The Evolution of Innovation

By: Stephen M. Shapiro

Due to space limitations, this piece never made it into the finished book, *24/7 Innovation.* If you feel well informed about Taylor and his disciples, this section (which was intended to be an appendix) may not be for you as it covers a largely historical territory. However, if you are either less familiar with the evolution of business management, or you are interested in a concise history of management with some commentary, please read on. It provides some interesting insights into modern management principles.

From time immemorial, mankind has sought to improve the world of work -- how it's done, the effort it requires, and the output that results from it. The primary goal has been efficiency and productivity. No doubt Eve was able to pick apples faster and faster during her lifetime, and Noah surely became a better sailor the closer he got to Mount Ararat. But the methodical search for improvement in work only dates from the Industrial Revolution. Before then, craftsmen were always looking for better ways to carry out their chosen specialty but they did so in an unstructured way. They sometimes showed flashes of innovation but there was nothing scientific about their quest. Their knowledge and skills frequently died with them or were passed on in an oral and hence imperfect tradition.

The Industrial Revolution saw a surge of scientific discovery, and that led to respect for science and scientific methods. Innovation exploded. The Revolution gave birth to new machines and made people conscious of the way men and women worked with them.

But the Industrial Revolution did not happen overnight. It was, in many ways, more evolutionary than revolutionary. In truth, it took shape through a spate of inventions in mechanical engineering that transformed the processes of production for all time. To some, these events appeared ominous, as a dark spot in history, an uprooting of the happy peasant from his rural idyll, the half-timbered cottage with the rose-covered trellis, and a move to some vile urban tenement shrouded in smog. But most observers and participants saw the Industrial Revolution as an opportunity, as liberation from the animal squalor of penniless country life, an event that turned disenfranchised peasants into empowered consumers.

It was not until the 19th century that discipline began to creep into the management of those machines. Early records of 19th century show factories in many cases as pretty chaotic places with very obvious potential for improvement in efficiency. They crudely transplanted the individualistic methods of the cottage craftsmen into the broader community of the factory. They left individuals with specific skills in almost total charge of their operations. There was rarely anyone with overall responsibility for "managing" the process as a whole.

Taylorism

A few scattered experimenters had tried to put method into the mechanical madness, but their work had not amounted to much. One of the pioneers was a 19th century gunsmith, Samuel Colt, who applied methods of mass production at his factory in Hartford, Connecticut, in the production of pistols and other firearms. As a result, the handmade flintlock rifle became a thing of the past. At around the same time, Robert Owen was introducing innovative methods of managing a workforce at his cotton mills in the Scottish Lowlands. But his motives were primarily social -- aimed at improving the lot of the workingman -- rather than as a means of boosting productivity.

The man who changed all this, the father of management as we know it, was an American Quaker named Frederick Winslow Taylor, who, among other things, won the men's doubles at the 1881 U.S. national tennis championships. He was also an engineer.

Taylor's working life began at the Midvale Steel Works in Philadelphia. He joined the company somewhere near the bottom of the career ladder in about 1878 and was rapidly promoted so that he was soon put in charge of the machine shops. In that post he began his lifelong attempt to improve the efficiency of the workingman for the benefit of the company. At Midvale he claimed that workers only produced one-third of their potential. Gradually he developed what he called "the differentiated piece rate," a system of paying workers according to the quantity, speed and quality of their output, as measured against some benchmark.

In his most famous publication, *The Principles of Scientific Management*, Taylor described a situation that he had observed in a number of different factories: "In an industrial establishment that employs say from 500 to 1,000 workers, there will be found in many cases at least 20 to 30 different trades. The workmen in each of these trades have had their knowledge handed down to them by word of mouth through the many years in which their trade has been developed.... In hardly any element of any trade is there uniformity in the methods which are used. Instead of having only one way which is generally accepted as a standard, there are in daily use, say 50 or 100 different ways of doing each element of the work."

Taylor set out to impose greater method and uniformity on this randomness and he did it in what he considered to be the scientific way. He began by observing the way workers performed their jobs, then by measuring that performance, and finally by deducing ways it could be improved. He was the first to practice what Peter Drucker later enunciated so memorably, "You cannot manage what you cannot measure." Indeed, Taylor set out to measure and then to use those measurements to manage.

It was assumed, of course, that this cerebral activity could only be carried out by high-level minds. In other words, it could only be done by managers: the people who had the intelligence to stand back and measure. It could not, it was presumed, be done by workers, who had neither the intelligence nor the time. So the workers were told to get on with doing what they were told to do. Don't get me wrong, Taylorism was quite innovative. And his treatment of worked was appropriate at that time in history. It's just that this style of management is antithetical to individual innovation that is needed today.

In his book *Principles of Scientific Managemen*', Taylor wrote: "Managers assume the burden of gathering together all of the traditional knowledge which in the past has been possessed by the workmen, and then of classifying, tabulating, and reducing this knowledge to rules, laws, and formulae which are immensely helpful to the workmen in doing their daily work." Among other things, this helped to lay the foundation for the separation of managers and workers, of blue-collar and white-collar employees.

Scientific management was based on what was known as "the task system". Each job was assessed for what was considered to be "a proper day's work". In one instance, which Taylor described at some length, he found that men were loading steel at a rate of 12 to 13 tons a day. When he calculated the "proper" rate for the job, he decided that it should be 47.5 tons a day. Significantly, he did not actually describe how he made this calculation. Because the basis of this approach is around tasks, it is an example of "boxed" thinking, in which work is broken down into small pieces without worrying how the pieces fit together to make a finished puzzle.

This "factual" basis was then used as the grounds for calculating pay systems and for devising management sticks and carrots. The real gains in productivity came not from greater exertion on the part of workers but from the elimination of waste -- waste of workers' time and machine time through delays of misapplied effort and of failure in efficient planning for quantities of units to be produced.

Indeed, the elimination of waste is a recurring theme in the history of business straight through to re-engineering in the 1990s.

Before Taylor's scientific management, organizations had relied for the most part on the workers' initiative to come up with better methods. But this way of doing things was flawed in several respects. For one, it failed to systematize the improvements. There was no organizational learning. Taylor himself maintained that it was flawed because in 19 out of 20 factories "the workmen believe it to be directly against their interests to give their employers their best initiative". The real problem, though, was that no one was addressing either the boxes or the lines. The easy conclusion was to focus on the tasks rather than the interdependencies.

And this leads to the fatal flaws of Taylorism. In general, this system was built for a "solid state" business world, one in which things were fixed more or less for all time. It was time-consuming to perform the task analysis, and so things could not be easily changed. And so, prescriptive compositions were created for businesses that were like a Beethoven symphony designed to last for centuries, unchanged. And Taylorism was built on the fundamental assumption that there was a single "best way" of doing things, a way that all companies could achieve if only tried hard enough.

So successful and so influential was Taylor that his "science" of management won universal acceptance -- and we spent much of the 20th century trying to escape from the false sense of permanence it preached. It is only now that we are coming to terms with the fact that management is much more a "seat-of-the-pants" affair, much more like something that has to be improvised to some extent as it rolls along. It is not a "science" that can be mined for eternal truths.

Perhaps the only truth is that the effective management of human enterprise is a very complex undertaking with many parameters -- economic, political, scientific, personal and industrial skills whose relevance changes as society and the business world change. It is, in fact, much more like a bunch of musicians playing jazz. On no two consecutive days do they give the same performance, but good musicians consistently deliver quality music. The focus is on outcome. The improvisational nature of jazz is a model that businesses need to adopt in this age of rapid change and unpredictability.

Taylor's influence on management thinking did not die with him. His disciples Frank and Lilian Gilbreth pushed it further and developed the idea of "time and motion" studies while they ran a construction business and then subsequently an international consultancy. It is also interesting to note they raised a family of twelve children, two of who later wrote a best seller called *Cheaper by the Dozen*, which described the efforts of the couple in the emerging industrial world.

Gilbreth used photography to examine the movements that his workers made in carrying out their tasks. "Eliminating unnecessary distances that workers' hands and arms must travel will eliminate miles of motions per man in a working day," he wrote. "Each motion should be made so as to be most economically combined with the next motion, like the billiard player who plays for position." Gilbreth claimed that the methods of scientific management enabled him to increase the work rate of his bricklayers from 1,000 bricks per day to 2,700.

The Assembly Line

It is not surprising that in the fixed and measured world of scientific management it should have been an overriding aim of the work of both Taylor and Gilbreth to strip out innovation and personal initiative, to design processes and techniques that could be repeated identically and indefinitely. Management was left "free" to get on with improving other processes, leaving the ones that they had redesigned to be executed unquestioningly by their workers.

This was a "dumbing down" process for workers on the shop floor that took little advantage of human sensibilities

and creative potential. In Taylor's system, workers were generally needed only for their physical attributes – mostly their eyes, their legs and their hands. The idea was to reduce to an absolute minimum all thinking and unnecessary movement. Brainwork was for management; brawn work was for the rest. But this was perhaps an appropriate method for a time when education was not as universal as it is today. Many early factory workers came straight off the land from an agricultural upbringing that trained them for little other than sowing and reaping harvests. The idea of training workers for factory life was a mere side effect of the work of the pioneers of management thinking. Productivity was their real objective.

The apogee of this objective was the invention of the assembly line. The opening of the Ford Motor Company's assembly line at Highland Park, Michigan, came in 1913, just two years after the publication of Taylor's work and at a time when enthusiasm for Taylorism was at its greatest.

It has been suggested that Henry Ford's genius lay in marketing rather than in revolutionizing production processes. The argument says that by doubling his workers' wages (thereby enabling them to buy his Model T cars), Ford created the demand that justified the setting up of the assembly line. The Ford Motor Company's own official history differs. The official version suggests that the demand was already there, and at a level sufficient to justify the revolutionary new manufacturing system.

Ford's official history relates that, "By the end of 1913, Ford Motor Company was producing half of all the automobiles in the United States. In order to keep ahead of the demand, Ford initiated mass production in the factory. Mr. Ford reasoned that with each worker remaining in one assigned place, with one specific task to do, the automobile would take shape more quickly as it moved from section to section, and countless man-hours would be saved. To test this theory, a chassis was dragged by rope and windlass along the floor of the Highland Park, Michigan plant in the summer of 1913. Modern mass production was born!"

Operations Research

The use of quantitative, or scientific, methods in management moved yet again after World War II. The influence of military engineers returning to civilian life brought business measurement and precision back into fashion. With the invention and spread of mainframe computers came enthusiasm for Operations Research (OR), the use of computer models. OR showed managers how to apply scientific methods to decision-making. It combined engineering, management, mathematics and psychology to reach strategic decisions on critical issues. Operations Research grew with the capability of the mainframe computer and had its heyday in the 1950s and 1960s. It was a time when, as Russell Ackoff, a leading OR academic from the Wharton School, once put it, the "use of quantitative methods became an 'idea in good currency'".

During that time, no self-respecting corporation of any substance could be without an OR department. But OR specialists were highly trained and expensive. Most firms could not afford to hire their own experts, so OR helped speed the acceptance of the then-youthful management consultancy business.

Years later, however, Ackoff had radically revised his ideas. OR, he said, had by then been relegated to "the bowels of the organization, not the head". "When it could no longer be pushed down, it was pushed out." He suggested that this had happened because OR had been "equated by managers to mathematical masturbation and to the absence of any substantive knowledge or understanding of organizations, institutions or their management". Ackoff claimed to have found a basic flaw in OR. It was, he said, designed to "prepare perfectly for an imperfectly predicted future", and it "helps us little and may harm us much". That echoes my criticism of Taylorism, a system that was also designed to prepare perfectly for an imperfectly predicted future.

In the late 1950's, we saw the emergence of four critical business TLAs (three letter acronyms): TQM (Total Quality

Management), JIT (Just-in-Time), BPR (Business Process Reengineering), and ERP (Enterprise Resource Planning). These became the major drivers of business over the past 50 years.

TQM

Immediately after World War II, in addition to OR, we saw the emergence of Total Quality Management (TQM), led by W. Edwards Deming. As its name implies, its focus was on improving quality. Deming was an electrical engineer by training but he had worked during the war as a statistician for the U.S. government. His TQM ideas did not attract a great deal of attention at first, but Japan saved him. After the war, he was invited to Japan to talk about the use of statistical concepts in the control of production processes. The Japanese, concerned to shed their reputation for producing shoddy goods, aggressively adopted his message. For Deming held out the promise that if manufacturers could only manage the levels of variation -- measured statistically -- in various processes, they could significantly improve the quality of their goods. As he once put it: "I think I was the only man in Japan in 1950 who believed my prediction: that within five years manufacturers the world over would be screaming for protection. It took four years." Deming's methodology helped to improve Japanese companies' quality and productivity and to take the country to the top of the industrial ladder.

Deming's ideas were not entirely original. They had been largely developed in the United States by other statisticians, including Walter Andrew Shewhart, author of the pioneering work *Economic Control of Quality of Manufactured Product,* published in 1931. But American industrialists were slow to take these ideas to heart, and only came to adopt them once the success of the methods in Japan became apparent.

By then, the Japanese had adopted Deming as their own, as they had another American, J.M. Juran. It was Juran who introduced Japan to yet more ideas about quality, particularly about methods of quality control based on applications of the Pareto Principle (that 80 percent of the benefit comes from 20 percent of the effort). Japanese industrialists went so far as to establish a Deming Prize, an award that was bestowed annually on the company that made the most improvement in quality management.

And they expanded their ideas about quality into something that could only be described as a "movement," a movement that came to be known as Total Quality Management.

Central to TQM was one idea in particular that struck a chord with the Japanese, the idea of continuous and incremental improvement, of making small but significant steps forward every day, and all the time. The Japanese even had a word for this, *kaizen,* a term that was being used long before the arrival of W. Edwards Deming.

Kaizen has also been translated as "refinement," the process by which a rough diamond gets polished very gradually until it is turned into a top class gemstone. In Japanese culture, the idea of refinement has a particular significance. It is not, for example, considered to be the act of a copycat to take someone else's idea and to refine it for yourself. That is considered to be no less than a celebration of your environment and talents.

By the end of the 20th century, the concept of *kaizen* had become central to manufacturing improvement. Once engineers escaped from the feeling that process design was all about coming up with one "perfect for all time" solution, they were soon converted to the idea that it was really about improving and adapting. They then set about trying to come up with little changes, lots of them and often, changes that were to be largely wrought by the people who were actually carrying out the processes. A step in the right direction, for sure, leading to the approach I am advocating in this book, continuous innovation. And General Electric took this concept and institutionalized it as part of their Work-Out team problem solving process in 1988. This decision-making and empowerment approach is designed to resolve issues and improve processes by using a team of experienced, knowledgeable people with a

stake in the issue at hand. The team is chartered with developing solutions and action plans, and they are then empowered to proceed with implementation.

JIT

Just-in-Time (JIT) inventory management marked the next major innovative step in the streamlining of industrial processes. As its name implies, its objective was to reduce time (and offload costs) by only keeping enough inventory on hand to meet immediate requirements. First adopted in the early 1970s by Taiichi Ohno of the Toyota car company, the JIT system was soon being used by businesses around the world. Its main claim was that it reduced the need for each stage in the production process to hold buffer stocks. In that, it marked a quantum leap in the elimination of waste and costs. What it did was create the discipline to order parts only when they were needed. At the heart of the system lay the *kanban*, the Japanese word for 'card', but a very particular sort of card. A *kanban* JIT card is the notification that is sent to reorder a standard quantity of parts that have been used up in a production process.

JIT was central to the "lean production" system developed by Toyota, a production system that made the Japanese car company the most efficient automobile manufacturer in the world. Despite the fact that it was unable to reap economies of scale on the same magnitude as the giant European and American car manufacturers, Toyota was able to bring its costs per unit well below those of its rivals - thanks to JIT and the innovative excellence of its processes. This was a revolutionary achievement.

Over time, JIT came to encompass much more than a simple reshuffling of *kanbans*. In 'Operations Management', a 1997 book by Roberta Russell and Bernard Taylor, the authors describe its fuller manifestation: "If you produce only what you need when you need it, then there is no room for error. For JIT to work, many fundamental elements must be in place - steady production, flexible resources, extremely high quality, no machine breakdowns, reliable suppliers, quick machine set-ups, and lots of discipline to maintain the other elements. Just-in-Time is both a philosophy and an integrated system for production management that evolved slowly through a trial-and-error process over a span of more than 15 years. There was no master plan or blueprint for JIT."

BPR

Dr. Michael Hammer is the father of Business Process Re-engineering (BPR). Re-engineering was the first time that customers came to the forefront of business thinking. And it was also the first time that radical thinking was espoused. His concept was launched in an article in the Harvard Business Review in the summer of 1990. Entitled "Re-engineering Work: Don't Automate, Obliterate", written by Dr. Hammer, who at the time was a professor of computer science at the Massachusetts Institute of Technology (MIT). The article was followed by a book in 1993 written by Hammer and James Champy, then head of the CSC Index consulting firm. Called *Re-engineering the Corporation*, it popularized the idea of BPR and put it on virtually every corporate agenda in Europe and America. Described by the authors as a fundamental rethinking and radical redesign of business processes to achieve "dramatic improvements in critical measures of performance such as cost, quality, service and speed", BPR held out the promise of a novel approach to corporate change.

The technique called for analysis of a company's central processes and reassembling them in a more innovative and efficient fashion. Invariably that meant riding roughshod over long-established (though increasingly irrelevant) functional distinctions between areas such as marketing, production and distribution.

Vertically structured functional "silos" were too often protective of information, and of their own position in the scheme of things. At best, this was inefficient. Slicing the silos into their different processes and reassembling them in a less vertical fashion exposed excess fat and forced

corporations to look at new ways to make themselves more efficient.

One of the faults of the idea that the creators themselves acknowledged was that process re-engineering became something that managers were only too happy to impose on others but not on themselves. Champy's follow-up book was pointedly called Re-engineering Management. "If their jobs and styles are left largely intact, managers will eventually undermine the very structure of their rebuilt enterprises," he wrote in 1994.

This brought home the point that process orientation was not something that could be imposed on certain sections of a corporation while others were left untouched. It was something that had to be embraced by the whole organization – from the chief executive to the most humble warehouse worker. It involved the most radical change that a company's employees were likely to see in their working lives. But, most importantly, it involved all of them. And it involved them every day.

But even during this period of radical thinking, processes had still not shed the straitjacket imposed on them by Frederick Winslow Taylor. They still raised the specter of mile-high binders detailing the minutiae of process flows. And the aim of all process design was still to come up with the best possible process that could be repeated in exactly the same way every time.

And BPR has had no shortage of critics. Some saw it as a backward step, a return to scientific management, inevitably involving a drastic reduction in the scope for human initiative. Others saw it as a shallow intellectual justification for reducing headcount. And indeed it became closely associated in the public's mind with the large-scale lay-offs, first described as downsizing, then as it become endemic in 1990s management, "dumbsizing". This took place at more or less the same time, largely as a result of the recession that hit Europe and the United States in the early 1990s. Both were, in my opinion, unfair assessments of reengineering.

ERP

The biggest step in process management since the appearance of BPR in the early 1990s has been the widespread introduction of ERP, enterprise resource planning systems. These computer applications enable the sharing of information across the entire company and provide box-standard functionality that can be tailored to meet specific needs. The short history of ERP is dominated by SAP (System Analyse und Programmentwicklung), the German software firm that carved out for itself an extraordinary share of the market. Founded in 1972, SAP had a share of the market for ERP systems by the late 1990s that was greater than that of its five nearest rivals added together. At the time, its systems were reckoned to be running in at least half of the world's 500 largest companies.

Unfortunately, many (or most) companies used ERP systems as a way of slamming in automated best practices from a functional viewpoint. But this is certainly not the power of ERP, for these software packages can enable companies to integrate their information systems across the board. It can give them a view of their organization as a whole that they had never previously experienced. This was an opportunity to start looking at the lines connecting the various groups together. It was a bit like seeing the early color photographs of earth taken from outer space. It enabled, for example, the sales force to have access to the same data as the production function and to find out exactly what was available to sell. A useful thing for them to know, most people would agree. But up until this point, even companies that wanted to encourage cross-functional communication had been unable to do so because of the way that their databases had been built up over time.

Tom Davenport, the Visiting Professor at Tuck School of Business, Dartmouth College, and the current director of Accenture's Institute for Strategic Change, once cited the example of Owens-Corning, an Ohio-based manufacturer of building materials. Owens-Corning made a large

number of changes when it introduced its SAP system, changes that went beyond reconfiguring its information systems. For example, it identified certain key processes that it was able to re-engineer in the light of the new information available to it. And the company also "re-engineered" its headquarters building so that managers from different functions were better able to communicate with each other.

An early pioneer in this area is a company called Adaptec, an American hardware and software firm that realized that its SAP system would be far more effective if the information systems it was putting into place could be extended to embrace those manufacturers in Asia to whom Adaptec outsources almost all of its production. So the company set up an extended system that sent orders that were keyed into its own SAP network flowing directly into its partner companies' systems via the Internet. The effect was to cut several days out of the company's supply chain. This cross-enterprise integration is now becoming the norm, and is the first time companies are truly beginning to focus on the inter-dependencies (the lines) rather than the boxes (individual departments or companies).

As you know by know, this is not the end of the story. In fact, for this book, this is only the beginning. Innovation is not something new. It has been around for centuries. But often it has been limited to upper management or the back room. It is only in recent years where companies can honestly say there is a move toward a more organic, pervasive innovation. Innovation that takes place every day, everywhere, by everyone. 24/7 Innovation.

About the author

Stephen Shapiro is the author of *24/7 Innovation: A Blueprint for Surviving and Thriving in an Age of Change* (McGraw-Hill, 2002, ISBN: 0-07-137626-7, $29.95) and founder of The 24/7 Innovation Group. Previously, he spent 15 years at Accenture. During his last three years, he was based in London and led the firm's European Process Excellence practice. In 1996, he was one of the founders and directors of Accenture's Global Process Excellence practice. And he was one of the leaders of the firm's reengineering practice from its inception in 1992. Shapiro has advised many of the world's leading organizations, from BMW WilliamsF1, ABB and UPS to Lucent and Xerox. He has also collaborated with other thought leaders including Michael Hammer and Peter Keen, and is recognized as one of today's most influential consultants in the area of process and innovation. Articles by Shapiro have appeared in over two-dozen newspapers and magazines, and he was recently quoted in *The New York Times*. For more information, go to www.24-7Innovation.com.