

## Research that Matters: Case of IBM under the Leadership of Sam Palmisano

By Nelson M. Fraiman\*, Jia Guo† and María J. Quinteros‡

\* Professor of Professional Practice and Director W. Edwards Deming Center, Columbia Business School; † PhD Candidate, Columbia Business School; ‡ Staff Associate, Columbia Business School

Sam Palmisano was the recipient of the inaugural Deming Cup in 2010. This prize grew out of Columbia Business School's drive to highlight the achievements of practitioners who adhere to and promote excellence in operations – the Deming Center's area of focus.

growth coming out of the global recession.

This annual award is given to an individual who has made outstanding contributions in the area of operations and who has established a culture of continuous improvement within their

*“Sam Palmisano has pioneered new concepts, like the globally integrated organization, that has inspired many other companies to seek better ways of servicing markets and communities around the world, and he has made significant contributions to the technological drive that continues to propel civilization forward in the 21st century. By launching initiatives like Smarter Planet, Sam Palmisano has helped bring together businesses, governments, and social organizations to develop new systems that promote sustainability in key development areas, including clean energy, effective water use, and urban planning” – Lorenzo Zambrano, Chairman and CEO, CEMEX*

The inaugural recipient, Samuel J. Palmisano, Chairman, President and CEO of IBM Corporation, won the Deming Cup for building one of the world's largest and most diversified IT services organization in the industry, IBM's Global Services, and for realigning the company for international

respective organization. The Deming Cup's nomination criteria featured seven areas of accomplishment. For example, the nominee was required to be a global leader who had applied and demonstrated the Deming principles. He or she must also have fostered an environment where operational

excellence has made a decisive impact on the competitive position of the firm<sup>1</sup>. This paper takes a look at one of IBM's functions, Research and Development. It considers how this function evolved under Sam's leadership.

### A century of innovation

IBM celebrated its 100th anniversary during 2011. Such longevity is rare, especially among technology firms. And it is even rarer that the firm remains a frontrunner in its industry, and continues to grow its lines of business around the world, with earnings quadrupling over the past decade and the share price at its all-time high. During the course of 100 years, IBM has produced a wide range of products and services, from punch cards to sorters, from clocks to typewriters, from copiers to test scoring machines, from mainframe computers to PCs, and from cloud computing to consulting services.

To many, the firm has done very different things from year to year, from decade to decade. Yet, as Sam Palmisano points out *"One can also say that IBM has been consistently doing the same thing – continuously moving forward, positioning itself ahead of strategic shifts, and committing to new research and*

*development"*<sup>2</sup>. Indeed, innovation is key to the success of IBM. The founder, Thomas Watson Sr., increased research spending even during the Great Depression. Thomas Watson, Jr. devoted \$5 billion (or \$35 billion in today's dollars) to develop the System/360 at a time when no such technology existed. Today such a belief in research and such a commitment to developing new products for the future continues. As Palmisano notes in his centennial lectures *"The information technology industry has a responsibility to contribute to the advance of technology. This responsibility requires patience and commitment since the payoff from fundamental research often does not turn up in a quarter or a year, even for a decade, and sometimes it may not come at all"*<sup>3</sup>. During the most recent economic downturn, IBM has resisted cutting R&D budgets to meet shareholder demands for higher returns. In contrast Palmisano launched a new Smarter Planet initiative in the fall 2008 at the height of the financial crisis.

The achievements of IBM Research are truly impressive. IBM has been awarded the highest number of US patents among corporations for 19 years in a row. A long history of major scientific

---

<sup>1</sup> See exhibit 1 for full list of Deming Cup criteria

---

<sup>2</sup> Sam Palmisano's Centennial Speech at Computer History Museum

<sup>3</sup> Ibid

breakthroughs by IBM researchers include FORTRAN in 1957, fractals in 1967, relational database in 1970, scanning tunneling microscope in 1981 (in 1986 IBM won the Nobel Prize for this work), Deep Blue in 1997, Nano MRI in 2009, and many more. IBM Research is also home to 5 Nobel Prize winners, 6 A.M. Turing Award winners (including Frances Allen, the first female recipient), 9 U.S. National Medals of Technology, 5 National Medals of Science, 19 memberships in the National Academy of Sciences, and 11 inductees into the National Inventors Hall of Fame. IBM researchers are also active members of the international scientific community, participating in seminars, conferences, and professional associations in a variety of functions.

Furthermore, IBM collaborates with numerous government agencies and academic institutions around the world in both fundamental scientific research and in developing new products.

In addition to organic research output IBM has also actively acquired many cutting-edge technology firms to enhance its existing analytics and research capabilities. These include Database Assets of Informix Corporation in 2001, PwC Consulting in 2002, Think Dynamics in 2003, Trigo Technologies in 2004, DataPower in 2005, Language Analysis Systems in 2006, DataMirror in 2007, AptSoft in 2008, SPSS Inc. in 2009, Clarity Systems in 2010, Platform Computing in 2011, and many more.

Fiscal Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>R&amp;D (\$ MM)</b>	4,986	4,750	5,077	5,874	5,842	6,107	6,153	6,337	5,820	6,026	6,258
<b>% of Total Assets</b>	5.65%	4.92%	4.86%	5.29%	5.52%	5.92%	5.11%	5.79%	5.34%	5.31%	5.37%
<b>% of Gross PPE</b>	12.99%	13.16%	13.68%	16.14%	17.05%	16.72%	15.95%	16.48%	14.70%	14.96%	15.60%
<b>% of Total Revenue</b>	6.00%	5.85%	5.70%	6.10%	6.41%	6.68%	6.23%	6.12%	6.08%	6.03%	5.85%
<b>% of EBIT</b>	43.55%	63.13%	46.69%	55.06%	47.78%	45.86%	42.47%	37.91%	32.09%	30.55%	29.80%
<b>% of Net Income</b>	64.56%	132.72%	66.95%	78.54%	73.63%	64.34%	59.06%	51.38%	43.35%	40.63%	39.47%

Figure 1: R&D expenses as percentage of financial measures

Source: Annual reports IBM

## Research that matters

Today, by virtually every measure the world is becoming more integrated and interconnected. As a result data are collected in unprecedented volumes and in real time from supply chains, traffic flows, weather patterns and billions of individuals using social media. As Palmisano pointed out at the “Smarter States of America” conference in 2010, the most important challenge of this century *“is not how much data there is but what it could tell us.”* In other words, it is the *“move from ‘big data’ to smarter data”*<sup>4</sup>. Hence superior analytics and smarter systems are now an essential component of management at both private and public institutions as they provide managers with an important context for the data so that informed decisions can be made. With close to 3,000 scientists, mathematicians and engineers in 11 research labs across the world IBM has been a leader in this movement. The research arm of IBM works closely with both private clients and public institutions to develop cutting edge technologies and apply them in innovative ways to solve real-world business problems such as supply chain management, as well as social issues which involve clean energy, health care, traffic control, public safety, and

education. Indeed IBM Research is research that matters locally and globally.

For example, today corporations especially those in emerging economies operate under increasing constraints. They need to deliver a better experience for their clients, improve operating efficiencies, generate higher returns for their investors, and at the same time minimize their environmental impact. To this end IBM researchers in China have developed an analytical tool, “Green Supply Chain”, which helps firms optimize their business decisions for lower carbon dioxide emissions. “Green Supply Chain” can be used to evaluate the carbon dioxide emissions of materials and various manufacturing processes, to evaluate the environmental impact of warehousing and storage requirements, and to monitor the carbon dioxide emissions for various transportation and distribution models, shipment sizes and service levels. Using this technology, the Chinese shipping and logistics giant, COSCO, for example, was able to reduce the number of its distribution centers from 100 to 40, lower logistics costs by nearly 25% and reduce carbon dioxide emissions by 15% (equivalent to about 100,000 tons of carbon dioxide per year). At the same time the firm was also able to maintain

---

<sup>4</sup> Sam Palmisano’s speech at The Smarter States of America conference, July 9, 2010

service levels for its clients and incur no extra costs.

they occur. Likewise Sun World, a private agribusiness in the US, uses

*“Sam re-oriented a massive organization to deliver real solutions for real people with real needs in the real world. From theories and models to operations and practice. From selling stuff to making the world better” – Shelly Lazarus, Chairman, Ogilvy & Mather Worldwide*

In addition, in the fall of 2008, IBM officially launched the Smarter Planet initiative, which includes a wide range of existing and new projects that use technology to improve the way the world operates in the new century. In Palmisano’s words, *“Any system can become smarter”*<sup>5</sup>. Smarter Educational System, for example, is in place in Alabama, where the state's largest school district uses advanced analytics to track student performance in real time, in order to better identify those at risk and make necessary adjustments to academic programs. Similarly, the Smarter Water Management initiative applies recent advances in technology including sophisticated sensor networks, smart meters, deep computing and analytics to monitor and analyze entire water ecosystems in real time. That includes rivers and reservoirs, as well as the pumps and pipes in residential buildings. The District of Columbia Water and Sewer Authority (DC WASA) now uses this technology to identify potential problems in the system before

analytics tools offered by IBM to evaluate various irrigation systems on different crops. As a result it has been able to decrease its water usage by 8.5% since 2006. This in turn has lowered its operational costs while minimizing its impact on the environment at the same time.

In 2010 IBM also launched the Smarter Cities initiative which awards \$50 million worth of IBM expertise to 100 cities around the globe to address a wide range of challenges facing cities today. In the area of public safety, for example, IBM has collaborated with the NYPD to collect and establish a data warehouse of billions of pieces of information previously buried in filing cabinets, on index cards and in handwritten notes. This information can often become crucial in solving crimes. Today the New York City Real Time Crime Center houses more than 120 million New York City criminal complaints, 31 million national crime records, 33 billion public records, and more. The sophisticated analytics of

---

<sup>5</sup> Ibid

IBM can then, in addition, make connections across these multiple databases to capture new trends before they become systemic. Information can also be accessed within seconds and critical data can be delivered to the officers at the scene almost instantly. With new technology what once took days now takes minutes. Since 2001 the crime rate in New York City has dropped 21%, and it is now one of the safest large cities in the world.

Likewise, IBM is also actively engaged in research to reduce traffic congestion. Since 9 billion gallons of fuel are wasted in traffic congestion each year this is a major global issue. Such research involves rethinking how cities are designed, how the drivers' experience can be improved, and how the public transit system can be optimized. For example, IBM Research in Tokyo has worked with the Department of Social Informatics at Kyoto University to develop a system that can simulate, at high speed various urban transportation situations involving millions of vehicles. Such simulations provide real-time analysis of traffic status, traffic volume, travel time, and levels of carbon dioxide emission throughout a metropolitan area. They also show how any modification of the existing traffic laws, as well as the timing or frequency of

traffic signals, can potentially alleviate congestion. Hence the new technology will enable urban planners to assess new and innovative transport measures more quickly and accurately.

In addition to tackling specific business and social issues IBM also applies its advanced technology and research capabilities to improve the business models of corporations and governments. For example, the IBM Smarter Government initiative argues for the "citizen-centric" model that helps governments around the world in reorienting their structures, services and policies around citizens. As a result many government operations and databases have moved online. This makes possible "one-stop shopping" for previously discrete sets of services and it allows for efficient information sharing and collaboration across regions and departments. Furthermore, not only does such technology improve efficiency it also significantly reduces the costs of operation. This is particularly significant at a time of fiscal austerity. Smarter Government Services are in place in the Alameda County Social Services in California, for example, where advanced analytics and real time reporting enable caseworkers to quickly identify the immediate status of any child, of associated staff members,

of support services and of programs. More than \$11 million has been saved through greater efficiency under this initiative. Smarter Transportation is in place in the Washington, D.C. Metro Area Transit Authority where it is managing and maintaining all of the assets including more than 12,000 bus stops and train stations, 106 miles of track, 1,144 rail cars, and 1,500 buses. A recent study from the Information Technology & Innovation Foundation finds that for every \$1.25 billion invested in smarter transportation infrastructure in the United States 35,000 jobs are created and supported. Likewise, the Smarter Healthcare initiative implemented at the University of Pittsburgh Medical Center has improved the center's processing capacity by more than 220% while reducing operating costs by \$104 million. Similarly, the University of North Carolina Health Care is using the analytics to improve the quality of patient care. Records for every patient can now be quickly examined for blood pressure, risk of chronic illness or drugs that have been administered. This not only reduces costs but also saves time and lives.

### **Globally-Integrated research**

IBM Research is the largest industrial research organization in the world

today. It has come a long way from the first small Watson Scientific Computing Laboratory established at Columbia University in 1945. Today, the core of research at IBM is carried out in 11 research facilities in 9 countries with close to 3,000 world-class researchers. Each facility has its special focus. The US research centers, for example, mostly focus on computer science, database, user interface, nanotechnology, life sciences and systems and physical sciences.

On the other hand, the facilities in Delhi and Bangalore, India, focus on e-governance, e-commerce, software engineering, speech technologies, high performance computing, mobile enabled emerging technologies, and so on. The newest labs in Brazil are currently studying smarter natural resource management, smarter devices, and smarter human systems. Furthermore, in addition to research carried out in the laboratories in Brazil, Australia, China, India, Ireland, Israel, Japan, Switzerland and the United States, a large amount of IBM research also takes place in the field around the world through collaborations with various partners. Such projects include studying solar energy and water desalinization in the deserts of the Middle East and monitoring the health

of the ecosystem surrounding Ireland's beaches and lakes.

Conducting fundamental research across the world is an integral part of IBM's establishing itself as a "Globally Integrated Enterprise" in the 21<sup>st</sup> century. As Palmisano frequently observes, one of the major shifts of this century is globalization, which reorders economies and markets and which implies that the clients of IBM will have new expectations for the products and services that technology firms provide. Indeed, the definition of a global firm has changed over the past century. In the late 19<sup>th</sup> and the early 20<sup>th</sup> century global firms had headquarters and

clients become global IBM has also relocated its various units to their most advantageous locations with each unit not only serving the local market but also global business needs. For example, semiconductor manufacturing is now located in New York and Vermont, data centers in Colorado, financing back office in Brazil, global procurement mission in China, global services delivery in India, etc. Different research initiatives are carried out in different research labs across the world depending on local staff expertise, existing research partnerships and the relevance of the subject for the local community.

*"Sam Palmisano has been a superb leader that has helped made IBM into one of the most innovative companies in the world. Sam has fostered a culture of continuous improvement that will endure". - Tom Cole, Chief Administrative Officer, Macy's*

operations centered in the home country while sales and distribution offices spread across the globe. In the second half of the 20<sup>th</sup> century global firms evolved to conduct operations globally by creating replicas of the headquarter office around the world, each serving its local market. In contrast, in the 21<sup>st</sup> century globalization necessitates the distribution of all company operations globally through a worldwide IT and communication infrastructure. As its

Indeed, the presence of IBM Research across the world enables IBM to better serve the needs of its clients in various markets by providing better and customized solutions for many local issues. Take the latest research lab in Brazil (opened in June 2010) as an example. The researchers are currently studying "human systems" with an emphasis on technologies for large-scale events. The outcomes of such research will have significant implications for the



local community as Brazil is preparing to host the World Cup and the Olympics in a few years. Similarly, since Brazil is a country rich in natural resources (with 22% of the world's arable land and 15% of the world's portable water), IBM researchers in Brazil are also conducting extensive research on natural resource discovery, exploration and logistics to address issues such as the safety of pre-salt exploration. Such research plays to IBM's core competence as it requires massive data gathering and management, imaging, model development, and scalable simulation. The outcomes from such research will have important implications for Brazil as there have been recent discoveries of large petroleum reserves in the pre-salt sediments off Brazil's coastline, which are now awaiting further exploration and development.

More importantly, as today's global challenges and their solutions become ever more complex the need for collaboration in research and development is also ever more apparent. The international presence of IBM Research enables IBM to forge closer relationships with local clients, research institutions and universities across the world to find better solutions more quickly. At IBM Research in Tokyo, for example, the firm participates in the

Shared University Research Program where IBM donates its equipment (servers, storage systems, PCs, etc.) to universities that conduct cutting-edge research and supports their research activities. Similarly, IBM operates numerous "collaboratories" in China, India and other emerging markets where IBM researchers work with a local university, government, or commercial partner to share skills, assets and resources in pursuit of a common research goal. One important initiative of the "collaboratories" is the development of a new discipline of learning, "Service Science, Management and Engineering (SSME)", to be implemented at universities across the world. It is back in the 1950's and 1960's, when IBM began working with universities (including Columbia) to make "Computer Science" a curriculum. SSME is a call for academia, industry, and governments to become more systematic about innovation in the service sector, which is the largest sector of the economy in most industrialized nations and which is becoming the largest sector in developing nations as well. The interdisciplinary curriculum uses scientific methods to understand the characteristics of services, to increase service productivity, and to realize innovations in services in a systematic way. This new initiative is particularly

important for emerging markets as it educates a new generation of leaders who are knowledgeable about the technology, the business models, and the ecosystem necessary to realize the potential of technologies such as cloud and mobile computing in delivering new services that will empower the masses in emerging markets in the future.

The strong presence of IBM Research in China, India and other developing markets and its commitment to the technological advancement of the local communities have also been integral to the rapid growth of IBM itself over the past decade. IBM was one of the first firms to recognize that emerging economies are important sources of growth. Today emerging markets as a whole account for 21% of IBM's total revenue and are expected to reach 25% by 2015. In India, for example, IBM was one of the first technology giants to increase its presence (opening its research labs in 1998). In addition IBM has continued to grow in India despite economic downturns and political instability. The IBM research lab in India is the first IBM lab outside of the US to lead a Research Big Bet, which is a long term, high investment exploratory project. IBM has also been honored with many prestigious awards by local

governments. The 2009 National Award for Empowering Persons with Disability, given by the Government of India, for example, acknowledges the achievement of the Spoken Web technology developed at IBM's research labs in India in improving the lives of persons with disabilities. Today, because of its strong commitment to the local economy IBM dominates the Indian telecom sector. Moreover IBM has established a close relationship with local entrepreneurs such as Sunil Mittal. As these Indian enterprises develop into multinational corporations and expand into new markets IBM grows with them. In China a similar story is unfolding since IBM opened its research facilities in Beijing in 1995. Through numerous collaborations with local governments and enterprises IBM's analytics and research capabilities are encouraging the development of a new generation of entrepreneurs. Wuxi, for example, is a city with a large number of highly educated software engineers and business graduates. Many are operating start-ups in the software development business. However, they often lack the financial capital required to invest in the necessary IT infrastructure. To address the problem IBM and the municipal government of Wuxi have collaborated on creating a hi-tech business park that offers shared resources for

entrepreneurs on a pay-as-you-use basis. The latest IBM cloud technology effectively enables these new software development businesses to have access to a world-class data center, complete with all the tools they need, and sized perfectly for their enterprises. Using cloud technology creating a new private environment for each business takes a matter of minutes rather than the weeks or months it would take for a business to build its own physical data center and deploy its own software. As such the IBM cloud reduces a significant barrier to entry for start-up companies. Today there are over 150 companies registered in the New Town Science and Education Industrial Park in Wuxi. Going forward these shared services will be made available not just inside the business park but also across the whole municipal area. With cloud technology, IBM has helped Wuxi build a new engine for growth and has encouraged a whole new generation of entrepreneurs in China.

### **Research with a lower center of gravity**

As Palmisano often notes, *“Today is no longer a world where the chairman or the CEO can dictate firm values and firm strategies top-down. Instead IBMers are highly intelligent and independent individuals and it is important to involve*

*everyone in decisions concerning firm strategies as well as in developing new research initiatives and products”*<sup>6</sup>. In other words it is necessary to operate with a “Lower Center of Gravity” in the 21<sup>st</sup> century.

Indeed there are many facilities in place at IBM to encourage innovation within the firm from bottom-up. ThinkPlace, for example, is a venue where employees can submit their ideas and engage in active dialogues about them. Similarly in July 2006 over 150,000 IBMers in 104 countries participated in an Innovation Jam where the company has promised to invest \$100 billion in the resulting projects. The Smarter Planet initiative, for example, grew out of these firm-wide discussions.

Furthermore, IBM researchers are also actively involved in the shaping of corporate strategies. Once a year, Palmisano spends a day with lab directors in predicting the future of the technology industry. Such discussions have eventually led to major changes in IBM’s corporate strategies, including the important decision to divest the PC business in 2004 and to increase spending on the acquisitions of many

---

<sup>6</sup> Sam Palmisano’s Centennial Speech at Johns Hopkins University, February 1, 2011

software and analytics companies over the past decade.

### Conclusion

As Palmisano notes in the centennial lectures, *“Because the frontier of what is truly innovative is moving, that compels IBMers not to sit still. It is a constant reminder never to define ourselves by the things we make, no matter how successful they are today”*<sup>7</sup>. Indeed, IBM has continuously been a frontrunner in innovation, research and development. It does so by conducting research that matters, by establishing long-term partnerships with institutions and corporations around the world, and by operating with a lower center of gravity to encourage innovation from all IBMers.

Sam Palmisano transformed a company to meet the future needs of society. When he came to Columbia University to deliver his last centennial speech on November 2, 2011 he came with a successor, Ginni Rometty, who took over as CEO of IBM on January 1, 2012.

This continues to show his keen understanding of who can lead IBM further into the future.

### Exhibit 1: Deming Cup Nomination Criteria

1. Global leader who has applied and demonstrated the Deming principles.
2. Organization that exhibits multidimensional excellence (for instance excellence in safety, environmental responsibility and a view towards inclusion).
3. Organization known for continuous improvement.
4. An organization that has increased in shareholder value over a sustained period of time due to organic growth.
5. An organization where operational excellence has made a decisive impact on the competitive position of the firm.
6. Evidence of a culture in which all stakeholders in the organization are treated with dignity and respect.
7. Leader who requires data driven analysis and has clear commitment to impactful training and skill.

---

<sup>7</sup> Ibid

## References

- [1] Kanter, Rosabeth M, “IBM’s Values and Corporate Citizenship”, Harvard Business School Case #9-308-106, April 15, 2011.
- [2] Kanter, Rosabeth M, “IBM in the 21<sup>st</sup> Century: The Coming of the Globally Integrated Enterprise”, Harvard Business School Case #9-308-105, October 7, 2009.
- [3] Marquis, Christopher, and Rosabeth M. Kanter, “IBM: The Corporate Service Corps”, Harvard Business School Case #9-409-106, July 12, 2010.
- [4] Bjelland, Osvald M., and Robert C. Wood, “An Inside View of IBM’s ‘Innovation Jam’”, Sloan Management Review Vol. 50 No.1, Fall 2008.
- [5] Lohr, Steve, “IBM Showing That Giants Can Be Nimble”, New York Times, July 18, 2007.
- [6] “IBM Global Services: A Brief History”, IBM Corporate Archives, May 2002.
- [7] “Deming Cup Award Ceremony 2011 and IBM’s Centennial Lecture”, W. Edwards Deming Center for Quality, Productivity and Competitiveness, Columbia Business School, November 2, 2011.
- [8] Bower, Joseph L., and Sonja E. Hout, “Leaders Who Make a Difference: Sam Palmisano’s Smarter IBM: Day 1”, Harvard Business School Case #9-311-030, March 29, 2011.
- [9] Bower, Joseph L., and Sonja E. Hout, “Leaders Who Make a Difference: Sam Palmisano’s Smarter IBM: Day 2”, Harvard Business School Case #9-311-031, April 27, 2011.
- [10] IBM Research website, <http://www.research.ibm.com>.
- [11] IBM Centennial website, <http://www.ibm.com/ibm100>.