«Book Review»

Summary and Comments on *Making the World Work Better: The Ideas That Shaped a Century and a Company*

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(Received on May 31, 2012)

1. Introduction

Making the World Work Better: The Ideas That Shaped a Century and a Company by K. Maney, S. Hamm, and J. M. O'Brien (2011) was written to commemorate the 100th anniversary of International Business Machines (IBM). It is actually three books in one, each written by one of the three authors.

The purpose of this paper is to provide a summary of the book and, at the end, some personal comments about it. The paper is organized as follows:

1. Introduction
2. Part 1: *Pioneering the Science of Information* by Kevin Maney covering the history and future of computing.
3. Part 2: *Reinventing the Modern Corporation* by Steve Hamm covering the history of IBM from four perspectives.
4. Part 3: *Making the World Better* by Jeffery M. O'Brien proposing a roadmap for tackling complex problems with which organizations must deal in this day and age.
5. Comments on the book.

2. Part 1: *Pioneering the Science of Information*

Pioneering the Science of Information by Kevin Maney is divided up into these six parts plus a look at the future of computing and information science:

- Sensing
- Memory
- Processing
- Logic
- Connecting
- Architecture

Sensing. How do computers get data to work on? Initially it was via Hollerith punched cards, something used for six decades up to the 1960s. Then came the computer terminal, the forerunner of the keyboard, using the ASCII[1)] code to convert the alphabet into computer language. Now the primary input devices are the keyboard and the mouse. However, computers can now get data from many other sources such as the ubiquitous bar code that initially saw use in grocery stores and now finds almost unlimited applications. Beyond that there are sources such as video surveillance systems, voice commands, and any number of sensors detecting almost anything of a physical nature. And now touch technology is coming into common use as a way to input data as exemplified by Apple's iPhone and iPod.

Memory. The Hollerith punched card was the earliest form of "memory" and, as mentioned, was in use for some 60 years. Then came the magnetic tape drive able to store much more information in a much more convenient way, but the data was not randomly accessible.

The disk drive, introduced in the mid-1950s, changed all that making it possible to randomly access and even change stored data. Also much more data could be stored. Further storage developments include the DRAM (dynamic random access memory), the solid-state flash drive, and better and faster hard

1) American Standard Code for Information Interchange

disk drives (HDDs). Now we're seeing more and more solid-state HDDs, which eliminate the need for the relatively cumbersome mechanics of the read/write arm, greatly speeding up that operation.

What the future holds for storage is unclear but it is sure to add to the remarkable advances thus far and perhaps, as the book says, to the point where there is almost no physical or financial limit to the amount. Indeed, the book speculates that eventually we will need to invent a machine for forgetting to avoid data overload!

Processing. The history of electronic computing begins with the ENIAC[2) developed at the University of Pennsylvania for the U. S. Army during WWII. Although much faster at calculations than the electro-mechanical machines, it used unreliable and power-hungry vacuum tubes. ENIAC and its soon to be follow-on UNIVAC[3) led to a flurry of developments by US companies with heavy government support since these were the days of Cold War. IBM, not wanting to be left out, came out with its first electronic computer that not only had electronic processing but also included an electronic main memory supplemented by slower disk and tape memories. This was its 701 model.

With the invention of the transistor the need for highly inefficient vacuum gradually went away. Then came the integrated circuit, which brought even more speed to processing and, just as important, massive miniaturization became possible. The 1971 System 370/Model 145 was IBM's first use of integrated circuits in a computer system and featured a new memory chip that could hold 512 kilobytes—a remarkable advancement at the time. The 370/145 was five times faster than the 360/40 model it replaced due to its integrated circuitry.

By the 1970s the demand for more and more speed spawned the age of supercomputers to do ever more complex tasks such as weather forecasting and

2) Electronic Numerical Integrator And Computer.

3) UNIVersal Automatic Computer.

genetics research. This surge in supercomputers was lead by Seymour Cray's Cray Research Company. IBM eventually got into the business in the 1990s with one-off machines for the government and later, in the 21st century, with a new design called Blue Gene. The key to the ability of these machines to do computing at super speeds lay in a massive parallel architecture where lots of relatively simple processors work simultaneously on the problem.

What's next? As the book points out there are two ways to improve computing speed: (1) make the components smaller and (2) come up with different material for building the components. Smaller components mean the electrical signals don't have to travel as far plus more chips can be packed into the same space. As for different material, one promising approach is the use of superconductors. Superconductors are perfect conductors with zero resistance when cooled to a low enough temperature. According to the book they've not yet been used in computers due to the cooling problem. But that may change with the drive to move into the exascale level of computing speed[4)]—a speed about 500 times the speed of supercomputers in 2010.

Logic. Setting up computers to use their hardware to make the logical choices desired has evolved from the use of wires on plugboards to what today verges on true artificial intelligence. From plugboards to machine-readable code was a big leap but the early codes were cumbersome and error prone. Early work to make a program that would translate human terms into machine code[5)] was another step forward but the translation was slow and inefficient.

The breakthrough came in 1957 when an IBM team led by John Backus came

4) A computer able to perform a million trillion calculations per second (10^{18}). In computer terms this would be exaFLOPS or 10^{18} Floating-point Operations Per Second. Floating-point is the common type of calculation computers use.

5) Known as a compiler.

up with the Fortran[6] language allowing those not experts in programming to do it. From Fortran many other programming languages developed such as COBOL[7] and BASIC[8] each either as an improvement on Fortran or for some specialize application. Also certain languages became standards such as Unix as the operating system for midsize business computers and C++ for “serious” programming.

In the 1970s and 1980s computers became more standardized and easier to program but, ironically, now there was less reason for the average user to do so as programming became “built in” to the applications and operating systems such as WordStar, WordPerfect, and eventually Microsoft Word, and the Apple/Windows operating systems.

Although we are still far from developing a computer that can think like a human, advances in both hardware and software have brought us remarkable advances in the area of artificial intelligence. In the 1980s a team of graduate students at Carnegie Mellon University built Deep Thought, a computer that was capable of playing expert chess. IBM hired the Deep Thought team and put them to work on building Deep Blue, also specialized for playing chess. In 1997 the reigning world champion played against Deep Blue and, after six meetings, Deep Blue won. This brought IBM into the supercomputer business and its next artificial intelligence project: DeepQA. The goal of this project was to create a program that could understand human language. Led by IBM’s David Ferrucci, the team’s goal was to build a computer that could compete with experts at the television game show *Jeopardy!*—a tremendous challenge given not only the need to understand English but the subtleties that would be involved in a *Jeopardy!* question. The showdown came over three days in

6) FORmula TRANslating system.

7) Common Business-Oriented Language.

8) A relatively simple programming language.

February 2011 when Watson (the computer's name) competed against two former *Jeopardy!* champions. By the end of the third and final day Watson had won more than three times the amount each of the other two had won. The key to Watson's success was not only a remarkable combination of processing hardware and programming (to apply the many algorithms[9] involved) but a massive database of information to be tapped into.

The implications of the Deep QA/Watson project are enormous. For specialized applications it should be possible to write programs that will allow natural language queries to be made of a computer that can draw on a database no one person could acquire or maintain up-to-date; for example in the field of medicine or law. And, who knows, maybe someday we will build a computer that will not even be restricted to a specialized area.

IBM continues to take the lead in supercomputing. A BBC news story of 18 June 2012 carries this headline: "IBM supercomputer overtakes Fujitsu as world's fastest."

According the article the computer, called Sequoia, "tested at 16.32 petaflops/s" or a thousand trillion (10^{15}) floating-point operations (calculations) per second. This is well above the second-place Japanese Fujitsu K computer's 10.51 petaflops/s.

Quoting from the article: "Sequoia will be used to carry out simulations to help extend the life of aging nuclear weapons, avoiding the need for real-world underground tests." (http://www.bbc.co.uk/news/technology-18457716)

9) Algorithm: a process or set of rules to be followed in calculations or other problem-solving operations, esp. by a computer: a basic algorithm for division. (Source: Apple computer dictionary Widget)

Connecting. The earliest machine-to-machine connectivity was something called Radiotype developed for use in WWII. A typewriter-like machine would punch holes into a paper tape—the holes forming the message to be sent. Then the tape was fed into another machine that would send the hole-coded message by radio to a receiving machine that would recreate the tape at that end. This tape would then be fed into a tape reader to activate the "typewriter" at that end. IBM decided not to pursue a civilian version of the Radiotype since it would have placed it in direct competition with AT&T's Teletype business and AT&T was one of its best customers.

So computer connectivity remained mostly dormant until the 1970 when The US Department of Defense's Advanced Research Projects Agency (ARPA) activated the ARPANET. Until this time the main computer connectivity was something called time-sharing whereby multiple users would share a single computer on a hub-and-spoke network. It was the continued improvement in speed and storage that made time-sharing possible, quickly processing each user's request. One reason there was little interest by companies like IBM in making connectivity friendly computers was a common approach by computer companies to be sure all connected equipment was by the same company. In fact the IBM 360 series was meant to be a stand alone all-in-one system and was not made for connecting to other, non-IBM, computers.

The ARPANET, activated in 1970, was the answer to connecting multiple computers to multiple users. It used something known as packet switching—instead of a single message going over a single line to its destination, the message data was broken up into small chunks called packets. Each packet had the all the information necessary to be routed to the right place and be reassembled in the right order to complete the desired message. The big advantage, besides making computer to computer communications possible, was if some portion of a network was down or knocked out the packet could go by another route and still get through—a real boon for improving network survivability in wartime. As for computer networking, the ARPANET provided scientists and engineers across the country access to the most powerful computers—a truly revolutionary thing.

However, not everyone could access the ARPANET so a couple of engineers at Stanford[10)] with ARPA support developed something called transmission control protocol/Internet protocol (TCP/IP) that allowed the ARPANET to initially connect with an academic network called CS/NET. However the turning point came when the US government funded a project that connected five supercomputers on a National Science Foundation network called NSFNET. Since this network ran on TCP/IP, it convinced other networks to switch to the TCP/IP protocol thus, in effect, giving rise to the Internet. Further improvements soon followed such as a way to quickly link to documents called hypertext[11)] and the first graphical browser[12)] allowing navigation of the Internet by simply clicking on an image versus "typing in strings of commands."

The next big step was the development of the local area network (LAN), which brought the Internet to not just big computers but to all the personal computers that were making their way on to so many company desktops at this time. With the further development of Internet search capability such as Google, the Internet now made it possible for almost anyone to have instant access to a vast amount of information about almost any conceivable subject. It also made possible today's massive social networking industry and, of course, the burgeoning "dot-com" commercial enterprises selling almost anything via

10) Robert Kahn and Vinton Cerf.

11) Invented by Tim Berners-Lee at the European particle physics laboratory (CERN).

12) Known as Mosaic and invented by Marc Andreessen and fellow students at the University of Illinois. According to Wikipedia there were a few lesser-known browsers before Mosaic.

the Internet.

The last two big steps in computer connectivity were the development of the Wi-Fi for wireless connectivity and, more recently, cloud computing. With cloud computing even a small mobile device can have access to almost unlimited document storage and whatever applications desired.

Today we have not only people accessing the Internet and communicating with each other but now, more and more, machines doing this too. As the book puts it: "In the coming decades, machine-to-machine conversations will skyrocket, overtaking data communications that relies on having a human at one or both ends" (p. 101).

Architecture. Borrowing from Wikipedia, one definition of computer architecture is: "…a blueprint, a description of the requirements and basic design for the various parts of a computer." In terms of how it played out with IBM's machines the story starts with a meeting between a Columbia University professor and IBM CEO Thomas Watson, Sr. in 1928 and continues even to this day with several remarkable developments such as the IBM 1401 and 360 systems and the IBM personal computer.

In 1928 Columbia professor Ben Wood met with Watson, Sr. and convinced him that computing could be used for more than just business purposes as had been the case up to that time—namely for scientific research. This opened up a whole new area of computer applications and became a major factor in how future computers would be designed.

Up until the late 1950, mainly due to their cost, computers were relatively few in number despite the remarkable advances in processing, logic, and storage. With the IBM 1401, introduced in 1959, all that changed. The 1401 was a general-purpose computer renting for $2,500 a month. This was much less than previous models, which were also much less capable. Obviously IBM had struck a cord with the market since, as the book tells it: "IBM was shocked to receive 5,200 orders for the 1401 in just the first five weeks after introducing it—more than was predicted for the entire life of the machine" (p. 108). The 1401 was a turning point in the history of computing in that it moved computing from something only the "elite" did to an essential tool for enterprises of all sizes. An important feature of the 1401 was its all-transistor architecture.

The next big advance in computing architecture came with the IBM 360 introduced in 1964. One problem, both within IBM and the industry as a whole at this time was a proliferation of incompatible hardware and software. IBM sensed it was time to do something about this incompatibility problem and a major investment was made to develop a new computer that would have "…strict compatibility among all processors [and] standard interfaces to permit interchangeability among input-output devices…" (p. 110). The result was the System/360. The "system" in the name was meant to indicate "an aggregation of interchangeable hardware units with program compatibility from top to bottom" and the "360" that it was a complete system suitable for all kinds of applications (p. 111).

The 360 proved even more successful than the 1401 with more than a thousand orders received within the first four weeks. The 360, on which Watson had essentially gambled the company, was a bet that paid off! The success of the 360 so overwhelmed the industry that the 360 interfaces soon became standards for the products of other companies.

The next significant advance in architecture was in the area of time-sharing, which was becoming popular in the 1960s. The major computer companies including IBM didn't see this as an area worth investing in and, in fact, time sharing was "nearly impossible" with the 360.[13] Time-sharing terminals that would connect multiple users to a single high-speed computer were the

13) IBM did eventually get onboard the time-sharing train with the 360/70 introduced in 1970.

forerunners of the next major architectural advance: the personal computer (PC).

The first practical PC was the MITS[14] Altair 8800, which was sold as a mail order kit. The Altair 8800 was quickly followed by RadioShack's TRS-80 and Apple's Apple II. About this same time the great success of the first spreadsheet program, VisiCalc, proved that PCs could be very useful business tools.

IBM realized it was time to act and, in August 1981 introduced the IBM PC. This project represented a complete change in IBM's approach to building computers—no longer would the computer be completely proprietary. Instead most of the parts for the PC would be bought with IBM essentially being the assembler, and sales would be through retail outlets such as Sears and ComputerLand. The IBM PC became enormously popular and spawned a boom in both software development and copycat clones. By this same time Bill Gates and Paul Allen had started Microsoft, which began playing a major role in producing PC software such as MS-DOS[15], the early operating system.

This latest architectural move once again changed the way people thought about computing, bringing it at a reasonable cost to almost anyone. Within the next ten years "computing had become a part of everyday life in business… …and [was] quickly becoming part of personal life too" (p. 121). PCs continue to become ever more powerful and, with connectivity to the Web, people are finding more things to do with them. And, this now also applies to smart phones and tablet computers such as the iPhone and iPad.

Another phenomenon that began to take place was the idea of "information" as an area of study in its own right. The book mentions the work of people like Claude Shannon at MIT who, in the 1930, showed how electronic circuits could

14) Micro Instrumentation and Telemetry Systems. This was an American electronics company that by the end of the 1970s had merged with another company.

15) Microsoft Disk Operating System.

perform Boolean algebra and the ability of algorithms to model almost anything. Since then people like Alan Turing[16] and Narendra Karmarkar (Bell Labs) have come up with improved algorithms—and the search for better algorithms goes on. And, of course, information technology (IT) is a common science now.

Today we now are entering the area of cloud computing made possible by advances in connectivity and server/data centers. With cloud computing even a small device like a smart phone can muster computing power once "reserved for giant corporations." Also we are moving more and more into the age of machines and sensors where data is gathered and operated on sans human intervention. Truly computer architecture has come a long way in a relatively short time and one can only speculate where it will go next.

Conclusion. This part of the book concludes with an example of what might be possible in the next ten years given how fast computing technology is advancing. This part also takes a look at some specific things we can look for in the future.

The example is of a man standing on the corner in Shanghai who needs to get to an address across town. He speaks into an app on his cell phone and asked: "Taxi or subway?" An answer comes back immediately "Nice day, traffic's terrible, you could use the exercise—get on the subway and here's the route." GPS knows where he is and where all the taxis in the area are and how fast they're moving (and thus the traffic conditions) and how long it will take to get a taxi. Also how far he would have to walk to the nearest subway station and to walk from the station nearest his meeting place. Monitors will know the man's current physical condition and current weather conditions and how those things would affect him should he have to walk very far.

Some of the things we can expect in the future:

16) An English mathematician.

- Computing that doesn't follow the "if this, then that" of traditional programming[17)] but be based more on how the human brain works with logic that is "more abstract and fuzzy." This will allow computers to be "trained" and "learn" so they can supplement our current architectures.
- One path to such processing is quantum computing using the spin of atoms. Such a computer could come up with "all possible answers to a problems at the same instant."
- Natural language software and immediate language translation so anyone can query data for answers.
- Machine vision that will draw conclusions about what seen.
- Simulations that previously required supercomputers.
- Improved security to stay "ahead of the bad guys." (pp. 132–133)

We can also expect the current trend of computing taking on more sophisticated analysis at the top end and providing more computing power for everyday life to continue as it has for the last 100 years. This will continue to free people to do those things uniquely human such as being creative and, quite frankly, thinking of new ways to use computing. This last point is one often mentioned in this part of the book; i.e., as we get more computing power it allows us to do new things which, in turn, drives our desire for getting more computing power—an endless cycle!

3. Part 2: Reinventing the Modern Corporation

Reinventing the Modern Corporation by Steve Hamm covers the history of IBM from these four perspectives:

- The intentional creation of culture
- Creating economic value from knowledge

17) Known as the von Neumann architecture.

- Becoming global
- How organizations engage with society

Using IBM as the prime example, Hamm discusses the importance of each of these four elements for a successful organization.

The intentional creation of culture

The book suggests that IBM was in the forefront of intentionally creating a culture and it began with its first CEO Thomas Watson, Sr. The key to the kind of culture desired is a set of positive values. For Watson, Sr. these were: respect for the individual, pursuit of excellence, and providing the best customer service.

Some of the other things over the years that shaped and improved IBM's culture were:

- Watson seeing all employees, regardless of position, as equal and working as partners—a most radical idea in 1915 when he first stated it.
- Hiring and treating women on an equal basis with men (starting in 1935).
- Over the years reducing the workweek, setting up a "study club" for employees, shifting from piecework to salaries, instituting vacation pay for hourly employees, and, in 1945, establishing pensions for all employees.

When Thomas Watson, Jr. took over in the 1950s, he continued to seek ways to improve the culture by promoting more delegation and giving the operating divisions more autonomy. He also set up a formal management education program and, in 1963, established the IBM Fellows program to recognize excellence on the part of IBM's scientists and engineers. Watson, Jr. also instituted a rigorous enforcement of IBM's code of conduct.

Another part of the culture was IBM willingness to take risks as evidenced by the "bet-your-company" investment in the 360 computer in the 1960s and a similarly risky program to develop the IBM PC in the early 1980s.

However, by the late 1980s, "…IBM had become complacent about its position in the computer industry and rapidly lost business" (p. 158). This was a sign it was losing sight of some of the core elements of its traditional culture such as a willingness to take risks and dedication to the customer. By the time Louis Gerstner took over in the early 1990s the situation had become acute and he began concentrating on once more reviving the culture.

Although Gerstner did improve the culture, the next CEO, Samuel Palmisano, who took over in 2002, sought to make it even better due a concern that (1) Watson Sr.'s Basic Beliefs had come to mean something different from their original intent, (2) there was a need for something to better knit the company together in a time of massive global expansion, and (3) there was a need to reengage on the "values" level. Accordingly in July 2002 he held a three-day "ValuesJam" involving all employees. Sadly it started off as a forum simply airing complaints. Eventually, however, it became constructive and yielded this revision to the original values:

Old ones	New ones
Respect for the individual	Trust and personal responsibility in all relationships
Pursuit of excellence	Innovation that matters—for our company and for the world
Best customer service	Dedication to every client's success

Although there is some resemblance, these new values are much broader with a global outlook and more in line with current technology and interpersonal relations. And, even more important, they came from the IBMers themselves versus being top-down imposed.

What can we learn from the way IBM has continuously sought to create and improve its culture? First and foremost that the key is to have it based on a set of positive values that are not only explicitly set forth but are practiced by how the company treats its employees. Second, in line with Palmisano's thinking of having the employees take ownership of the culture—think the 2002 ValuesJam experience and outcome—the ideal situation is for managers to play a smaller role in running the company. That is the employees at all levels will be so imbued with the company's values they'll instinctively know how to act and behave in most situations. Couple that with the advances in computer technology the day may soon come where sophisticated decision-management software will be developed "that in many cases will enable employees to make decision that they formerly depended on managers to make" (p. 166).

Given the ever more competitive and complex environment in which businesses operate it is probably not too far fetched to say survival will depend on not just proactively creating a culture, but continually striving to improve and make it second nature to all employees. In this regard, there is a lot to learn from IBM's experience.

As an example of how IBM's culture plays out in the real world, I asked a retired IBM Senior Engineer/Manager[18] to tell me his approach to management; i.e., what were his management skills that helped him be so successful. The appendix to this paper is his verbatim response. I believe it reflects in many ways the positive culture created by IBM over the years. Note in particular his last item about respect for the individual, one of Watson Sr.'s original values.

Creating economic value from knowledge

IBM has a long history of creating economic value from knowledge. You might say it started with Watson, Sr.'s admonition to his employees to

18) Worked in Technology Products Process Development with 28 plus years of service.

"Think"—an idea that soon spread throughout the company and seems to have become ingrained within the culture.

One of Watson's first act upon taking over the company in 1914 was to set up a product development department staffed with engineers "to dream up new ways of doing things…"; by 1935 IBM had 300 engineers working for it. Ten years later Watson set up the first corporate scientific laboratory at Columbia University. The idea was not just to engage in research with a direct application to IBM's business but also to come up with ideas that would better the world.

The small lab at Columbia was just the start of IBM investment in general research. The impetus for significantly further expansion was Watson, Jr. who, in the early 1950s, set up an independent research facility similar to the famous Bell Labs of AT&T. Although the aim of this research was, of course, to create economic value it didn't matter if some projects didn't lead anywhere since so many did pay off.

IBM was soon becoming a leader in scientific research as evidenced by its lead in patents and the number of its scientists receiving Nobel Prizes (five thus far).

Since the early 1970s there has been a consistent push to focus the research more and more on product development and, in 1980, IBM set up "joint programs" that married researcher with product developers—it proved a big success! Today IBM has nine research labs throughout the world and "dozens of hardware and software development centers."

Some of the other ways IBM has come up with to gain knowledge for creating economic value:

- *Collaboration with academia and the government*. IBM works with some 6,000 colleges and universities and, over the last five years (up to 2011 when the book was published), has invested more than $500 millions in these programs. A government collaboration example is

IBM's work with the Defense Advanced Research Projects Agency (DARPA) in association with some universities to create a compact computing system with human brain capabilities.

- *Collaboration within IBM*. IBM has pioneered in this area with one of the first intranets long before local area networks (LANs) came on the scene with it Professional Office System (PROFS). With the advent of the Internet and advanced software it has become even easier to share ideas within a company. IBM's policies also encourage people to work together and think creatively. For example in 2006 IBM's InnovationJam brought together more than 150,000 IBMers and clients and spawned several new business initiatives.
- *Collaboration with clients*. IBM has come to realize the value of working with its clients to not only improve customer satisfaction but to get ideas for new products for which there was a hidden market until then.
- *Gaining innovation through acquisition*. This is something that began with the venture capital movement starting in the late 1940s. It represents a quick way to fill gaps in a company's technology to better satisfy customer needs by buying up smaller companies. IBM's acquisition of Lotus Development Corp. during Lou Gerstner's reign to take advantage of its spreadsheet and collaboration technology provides a good example of this.
- *Open collaboration*. With the advent of the Internet and Web the potential for collaboration with almost anyone, regardless of where they are, has become a reality. Besides just being able to use the Internet for collaboration on any project, another form of collaboration is working together on open source software such as Linux. In fact Linux provides a good example of how IBM has taken advantage of this sort of

collaboration by making substantial investment in this system starting in 2000. IBM recognized that Linux would eventually succeed and eat into its equivalent business so the decision was made to partner with it and this has paid off since. It also represented a sea change from the way IBM had been doing business: now IBM would "participate in open source efforts for building-block technologies and differentiating itself from the competition with homegrown proprietary technologies built on top of them" (p. 194).

- *Collaboration across global systems*. It will be necessary to look for even more innovative methods of collaboration for the purpose of creating value amid the opportunities and challenges of the future. For example future research may take the form of combining multiple disciplines. An example is IBM working with Roche, a Swiss pharmaceutical company, to develop a way to quickly and cheaply map the genomes of many individuals to help doctors treat diseases. In this case a combination of research in the areas of nanotechnology, data analysis, and genetics is being used.

What can be said about how the business of creating economic value from knowledge will evolve in the future? According to the author of this part of the book (Hamm) IBM scientists see advances in three areas that will greatly improve our ability to create value from knowledge: computing power, understanding human cognition, and analytics[19]. It is suggested that future "analytic engines" will be almost human-like, knowing an organization's

19) One definition of analytics is "the process of developing optimal or realistic decision recommendations based on insights derived through the application of statistical models and analysis against existing and/or simulated future data." It draws on the disciplines of computer technology, operational research and, of course, statistics. (Wikipedia, May 2012)

capabilities in terms of its human and software resources; and therefore be able to greatly improve decision-making. As a result organizations will become more productive in achieving their goals. Given such advances in almost human behavior it will be important that such a capability be used "profitably, ethically and for the benefit of humanity."

Becoming Global

The idea of doing business globally probably began with companies that did trade with colonies in the 17th century such as the British East India Company. Eventually international business was no longer just "colonial" trade but trade with the entire open market. Then came the fully independent international corporations, but they still worked on the hub-and-spoke model with operations still managed from the home office. Post-WWII saw the rise of the multinational corporation with fully sufficient operations in each foreign area of interest. This was also a time when these corporations had to begin dealing more and more with tariffs, nationalized economies, and other complexities of doing business in foreign lands.

IBM's predecessor, C-T-R[20), was already doing business internationally but became even more global with Watson, Sr. at the helm. In 1924 Watson changed the name to International Business Machines to reflect this. By the time Lou Gerstner took over in 1993, IBM was a classic multinational with autonomous operations in almost 100 countries. Unfortunately these foreign subsidiaries were often *too* autonomous and often failed to work in harmony with the corporate headquarters. To correct this problem Gerstner reorganized IBM "around global teams focusing on a dozen major industries." Now IBM would no longer be a "country-centric, product-focused company" but "a global, client-oriented organization" and one much better able to respond to customers'

20) Short for Computing-Tabulating-Recording Company.

needs (p. 208).

The rise of the Internet and the ability of foreign companies to begin competing with American companies with equal or better services at less cost was a reason for IBM to once more rethink it's global approach to doing business. IBM soon realized it made sense to begin hiring more foreign workers and take advantage of what the best and brightest had to offer.

When Sam Palmisano took over in 2002 he began an even more radical reorganization of IBM by selling off commodity businesses and moving work into higher profit areas such as tech services, consulting, and software. He also began shifting a lot of work to low-cost countries and set up "global service delivery centers" around the world. Thus IBM was continuing to move closer to the ideal global organization: one "integrated through common values and processes" and able locate "operations and functions anywhere in the world based on the best mix of cost, skills and business environment" (p. 214).

A key issue is how do you coordinate such diverse and far-flung operations? IBM tackles this issue three ways: leadership training, good collaboration technology, and the use of special teams to help local managers. Also, a big factor is the IBM culture, which binds every IBMer to a common set of values no matter where they are.

As far as what the future holds, IBM expects the pace of international business to continue unabated with more opportunities opening up in places such as the Middle East and Africa—places not only as markets but as "nodes in its global talent network."

It is also anticipated that it will be necessary to work more and more with other businesses, governments, and universities to not only promote economic growth in countries but also enhance "global security and order." In other words, the complexity of today's world problems can no longer be handled by just business or government alone but will require joint efforts. IBM is sure to be in the middle of such joint efforts.

How Organizations Engage with Society

The world's problems make it imperative that businesses become involved in the betterment of society versus simply worrying about making a profit for their shareholders. Such involvement is not only for the sake of society but for the sake of the corporation too; as societies improve so does the business environment.

The book cites a classic example of how this works. In the mid-1990s Mexico's largest building materials company, CEMEX, began selling directly to individual Mexicans who wanted to build their own homes. By combining the product sales with financing and advisor/logistics services the program proved highly successful for all concerned. Typically construction time and costs were greatly reduced and the way of life much improved for hundreds of thousands of people. And, of course, CEMEX has developed a lucrative new market, which is now expanding into other Latin American countries.

As already mentioned, businesses can no longer operate in isolation. Economic growth and society betterment go hand in hand and require "governments, business leaders and individuals to work together to optimize those global systems for the health, wealth and sustainability of the whole" (p. 228).

The history of corporate involvement in "helping" society goes back to the days of people like Andrew Carnegie and their philanthropy. Watson, Sr. believed companies, just as individuals, had a social responsibility and showed this through both corporate philanthropy and being socially responsible as a company—e.g., by adopting progressive workplace practices such as being at the forefront of civil rights and protecting the environment.

Since then IBM has moved from just handing out money to direct involvement in such issues as clean energy, curing HIV/AIDS, developing more nutritious rice, and facilitating volunteerism.

No matter what, the modern corporation will play a major role in making society either better or worse. Most corporations will see the wisdom of the former—not just for society's sake but for their own success and, even, survival.

Conclusion

This part of the book has looked at how corporations, and IBM in particular, have evolved in the four areas of creating a culture, creating economic value, becoming global, and engaging with society. It is very likely that despite the progress to date, the world as it continually changes will required even more creative ways to address these basic corporate concerns. And, no doubt, IBM will be in the forefront of this effort.

4. Part 3: Making the World Better

Making the World Better by Jeffrey O'Brien is divided up into five parts: seeing, mapping, understanding, believing, and acting.

In this part of the book, O'Brien sets forth a way to make the world better based on these five steps. His purpose is to provide a way to move from the plethora of data available today to finding ways to use that data to actually make things better. In a sense it is simply another approach to problem solving. However, O'Brien seems to be focusing more on solving those *really big* problems that we continue to face in this modern world. And to take advantage of the remarkable advances in technology that have enabled us to "see," "map," and "understand" better and thus have the confidence to believe we can make a difference and, therefore, act on what we've come to understand. Most of this part is providing examples, many of which involve or have involved IBM. O'Brien calls this step-by-step procedure *smuba* for short.

Briefly *smuba* can be described as follows:

- Seeing: Collecting data about the issue of interest.

- Mapping: Organizing that data in a meaningful way.
- Understanding: Analyzing the data to make sense of it.
- Believing: Trusting the analysis to the point you're ready to act on it.
- Acting: Taking the action necessary to make things better through organization, collaboration, persuasion, etc.

Seeing

Our ability to gather data has increased immensely. We can now do things like use powerful telescopes to peer even further out into the universe and more mundane things like monitor traffic. Also the Internet has provided an enormous source of data right at our fingertips. Also we can look inwardly at things like what's happening within the human body. This remarkable ability is allowing us to see a reality never before available to us, something in the jargon called "augmented reality."

Mapping

When we map we are using the data we've gathered selectively towards some goal. One example given is the mapping done by John Snow during the 1850s to pinpoint the source of a raging cholera epidemic in London. Or how about the Dewey decimal system for organizing knowledge in libraries or the periodic table of elements?

Beyond these historical examples we can look at what is available today to help us organize our data into a meaningful map. The book cites the Structured Query Language (SQL) and the spreadsheet as powerful mapping tools now available. Also the powerful ability to come up with customized maps using Google Maps. Wikipedia, in a sense, is a massive map of all knowledge from which an individual can draw selectively for his or her own purposes. And networks like LinkedIn afford one the ability to "map" people of potential business interest. A classic and challenging present day undertaking is the mapping the human genome with far-reaching implications if successful.

Several other examples are given.

Understanding

Once we have the data organized in a map we want to see what useful information can be gained from it. An excellent example of understanding coming from mapping is the work of Norman Borlaug in the mid-twentieth century. He is famous now for developing disease-resistant wheat that may have saved countries like China, India, and Pakistan from famine. He did this by trying out different types of wheat and carefully recording how they did in various environments—and all this before modern-day computing was available.

A good example today is how Amazon organizes customer buying data in a way it can begin to make a good guess at what each customer might want to buy next and then suggest it to the customer.

One interesting example cited is Vextec, a company that has a database of "the world's known metals, ceramics, composites and plastics" (p. 288). With this information, Vextec has the ability to actually predict "the durability, performance and lifetime cost of machine parts by understanding the behavior of their component materials." The advantage of this is obvious: greater predictability in when a part might fail. Thus an airline for example will know when to replace a part before it fails.

The author discusses also the part predictive models play in understanding data. Before we had today's very powerful computers, it was necessary to keep such models fairly simple so they could be solved analytically. Now however we can use the brute force of computer power to rerun the simulation many times based on a less than perfect model and "erroneous conclusions tend to fall to the far ends of the bell curve" (p. 291).

Again, several other examples are given.

Believing

This part was not that clear. I wasn't sure if O'Brien was talking about the individual (or group) that has done the first three steps to believe in the merits of what they have learned or in getting *others* to believe. Perhaps it is both since he talks about Edison as an example of someone who not only believed in the light bulb but also worked hard to promote it with others so it could become a practical reality.

Also cited is President Kennedy's famous 1961 "moon-shot" speech that we would be landing a man on the moon by the end of the decade. Kennedy's belief that this was possible must have been based in large part on the remarkable technological advances that had been taking place and were considered possible at that time. The book traces these various advances starting with the work done on something called the Astronomical Calculator donated to Columbia University in 1945 by IBM. It turned out IBM played a major role in many of these technological breakthroughs. I think the point is that on the road to the goal of landing a man on the moon, a lot of data had to be gathered, mapped and understood, but it took someone like Kennedy to focus all that effort into action by getting enough other people to believe such a feat was possible.

Another example where it was necessary to get enough people to believe in something to be able to implement it (the act step) is a plan concocted to relieve congestion in the city of Stockholm. Although mostly resisted by the citizens of Stockholm because it involved a "congestion tax," a seven-months trial with the promise to hold a referendum after that convinced the citizens of the merits of the program which significantly reduced congestion and emissions and improved the quality of downtown life. One purpose of this example is to show the importance of leadership in getting others to believe in something.

Acting

Just as I had trouble understanding the last step of "believing," I found this one hard to distinguish from what O'Brien said about that last step. For example, he takes the reader through a couple of examples—Alameda County's (California) social services and the Memphis (Tennessee) police department—where it seems like those leading the effort are again doing the "believing" step by running pilot programs to gain consensus (belief) for the project.

However he does go into some good points about "acting" or running a complex project. For example it often may be better to make what he calls "pinpoint" interventions rather than trying for a wholesale intervention. He also stresses the need to make continuous reassessments as the project is in progress to see what we've learned thus far and how that might be applied as we go forward. Also the importance of strong leadership is discussed which includes being a good collaborator and communicator.

Some other points relevant to this step:

- As we move through this acting step we may find the situation has changed so much we need to consider taking unforeseen actions. An example given is a project to improve San Francisco's wastewater treatment facility—as technology was used to better monitor the facility, it turned out less maintenance people were needed. This was because faulty components of the facility were now less likely to fail before being detected by the computerized monitoring system. On the other hand more IT personnel were needed. Accordingly it became necessary to make significant adjustments to the skill sets employed (and deal with the associated ramifications).
- Given the ability we have now to gather massive amounts of data (the "seeing" step), issues of privacy and data security will become of more important than ever. Related is the need to do all we can to ensure our data doesn't fall into the hands of those who might use it for criminal acts.

- Realize that in solving one problem you may learn things that can be applied to other problems, even those in a completely different field.
- Finally, consider the *smuba* process as a continuous cycle; i.e., as soon as you've made the world a little better in one area consider using it again to make further improvements in that area. This point is reminiscent of the famous PDCA Shewart/Deming[21] Cycle, which is simply Plan, Do, Check, and Act.

5. Comments on the Book

Except for part 3 (*Making the World Work Better*), I enthusiastically endorse the book. The first two parts are most timely in telling the story of computing from its earliest days (part 1) and, using IBM as an example, how a large company can be successful (part 2).

Part 1, *Pioneering the Science of Information,* is a fascinating look at how far we've come in such a short time in being able to gather, process, and share information. It seems most appropriate that this part is written mostly around IBM activities over its last 100 years given IBM's role in developing information technology. In fact, arguably no other company has contributed more to the advancement of the field as should be evident from the book and, even, the summary provided in this paper.[22]

Part 2, *Reinventing the Modern Corporation*, I also found extremely interesting and believe worthwhile for anyone running a business. Its four perspectives—culture, use of knowledge to create value, going global, and social responsibility—are important and timely topics and provide much useful food

21) Walter A. Shewhart and W. Edwards Deming are famous for their pioneering work in the field of statistical process control and quality management.

22) I recall being told once that IBM was so well respected in the field of computing that a saying developed in business: "No one was ever fired for buying IBM."

for thought on how a big corporation or even smaller organizations can improve their chances at success. Although four topics are discussed it struck me that the most important one was developing a highly ethical culture—one that breeds a desire on the part of all members of the organization to not only be ethical but also strive to make the world better in whatever way they can. In a way it has much in common with the basic philosophy of total quality management (TQM); namely continuous improvement.

Part 3, *Making the World Work Better*, did not grab me like the first two parts. Even after rereading it I still came away with the feeling it was an interesting idea but one that was trying to justify itself versus being able to stand on its own. The idea of seeing, mapping, and understanding the data needed to help you solve some problem seems very obvious. And the author's steps of believing and acting again seem obvious prerequisites to accomplishing whatever goal might be in mind. In fact I felt the "believing" step could have been left out altogether as why would one go to all the trouble of the previous steps if you didn't have a strong belief that what you were doing was right?

Part three did provide a lot of examples of seeing, mapping, understanding, believing, and acting which might help someone get a better handle on doing these things in the course of solving some problem, especially a very large problem which is the author's focus.

In conclusion, I recommend anyone interested in computing and/or organizational change in a dynamic world environment read and study what this book has to say.

Appendix

Comments by a Retired Senior Engineer/Manager with 28 plus years of service with IBM regarding his management approach— an insight into IBM's culture

(Source: June 27, 2011 email to author. Verbatim with some abbreviated terms spelled out.)

1. I didn't try to be "chief engineer" of my departments, like some other managers did. I had well-paid and intelligent engineers and techs, and I didn't want to make them into "gofers."
2. I'd try to spend some time with each every day on their turf, allowing them to talk about whatever they wanted to. Could be job, family, etc.
3. I was blessed with some good bosses who gave me a lot of freedom. I was always honest with them – gave them my opinion, good or bad. Also, always backed them up, and tried to make them look good. In addition, never tried to BS upper mgmt. If we had problems, I'd give them the straight story, and outline exactly what we were doing to resolve them.
4. I was sort of an IBM "wild duck,"* but I flew in formation most of the time. I was known to subtly recruit good workers from other departments who I knew were unhappy or in an assignment that they were not really suited for. Also, when we had re-organizations, I'd manage to get some good ones and shed some that didn't really fit. The net was that the department was a pretty good team.
5. Every few years there would be a lengthy opinion survey, covering IBM, job, pay, management, etc. My departments always came out near the top in my particular organization. In my 24+ years in management, I had a number of different departments and a total of about 90 different people working for me over those years. Some were with me (their choice) for 10 to 15 years.

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*According to the book the IBM "wild duck" concept originated with a memo written by Watson, Jr. in 1959. Wild ducks are "rebels who sometimes buck the organization." According to Watson, "We are convinced that any business needs wild ducks, and in IBM we try not to tame them" (p. 160).

6. We didn't always get our particular assignments done on time, but the processes we developed and the equipment we installed were always in place and working properly prior to other steps in the manufacturing process. Thus, we were never the holdup.
7. One of IBM's key tenets was Respect For The Individual. That was mine also.