VMware has a strong presence in standards-setting organizations and has established alliances with a wide variety of cloud players. Its most recent move involved an alliance with Salesforce.com, in which they jointly launched VMforce. VMforce is an enterprise-oriented Java-based PaaS offering that runs on top of VMware's virtualization software.[43]

Endnotes

1. IBM Annual Report, 2009.

2. IBM Smart Business Thought Leadership White Paper (2010), "Dispelling the vapor around cloud computing: Drivers, barriers and considerations for public and private cloud adoption," January.

3. Mell, P., and T. Grance, Version 15, October 7, 2009, http://csrc.nist.gov/groups/SNS/cloud-computing/.

4. Adapted from Sam Johnston's definition on Wikipedia.org, "Cloud computing."

5. IBM Archives: 1930s.

6. IBM Archives: 1940s.

7. Wikipedia.org, "History of IBM."

8. Lohr, S. (2002), "He loves to win; At IBM, he did," *The New York Times,* March 10.

9. Gerstner, L. (2002), *Who Says Elephants Can't Dance? Inside IBM's Historic Turnaround* (New York: Collins).

10. Ibid.

11. Ibid.

12. Ibid.

13. IBM Archives: 1997.

14. Lohr, S. (2004), "Big blue's big bet: Less tech, more touch," *The New York Times,* January 25.

15. Spooner J., and S. Junnarkar (2002), "IBM talks up 'computing on demand,'" *CNET News,* October 30.

16. Bulkeley, W. M. (2009), "IBM set to cut more U.S. jobs," *The Wall Street Journal,* March, 25.

17. Lohr, S. (2007), "New effort to tap technology to aid the service economy," *The New York Times,* March 28.

18. Bulkeley, W. M. (2009), "IBM set to cut more U.S. jobs."

19. Lohr, S. (2007), "IBM showing that giants can be nimble," *The New York Times,* July 18.

20. Bulkeley, W. M. (2009), "IBM set to cut more U.S. jobs."

21. Ibid.

22. Hamilton, J. (2010), "Cloud computing economies of scale," Mix 10 Conference, March 10.

23. Interview with Irving Wladawsky-Berger accessible at www.ibm.com/ibm/cloud/why_ibm/.

24. Gartner Newsroom (2009), "Gartner says worldwide CRM market grew 12.5 percent in 2008," July 15.

25. http://en.wikipedia.org/wiki/Cloud_computing.

26. Worthen, B., and J. Scheck (2009), "As growth slows, ex-allies square off in a tech turf war," *The Wall Street Journal,* March 16.

27. Talk by Dan Reed, Scalable and Multicore Computing Strategist, Microsoft, at CERCS Cloud Computing Workshop, Georgia Tech, April 23, 2009.

28. Karadogan, B. (2007), "Five computer clouds are all we need," *GigaOM,* November 22.

29. "The Internet industry is on a cloud–Whatever that may mean," *The Wall Street Journal,* March 26, 2009.

30. www.infoworld.com/d/cloud-computing/what-cloud-computing-really-means-031?page=0,2.

31. Schonfeld, E. (2007), "IBM's blue cloud is just web computing by another name," *Techcrunch,* November 15.

32. "IBM opens four Cloud Computing Centers to meet growing demand in emerging markets," IBM Press Center, September 24, 2008, Armonk, NY.

33. Higginbotham S. (2008), "IBM gives cloud computing a seal of approval," *GigaOM,* November 23.

34. Thibodeau P. (2008), "Google and IBM are bonding in a serious way–PC era fading, cloud computing rising–watch out, Microsoft?" *ComputerWorld,* May 2.

35. "Google and IBM announce university initiative to address Internet-scale computing challenges," Google Press Center, October 8, 2007.

36. Rough Type—Nicholas Carr's Blog: "The Omnigoogle," September 7, 2008.

37. Karnitschnig M., W. M. Bulkeley, and J. Scheck (2009), "IBM in talks to buy Sun in bid to add to web heft," *The Wall Street Journal,* March 18.

38. Hechinger, J., W. M. Bulkeley, and B. Worthen (2009), "IBM signals strategy shift with talks to buy Sun," *The Wall Street Journal,* March 19.

39. "The Internet industry is on a cloud–Whatever that may mean."

40. http://cloudmiddleware.com/.

41. Rosenberg, D. (2010), "IBM grabs largest enterprise cloud deployment," *CNET News,* January 13.

42. Palmisano, S. J. (2008), "A smarter planet: Instrumented, interconnected, intelligent," *IBM.com,* November.

43. "Salesforce.com and VMware form strategic alliance to launch VMforce, the world's first enterprise Java cloud," VMware news release, April 27, 2010.