AUTOMOTIVE QUALITY

Back to the Future At Ford

by **Larry R. Smith**

In the movie *Back to the Future*, Michael J. Fox travels back in time to the 1950s in a modified DeLorean. Once there, he must reestablish a certain sequence of events so he can move forward to the future.

Although he was not about to drive a DeLorean anywhere, Nick Scheele, COO of Ford Motor Co., announced in August 2001 the company would move forward by "going back to basics." In a September 2001 town hall meeting he was asked, "What do you mean by going back to basics?" To appreciate his reply, let's use a time machine of our own to go back in time and consider the major system trends that have affected American industry over the past three pivotal decades.

Although the timing and specific details of particular trends will differ from industry to industry, what Ford experienced in these decades is representative not only of the U.S automotive industry, but of U.S. industry in general (see Table 1), and provides lessons for us all.

In 50 Words Or Less

- **U.S. industry experienced dramatic change during the past three decades, and not all of it was for the better.**
- **By making the decision to move forward by going back to basics, Ford saw a 27% decrease in warranty spending and saved more than $2 billion with Six Sigma.**

Mass Production (1970s)

Taking advantage of a domestically captured market in the late 1970s, the U.S. auto industry was selling virtually every vehicle it could produce. Competition was among the Big Three, and the primary management focus was mass production, with an emphasis on reducing short-term cost.

In manufacturing, quality was primarily assured by inspection. Armies of inspectors randomly sampled parts produced in each department and made sure these parts met the required specifications. If they found parts that did not meet specifications, the operation producing these parts was shut down for repair, and the parts were rejected and sorted.

TABLE 1 Ford Timeline: System Overview

	1977 to 1980: Mass production	1981 to 1993: Competitive quality	1994 to 1998: Global economy	1999 to 2001: Niche markets/acquisitions	Back to basics vision
Management	• Mass production in a captured market, with Big Three competition. • Reduce short-term cost.	Emphasis on: • People (employee involvement). • Teamwork. • Processes. • Systems thinking. • Cost.	• Cycle plan. • Worldwide centers of excellence. • Common world vehicles and processes. • Customer satisfaction emphasis via added vehicle features.	• Emphasis on developing niche markets and acquisitions. • Push for youth and diversity in management (outside hires). • A, B, C ranking of people. • Bias for actions that provide rapid returns.	Emphasis on: • People and knowledge. • Teamwork. • Processes. • Systems thinking. • Cost/profit. • Eco-effective design.
Manufacturing	• Reliance on manufacturing experience. • Inspection department to find and contain defective product.	• Quality is job number one. • Q1: basic quality system. • Variability reduction using statistical process control (SPC) and design of experiments (DoE). • Process improvement. • Regular senior management quality meetings.	• Plant vehicle teams established for find and fix problem solving. • Focus on top 25 issues. • Advanced product quality planning, ISO 9000 and lean emphasis.	• Strategy of "seek, contain, repair" for product issues and improvement. • Implementation of lean and flexible manufacturing systems. • Short-term cost (not profit) focus. • Six Sigma used for find and fix.	• Q1: basic quality system. • Variability reduction using SPC and DoE. • Process improvement. • Lean/flexible manufacturing. • Six Sigma problem solving. • Regular senior management quality meetings.
Engineering	• Reliance on engineers with great experience. • Find and fix warranty. • Push on failure mode and effects analysis (FMEA) and basic reliability tools. • Design standards and verification manuals.	• Increased emphasis on "prevent." • Training and books available on statistics, learning organization, SPC, quality function deployment (QFD), DoE and Taguchi from world experts. • Increased interaction with customers, manufacturing and suppliers.	• Reorganized into platform teams; engineers rapidly rotate jobs. • Quality training centralized, but no longer taught by subject matter experts. • QFD replaced with marketing reports and activity.	• Program content costly and complex. • Emphasis on analytical models. • Heavy cost reduction focus and a cutting of programs. • Quality training available on the Web. • Push on FMEA and basic reliability disciplines.	• Q1 program for engineering. • A disciplined system to implement "prevent" quality methods tied to reward and recognition (design for Six Sigma). • Training and software on powerful, cutting edge methods of TRIZ and axiomatic design.
Suppliers	• Multiple suppliers for each part. • Most business sourced to the lowest bidder.	• Strive to reduce supply base and establish collaborative partnerships. • Increased interaction with Ford engineers in design, quality and cost. • Transfer of engineering competence to full-service suppliers (FSSs) begins.	• Supplier technical assistance reorganized under purchasing. • FSSs operate independently. • Supplier technical assistance (STA) staff greatly reduced; suppliers self-certify. • Cost reduction emphasis.	• Visteon becomes a supplier. • Further reductions in supply base emphasize lowest bidder. • Increased STA staff to deal with program issues.	• Longer term collaborative partnerships operating in a lean value stream.

It was the manufacturing foreman's job to produce and ship as many parts as possible. The system actually rewarded foremen who refused to shut down a machine for repair and slipped defective parts past the inspectors. So inspectors and foremen occasionally found themselves working against each other!

The burden on the inspectors was great because many processes were simply not capable of producing parts to specifications. In addition, many parts were manufactured using huge automated transfer lines, which were very costly to shut down and repair. If one station in a long sequence of operations was not performing properly, management had to either completely shut down production or find a way to deal with the problem offline.

In engineering as well as manufacturing, the corporation relied on engineers who had been in their jobs for up to 20 or 30 years and had great knowledge and experience. These engineers were a ready source of knowledge and on-the-job training for new hires. These same engineers were also responsible for current and future product and therefore split their time between finding and fixing warranty problems and working on new product development.

The new product development process was aided by the use of design standards and verification manuals—yellow notebooks that contained tabs for key product development disciplines such as failure mode and effects analysis (FMEA) and other basic reliability tools. The manuals provided a guide and a filing system for documents associated with various engineering activities and were periodically reviewed by management.

In the supply base, it was normal for a particular component to have multiple suppliers. These suppliers competed with each other for future business, which was often awarded to the lowest bidder.

Competitive Quality (1980s to early 1990s)

As a result of an oil crisis in the Middle East, the first few years of the 1980s were brutal for the U.S. auto industry. Ford lost $3.3 billion, or 43% of its net worth, from 1980 to 1983. Wanting smaller, more fuel efficient vehicles, Americans discovered Japanese vehicles, creating strong competition for automotive market share with an emphasis on quality.

Alan Gilmour, then VP of finance at Ford, said, "It became very clear to our management team that we were uncompetitive in every element of our business. We didn't have the cars people wanted to buy. We didn't have good quality, and our costs were too high. Furthermore, we had poor relationships with practically everyone—our employees, dealers, suppliers and the government."[1]

Louis Ross, leader of product development, said, "Imports in 1984 took 26% of the U.S. car market. So here in our home market, domestic auto manufacturers—and their supply base—are playing in the World Series, and … to score we have to be able to meet or beat the world's best in quality, in cost, in productivity and in product content."[2]

In the midst of this intense competitive and economic pressure, Ford literally experienced a renaissance. Guided by W. Edwards Deming, it began with the establishment of a mission, values and guiding principles (see "Ford's Mission, Values and Guiding Principles"). What made these definitions so compelling is that they came from the heart of the senior management team, who meant every word. They then walked the talk and expected everyone else to walk the talk.

The establishment of Ford's mission, values and guiding principles (MVGP) created an environment in which people, not technology or profits, became the key to success. Don Petersen, then president and chairman of Ford, said, "It's difficult to believe we can have a truly excellent product unless literally every process and activity in the company emphasizes quality."[3] The MVGP provided a framework for decision making, without which decisions would have simply been made by optimizing short-term cost.

Quality became the focus of everyone and every process. In manufacturing, senior management came to each manufacturing facility every month, spending one full day focused on quality. In business meetings, safety and quality items were first on the agenda—cost items were last. Basic standards were established for manufacturing quality systems. These standards were audited and formed the basic criteria for Ford's Q1 Quality Award.

Manufacturing operations became focused on reducing variability around significant product or process characteristics that impacted customers. The goal was to achieve manufacturing capability of 2 C_{pk}, or six sigma, using tools such as statistical

Ford's Mission, Values And Guiding Principles

Mission: Ford Motor Co. is a worldwide leader in automotive and financial products and services. Our mission is to improve continually our products and services to meet our customers' needs, allowing us to prosper as a business and to provide a reasonable return for our stockholders, the owners of the business.

Values: How we accomplish our mission is as important as the mission itself. Fundamental to success for the company are these basic values:

- **People:** Our people are the source of our strength. They provide our corporate intelligence and determine our reputation and vitality. Involvement and teamwork are our core human values.
- **Products:** Our products are the end result of our efforts, and they should be the best in serving customers worldwide. As our products are viewed, so are we viewed.
- **Profits:** Profits are the ultimate measure of how efficiently we provide customers with the best products for their needs. Profits are required to survive and grow.

Guiding Principles:

- **Quality comes first:** To achieve customer satisfaction, the quality of our products and services must be our number one priority.
- **Customers are the focus of everything we do:** Our work must be done with our customers in mind, providing better products and services than our competition.
- **Continuous improvement is essential to our success:** We must strive for excellence in everything we do; in our products—in their safety and value—and in our services, our human relations, our competitiveness and our profitability.
- **Employee involvement is our way of life:** We are a team. We must treat each other with trust and respect.
- **Dealers and suppliers are our partners:** The company must maintain mutually beneficial relationships with dealers, suppliers and our other basic business associates.
- **Integrity is never compromised:** The conduct of our company worldwide must be pursued in a manner that is socially responsible and commands respect for its integrity and for its positive contributions to society. Our doors are open to men and women alike without discrimination and without regard to ethnic origin or personal beliefs.

process control (SPC), designed experiments, product and process FMEAs and control plans.

Both manufacturing and business processes were studied and redesigned using a seven-stage process improvement methodology, which increased quality and productivity while saving millions of dollars.

Departments focused on establishing quality operating systems, which consisted of standardized processes with appropriate measures, with the intent of continuously improving the satisfaction of internal and external customers.

In engineering, the focus shifted from finding

and fixing problems to preventing problems in design. The following changes took place:

- A statistical methods office and statistical methods council were formed and met with Deming monthly.
- Opportunities were created for engineers to obtain master's degrees in quality and statistics from local universities because Deming believed not enough engineers understood these subjects.
- The Quality Education and Training Center and Ford Design Institute were established to create and deliver basic quality courses.
- Additional courses in quality and statistics taught by experts such as Stuart Hunter, George Box, Yoji Akao, Peter Senge, Dorian Shainen and Genichi Taguchi were also available.

Engineers were empowered to use these methods and solve problems. Many went out of their way to improve carryover designs in situations in which there were no formal funds budgeted for design work. Quality and cost improved dramatically, and Ford became a leader in the use of methods such as quality function deployment (QFD) and designed experiments.

Engineers were also encouraged to visit suppliers. Many improvements in both quality and cost came about as a direct result of improved communication between product engineering and the supply base. At that time, Ford purchasing made a real effort to reduce or eliminate multiple suppliers and establish collaborative partnerships.

The results from this activity were amazing. Employee morale was high, and Ford quality was the best of the Big Three.

Global Economy (mid-1990s)

The mid-1990s brought changes in management and management's focus. Deming had passed away, and many high level managers who had worked with Deming had retired.

Alex Trotman, Ford's new chairman and CEO, had a passion for new product and a global vision for how Ford could operate. He once remarked, "[I will] sell the bloody furniture before I cut out new product programs."[4] Management's emphasis was on the product cycle plan, with a special emphasis on European recovery, using worldwide engineering centers to develop common world vehicles from common processes. The strategy included the addition of more vehicle features as a means to increase customer satisfaction.

In manufacturing, it was decided problems could be identified and solved faster if product engineers were permanently stationed at the plants in the form of plant vehicle teams. They focused on the vital few problems associated with each vehicle line and made dramatic improvements in quality.

Process FMEAs and control plans were emphasized as part of an advanced product quality planning process. ISO 9000 and lean manufacturing were also emphasized. Monthly quality meetings still took place, but the responsibility for attending these meetings was delegated to lower levels of management. The strategy of variability reduction on significant characteristics and the use of SPC began to rapidly decline.

Product engineers were reorganized into a matrix system of management that emphasized vehicle platform teams. Once a vehicle was launched, the engineers were reassigned to a new area with a new platform team. A typical engineer no longer became an expert in a particular discipline, but instead changed positions and disciplines every few years.

Quality training was rewritten and centralized into one activity in which professional teachers, not subject matter experts, provided instruction. For the most part, these teachers had no previous experience in the various quality disciplines and could not answer detailed questions.

Supplier technical assistance (STA) was reorganized from quality to purchasing. More and more suppliers became full service and operated independently of Ford engineering, certifying their own quality. Purchasing found it could reduce cost by decreasing STA staff, allowing more and more suppliers to self-certify prior to production. Purchasing also strongly encouraged suppliers to aggressively cut costs.

Niche Markets and Acquisitions (late 1990s and early 2000s)

At a midlevel manager meeting in 1999, HR announced Ford was adopting a performance management program (PMP) that used an A, B, C system to rank management at each level, where 10% had to be rated "A" and 10% had to be rated "C." The A's received greater merit raises and bonuses. The C's received no raise or bonus and were given

remedial coaching and the opportunity to leave the company. If a manager received two C ratings in a row, the opportunity to leave the company was no longer voluntary.

When Jac Nasser became CEO of Ford, he pushed for youth and diversity in management, bringing senior level managers from Europe into the United States and hiring thousands of people from outside Ford and putting them into significant management positions.

Although bright and energetic, these managers were not familiar with Deming. They did not know Ford's U.S. culture and weren't familiar with what Ford had gone through in the early 1980s. And there was no way for them to learn because the MVGP and Deming's philosophy were no longer taught.

By this time, Ford had transformed into a company that was completely different from the one Deming knew. Where Deming advocated people and knowledge, 10% of the people were now considered deadwood. Knowledge and experience were not appreciated as they were before—it was believed anyone could do anyone's job anytime.

Deming advocated teamwork, and when someone had an idea, peers used to jump in to help. This level of teamwork diminished with the PMP system. Peers gained advantage by not providing the previous level of support to others who needed help. The culture became adverse to risk.

Deming advocated work on processes, but one of the new criteria for ranking people was "bias for action." This was interpreted as not working on processes because it was thought process related work took too long to see results. Process improvement activities and "prevent" work in engineering declined.

Bright spots for quality during this time included the introduction of Six Sigma, the emphasis on lean manufacturing tools and increased STA staff. Six Sigma made a huge difference in problem solving because it gave engineers training in basic statistics and provided them with powerful software.

Six Sigma was quickly accepted at Ford because senior management believed it had produced good results at General Electric and thought significant progress could be made in a few months. Lower levels of management, especially in the plants, had grown up during the Deming era. They desired a return to statistical thinking and believed Six Sigma could make it happen. They went out of their way to provide exceptional support and contributed to the success of Ford's Six Sigma effort.

STA staff dramatically increased because Ford was experiencing quality problems with suppliers that had self-certified. About 200 engineers were hired to work with the supply base and were given specially developed, fairly extensive training to develop their skills.

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Back to Basics

So what did Ford COO Nick Scheele say when he was asked, "What do you mean by going back to basics?"

"Going back to basics means building quality products on time and at the right price—with a value proposition that is absolutely compelling," he replied.[5] When shown a matrix similar to Table 1, Scheele pointed to the column labeled competitive quality and said these activities were what he intended by going back to basics.[6]

It blends a driving vision with a mission and guiding principles that lead to quality by valuing people, teams and processes. An ideal back to basics vision, shown in the right-hand column of Table 1, incorporates the best practices found over a three-decade period. It begins with the philosophy of Ford's original MVGP and has an added emphasis on eco-effective design—designing and building vehicles whose use improves conditions for human and the environment.

In manufacturing, the back to basics vision begins

with the implementation of a fundamental quality system (Q1 criteria) that is audited for effectiveness over time. It includes the notions of variability reduction, process improvement, lean and flexible manufacturing systems, Six Sigma problem solving and frequent attention from senior management.

In product engineering, an ideal vision involves the up-front implementation of a disciplined system that seamlessly integrates the "prevent" quality disciplines, such as design for Six Sigma. It includes the notion of measuring how well engineering is being done (a Q1 system for engineering) with appropriate rewards and recognition for progress. Training for engineers includes cutting edge methods, such as how to perform TRIZ (a Russian acronym for theory of inventive problem solving)[7] and axiomatic design[8] using the appropriate software.

The vision for the supply base involves implementing the basics in manufacturing and engineering to establish longer-term collaborative partnerships that operate in a lean value stream.

Results

Ford is making progress. Jim Padilla, Ford's current CEO and president, has identified the following vital priorities:

- Improve quality.
- Improve quality.
- Deliver exciting products.
- Achieve competitive cost and revenue.
- Build relationships.

The A, B, C system of ranking management is gone. Engineers have been reorganized back into functional groups, and a technical growth path has been emphasized to reward engineers who develop technical depth. A design for Six Sigma program is in place,[9] and process improvement is making a comeback with the return of quality operating systems and Six Sigma *kaizen* (an integration of Six Sigma with lean and *kaizen* methodologies).

In a speech at the Juran Center Quality Summit, Debbe Yeager, Ford's current director of Six Sigma, said Ford is experiencing major reductions in warranty spending (27% decrease from 2001 to 2003), impressive savings through Six Sigma (more than $2 billion since inception) and validation from external indicators.[10]

Chairman William Clay Ford Jr. recently said, "We have to get the fundamentals right before we move forward. Right now it's just three yards and a cloud of dust and it is not sexy, not fun. But I don't want the organization to get distracted, and in the past, Ford has been easily distracted."[11]

Ford is a great company staffed with fabulous people. I wish Ford and other corporations that have experienced similar trends a fond bon voyage as they progress by moving back to the future.

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LARRY R. SMITH *is senior vice president of design and innovation at the Juran Institute in Southbury, CT. He recently retired from Ford, where he held a variety of quality management positions over a 27-year period. Smith earned master's degrees in physics and metallurgical engineering from the University of Michigan in Ann Arbor and a master's degree in industrial engineering from Wayne State University in Detroit. He is also a Senior Member of ASQ and a national director for 2004-2005.*

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