Chapter 1

Quality as a Strategy

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In the early 1980s Motorola was losing market share to the Japanese competition in their core product lines—semiconductors, cellular phones, and pagers. Following visits to Japan, Motorola executives realized that the competition was producing better quality product at a lower cost. While Motorola was satisfied with an acceptable quality level, the Japanese were pushing for perfection. The conventional thinking was that the higher quality could only be achieved at a higher cost. The Japanese were proving this theory wrong. Bob Galvin, the chairman of Motorola, was determined to match and beat the Japanese, and so, in 1983 he initiated a Total Quality Management program. By 1987 the concepts Motorola learned from the Japanese and the Quality gurus like W. Edwards Deming, Joseph Juran, and others were adapted to their culture and labeled the Six-Sigma program. The result was a drop in defect rates from 6 per thousand in 1986 to 40 per million by the end of 1991. But Motorola did not stop at applying their TQM techniques to manufacturing. The same approach helped the corporate finance department close its books in four days instead of twelve and, service centers have cut their repair time from twelve days to seven. As a direct result of the program, new products are also brought to market quicker. In 1988 Motorola won the Malcolm Baldrige National Quality Award. In addition to the recognition, the results have also been spectacular. Motorola has regained market share and at the same time increased its profits.

In 1981, Marshall McDonald, the chairman of Florida Power and Light (FP&L), recognized that the utility faced a crisis. Costs were rising faster than regulators permitted rate increases. In addition, FP&L compared poorly to utilities in the other states. McDonald determined to transform it into the best managed utility in the United States. At the same time, Kansai Electric in Japan was performing impressively. The average FP&L nuclear reactor shut down five to seven times a year with false warning signals, whereas Kansai had no shutdown for the entire year; FP&L customers averaged 85 minutes of outage per year, but customers of Kansai averaged only 7 minutes per year. In 1984 Kansai had won the Deming Prize for Quality. This highly regarded prize, named after TQM guru W. Edwards Deming (see Chapter 2), is awarded only to the exemplary practitioners of TQM in

Japan. McDonald charged the president, John Hudiburg, with introducing the TQM concepts employed at Kansai to FP&L. Between 1986 and 1989 customer complaints declined 60 percent, lost-time injuries fell almost 70 percent, and the reliability had improved 30 percent. In 1989 FP&L won the Deming Prize for Quality—the only American company to have done so. In 1994 a Deming Prize review committee commended FP&L for the progress made over the five years. The Turkey Point nuclear plant, which had been rated one of the worst by the Nuclear Regulatory Commission, was rated among the best by 1993. In constant dollars, the cost of energy supplied by FP&L today is lower than at any time since 1980.

◆ THE GLOBAL BATTLEGROUND

Motorola embarked on its TQM initiative in response to competition from across the globe. FP&L adopted the TQM practices when it recognized that their customers got lower levels of service than utilities in other states provided their customers. Increases in world oil prices had forced them to raise their prices. But customer dissatisfaction was rising fast, and the state's Public Service Commission was pressing them to improve.

Other companies were faced with their own crises in the early 1980s. In many cases these crises were brought on by changes in the global business environment. For FP&L it was a global increase in prices, whereas for Motorola it was a global increase in competition.

Economists consider the trade deficit to be an indicator of manufacturing competitiveness. By 1986 the overall trade deficit for the United States was $170 billion (see Exhibit 1.1). Among those that had lost more than 50 percent of their share of the world market since 1960 were manufacturers of automobiles, computer chips, machine tools, televisions, and microwave ovens.

Dertouzos, Lester, and Solow (1989), as leaders of the MIT Commission on Industrial Productivity, studied eight major industries--automobiles, chemicals, commercial aircraft, consumer electronics, machine tools, semiconductors and computers and copiers, steel, and textiles. Of these, by 1987 only two (commercial aircraft and chemicals) had a positive trade balance. Exhibit 1.2 shows the trade deficits in 1987, comparing them to trade deficits ten years earlier.

The automobile industry is the largest industry in the United States. In 1970 more than 70 percent of all cars in the world were made in the United States. By 1987 both Europeans and Japanese built more cars, with the United States now third in automobile production. Consumer electronics—radios, televisions, and video recorders--are now dominated by the Japanese. The machine tool industry was also being taken away by the Japanese at the low end and the Germans at the high end. Japanese competition also threatened the semiconductor and copier industries. Xerox has successfully regained some of the market share it lost but only because it copied the TQM practices of the Japanese. Steelmaking capacity in the United States dropped to third place behind the Soviet Union and Japan. Today textiles are dom-

Exhibit 1.1

U.S. Trade Balance

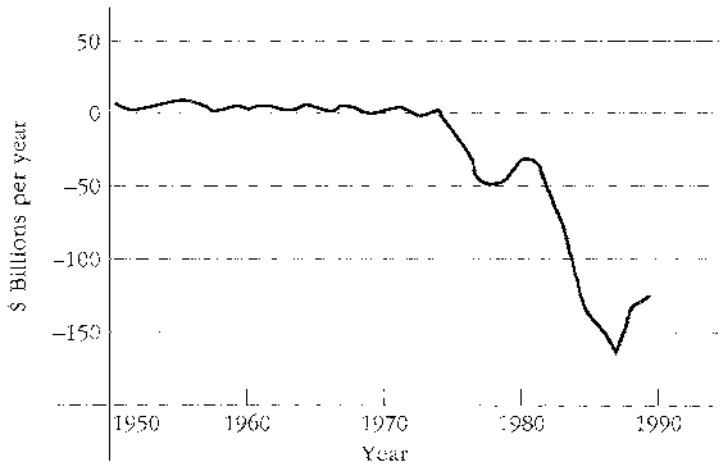


Exhibit 1.2

Trade Balances 1977 and 1987

Industry	Trade Balance in 1987 Dollars (billions)	
	1977	1987
Automobiles	(12)	(58)
Chemicals	6	10
Commercial aircraft	6	15
Consumer electronics	(4)	(10)
Machine tools	—	(1.5)
Semiconductors, computers, copiers	2	(15)
Steel	(5)	(8)
Textiles	(5)	(24)

source: U.S. Department of Commerce, International Trade Administration, Office of Trade Information and Analysis.

inated by Italy, Hong Kong, and Germany. The United States still dominates the commercial aircraft industry, but competition is increasing with the formation of Airbus Industrie by the British, French, and German governments. The U.S. chemical industry is also a success story. Competition is primarily from the large chemical companies in Germany (Bayer, BASF, and Hoechst) and England (ICI). Each is 30 to 50 percent larger than the largest U.S. company (Du Pont).

Although Japan has been a very effective competitor, other countries have also been successful competitors. Germany, for example, is a strong competitor in machine tools, textiles, and chemicals. England, Italy, France, and others each have industries in which they excel. As these foreign companies improve their earnings, they accumulate funds that they naturally invest. A prime target has been American firms, real estate, and farmland.

In 1988 the British invested almost $200 billion in the United States. The Japanese were second, with slightly more than $100 billion. Some of the Japanese purchases have been eye-catching. Mitsubishi bought Rockefeller Center and Radio City Music Hall; Sony Corporation purchased Columbia Pictures; Bridgestone bought Firestone Tires. Other purchases can put U.S. industry at a permanent disadvantage:

- Foreign companies own almost 25 percent of the American chemical industry. As a result, American companies no longer find it profitable to make commodity chemicals. So, they are redirecting their efforts to specialty chemicals.
- Almost all of the research and development is performed by manufacturing companies. When these companies are purchased by foreign interests, the innovations will be more quickly available in their countries, enabling their industries to build a technological lead over the United States.
- If better technology is available abroad, the Department of Defense may be forced to depend on other countries for armaments and materiel. This could compromise national security.

In their conclusions, the MIT Commission focused on two outdated strategies that contributed to the plight of American industry in the 1980s:

- Mass-production systems designed for large volumes of standard products, which encouraged maintaining a distance from suppliers and customers.
- Parochialism, which led to manufacturers concentrating on the large domestic market while ignoring foreign markets and foreign competitors.

Other studies have confirmed that these strategies are no longer effective. Over the years foreign markets have grown, and more companies have risen to satisfy that demand. As consumers are offered more choices, they become more discriminating. The sophisticated consumer is no longer satisfied with the standard product delivered by mass-production systems and created to satisfy the tastes of Americans.

◆ THE PIMS STUDY

One of the more comprehensive studies documenting the impact of product quality was conducted by the Strategic Planning Institute (SPI). SPI analyzed data

from 3000 business units collected over a two- to twelve-year period. The data consisted of

- The market conditions describing the size of the market, the rate of growth, inflation, and the distribution channels.
- The competitive position measured by market share and, relative to the competition, the quality, prices and costs, and degree of vertical integration.
- The financial and operating performance.

Then they analyzed the data to uncover the strategic actions that affected performance. They found that "In the long run, the most important single factor affecting a business unit's performance is the quality of its products and services relative to those of its competitors."

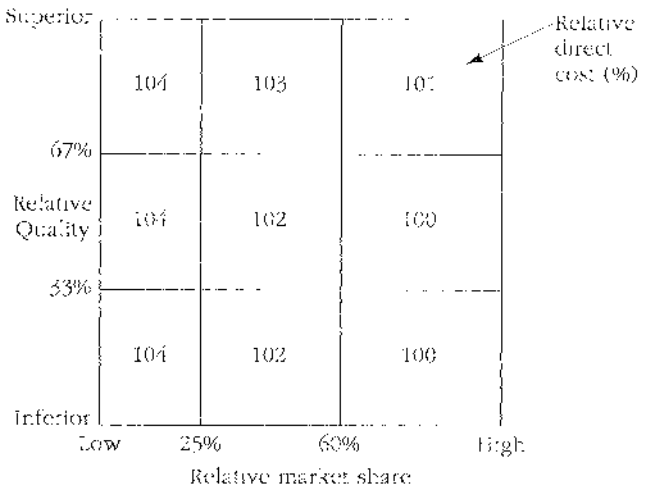
One reason why is that customers are willing to pay premium prices for superior quality. The 1989 ASQC/Gallup survey asked executives how much more they felt the average consumer would pay for a higher quality product. Answers ranged from a $20 premium for a $30 pair of shoes to almost $2700 for a $12,000 car. At all price levels the premium was at least 20 percent. The following incident supports their view:

> In the mid-eighties a person known to one of the authors wanted to buy a new car. Consumer Reports and other media were consistently reporting that GM quality was not as good as Toyota. So, she shopped for a Toyota and finally decided to buy a Corolla. At the time, the Corolla was being made in the New United Motor Manufacturing Inc. (NUMMI) in Fremont, California, as a joint venture involving GM and Toyota. The author encouraged her to look at the Nova which was made in the same plant. She saw it had the same design and it was $600 cheaper!
> But Toyota had the quality reputation. She bought the Toyota.

Another reason is that superior quality results in an increased market share. This may result in economies of scale that can drive down costs. Using a cost-cutting approach that sacrifices quality does not help. As an example, consider what happened to Schlitz in the early 1970s. In an effort to improve the bottom line, Schlitz reduced material costs, relying on lower quality hops, and shortened the brewing cycle by 50 percent. In the short term, the results were spectacular and significantly better than the industry leader Anheuser-Busch. But by 1980 Schlitz had dropped from being the second largest beer producer to the seventh. Even with a new formula Schlitz was unable to regain its former market share.

Significantly, the data also show that companies with the same market share but with superior quality products have costs that are not much different from those of their competitors (Exhibit 1.3). This may be because the costs of rework, scrap, and handling customer complaints and failures in the field are much lower. Lifeline Systems Inc. in Watertown, Massachusetts, improved its product quality, enabling it to eliminate its entire field service department.

Exhibit 1.3 Effect of Share and Quality on Costs



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◆ THE HISTORY OF QUALITY IN THE UNITED STATES

With such strong evidence of the competitive advantage of good quality, why did American management choose to emphasize alternative competitive strategies? The answer lies in the outdated systems mentioned in the MIT study and how they evolved.

At the turn of the century, the workplace was significantly affected by the works of Frederick W. Taylor, generally regarded as the Father of Scientific Management. The workforce at the time consisted mostly of new immigrants and displaced farm workers who had no understanding of the machinery they were expected to operate. Taylor suggested that the work be designed by engineers who would standardize tools and procedures. The worker was not expected to think but merely perform the work assigned. The quality of the work was the responsibility of the inspector. Large tasks were sliced up into smaller tasks, and each was assigned to a person. The result was a high degree of task specialization. Workers performed to meet the standards set by engineers, and managers and inspectors ensured the workers met the standards. Naturally, inspectors and workers often viewed each other as adversaries.

Task specialization also led to the introduction of the assembly line. It had made possible volume production of standard and interchangeable parts. As volume increased, the tasks would be sliced into still smaller units. The costs for material handlers to move materials from one operator to the next began to get inordinately high. Henry Ford decided to automate the material-handling task by introducing the assembly line. His adaptation of Taylor's ideas to the production

floor enabled him to reduce the cost of a Model T Ford from $850 in 1908 to $290. In terms of 1990 dollars, he reduced the cost from $12,000 to $2,100.

As products became more complex, inspectors were called on to do more than simply conduct a visual check of the parts. Checking dimensions required increasingly more sophisticated measuring tools. These tools had to be calibrated on an ongoing basis. The work for the quality inspectors was growing at an exponential rate.

In the 1920s inspection activities were formally recognized as a quality control function. Quality control was responsible for developing tools to check product dimensions and characteristics, detecting errors, and having the necessary rework be performed. It was assumed that the only way to ensure good quality was to inspect all of the items being produced.

It was at this time that Bell Labs hired Walter Shewhart as a quality control inspector for telephones. At the time the Hawthorne Plant had 40,000 employees, of which 5200 formed the quality control department. Shewhart studied the chronic variation of production. He suggested using statistics as a way of reducing the amount of inspection, and found that indeed this approach significantly reduced the amount of inspection that had to be done. Instead of checking the entire lot, only a sample drawn from the lot would have to be checked. This might mean some defectives could get shipped. Shewhart argued that if the number of defects was small, the savings in inspection costs would make it worthwhile.

Mathematical statistics made it possible to infer with a high level of certainty a range within which the true defect rate would fall. So, it was possible for the quality control inspector to make statements such as, "I am 95 percent certain this production lot has only 5 percent defects." If management would be satisfied with this level of defect rates, the inspection costs could be reduced substantially. This acceptable average defect rate was called the **Average Outgoing Quality Level (AOQL).** Reducing the AOQL could be achieved by inspecting larger samples. This meant more inspection would be performed, which in turn would raise the producer's costs. Raising the AOQL meant that more defective items were passed on to the customer, thereby raising the consumer's costs and resulting in dissatisfied customers. This tradeoff is captured by the Cost-of-Quality model discussed in Chapter 2 and described in more detail in Chapters 4 and 5. Management selected an AOQL to balance the costs to the producer and to the consumer.

Shewhart also recognized the importance of process control. He is reputed to have created the first **control chart** (an in-depth explanation of control charts is provided in Chapter 7). The control chart is used to monitor the performance of the process by periodically sampling critical aspects of the process, most commonly the output. Today TQM organizations agree that focusing on the process and ensuring it is in control is an effective approach to producing quality parts; the control chart is considered one of the seven basic statistical tools (see Chapters 6 and 7).

During World War II, the Defense Department needed to make sure arms and ammunition delivered to the front lines had a high level of quality. Since the statistical methods developed by Shewhart had not been widely disseminated through industry, the Defense Department was relying on the traditional approach of 100 percent inspection. As a result, the inspection process became a major bottleneck in the production of war materials.

Shewhart was convinced that the sampling techniques he had developed could have wider applicability. He proposed that the Department train all of the contractors in process control techniques and train the inspectors in acceptance sampling. After the Department decided that the latter approach was more expedient, 8000 people were trained in statistical methods for acceptance sampling by the end of the war. The number of inspectors required fell from 42 to 12 per million dollars of accepted material.

After the war, the initiative for improving quality remained with the Defense Department. Defense contractors learned of the statistical sampling methods and applied it to their processes, and some even applied the concepts of process control. Although they reported spectacular gains, these statistical methods were not readily accepted.

Perhaps part of the reason was that nondefense businesses were supplying customers in a booming American economy. In 1945 this economy made up 80 percent of the world market, and it retained a dominant share for the next 20 years. Business capacity was less than the demand. Thus, business could build standard products, supply them to the domestic market, and make good profits.

Foreign markets were small, and so were the foreign competitors. American industrialists surveying the world economy saw no significant competition. It appeared obvious that American manufacturers were more efficient than those of any other country. John Kenneth Galbraith, writing *The Affluent Society*, pronounced the manufacturing problem was solved.

The Defense Department continued to demand better quality. In 1961 it demanded and received from the Martin Corporation a Pershing missile with zero defects. Philip Crosby, another of the TQM gurus (see Chapter 2 for a detailed discussion of his philosophy), was in charge of the quality control activities for the Pershing. He proposed a broader approach to achieving zero defects, one that included behavioral changes in the organization in addition to using statistical methods. Despite his success with the Pershing, his ideas met with resistance from other industries.

Meanwhile, the Defense Department, recognizing that it could get top quality at delivery, pushed contractors to provide better quality over the life of the product. Just as quality assurance checks a product after it is made, so this new emphasis on reliability checked a product after it was put into service. Quality professionals concentrated on measuring quality after the product was made. As this thinking made its way into consumer goods, companies began to provide warranties and after-sale service and parts. The parts and service business proved to be very lucrative. As a result, the concept of improving quality by focusing on

process control and process improvement while making the product was pushed deeper into the background.

As competition started to increase, American managers complained that "the playing field was not level." They felt that the United States did not hold foreign competitors to the same standards. Many claimed the foreign competition was "**dumping**" products—selling them in the U.S. market for less than it cost to make it. They ascribed the lower prices to lower labor costs, suggesting the unions were to blame. The U.S. dominance in one industry after another eroded. First, it was the shoe industry, then textiles, and finally steel. By 1980 the competition was taking market share from the automobile and electronic component industries. Several companies conducted studies to prove the competition was "dumping" and to evaluate the impact of lower labor costs. Many of these studies concluded that the competitors truly were more efficient manufacturers and that this was largely a result of their obsession with quality.

One of the studies that struck home was conducted by Hewlett-Packard. In 1980 it tested 300,000 RAM chips from three Japanese manufacturers and three American manufacturers. The Japanese chips had a zero failure rate during incoming inspection, whereas the American chips ranged between 0.11 and 0.19 percent. After 1000 hours of use, the Japanese chips failed between 0.01 and 0.019 percent. The American chips failed between 0.059 and 0.267 percent.

Along with the Hewlett-Packard study, other studies confirmed the dominance of Japanese manufacturers in quality. It was also an eye-opener to realize these improvements had not increased costs. Toyota talked with 53 of its North American suppliers in 1990 and told them that if they wanted more business they would have to improve their quality and at the same time reduce costs. Although these suppliers had a defect rate of only 1 per thousand, their Japanese counterparts had defect rates of 10 per million.

◆ A NEW THEORY OF QUALITY

It was becoming apparent that the manufacturing infrastructure had a significant impact on the corporate strategy. Management could no longer use the same approach in every market in which it wanted to compete. Skinner (1969) argued for defining a **manufacturing policy** that could support the corporate strategy. Such a policy would require management to understand the many aspects of the production system, such as types of processes, the impact of plant location and facility layouts, planning and control systems, and ways of motivating and organizing the workforce.

The first step toward defining a manufacturing policy is to establish a viable competitive edge that differentiates the company's products. Most managers can think of several specific elements, such as lowest cost, best quality, many models, readily available goods, ability to adapt to technological change, and reliable product. These elements can be categorized along four dimensions:

- Cost or efficiency of process that would result in low-cost product.
- Quality implying the product would have greater functionality than the competitors, consistently meet the designed specifications, and perform well in the field.
- **Dependability** of delivery so commitments to customers would be met with a high degree of reliability.
- **Flexibility** so new models could be created quickly in response to customer needs and technological changes.

In 1969, Skinner postulated a **tradeoff model.** He argued that a company would have to trade off performance in one area to excel in another. For example, with respect to quality he posed the tradeoff as "high reliability and quality or low costs"; in other words, improvement in one area would result in a degradation of performance in other areas. This model prevailed for years. Shorter lead times could be obtained by building inventory, which meant increased costs; increased flexibility required more capacity and general-purpose machines which would also increase cost, and so on.

In 1980 the Japanese proved that the tradeoff model was flawed. In comparing Japanese and American automobiles, it was clear that the Japanese had lower costs (one study showed a car from Japan cost $2000 less landed in California than the comparable American car), better quality (see *Consumer Reports* assessments over several years), and better flexibility (time to market for a new model was three years compared to the U.S. norm of five to seven years). American industry, relying on the tradeoff model, assumed that an improvement on any one of these dimensions had to be accompanied by a deterioration on another. The tradeoff model could not explain the ability of the Japanese to improve their performance on multiple dimensions.

During the 1980s, researchers of manufacturing policy wondered whether such improvement could be obtained by working simultaneously on all fronts or whether there was a hierarchy. In other words, in order for a company to improve in any one dimension, did it have to improve in other dimensions as well?

One fact seemed evident: improved quality practices could result in lower costs, but practices aimed at lowering costs did not usually improve quality. The experience of Schlitz Brewing described earlier was an example of lower costs achieved at the expense of quality. There appeared to be a hierarchical relationship between cost and quality. Perhaps, they theorized, there was a hierarchical relationship between the four dimensions.

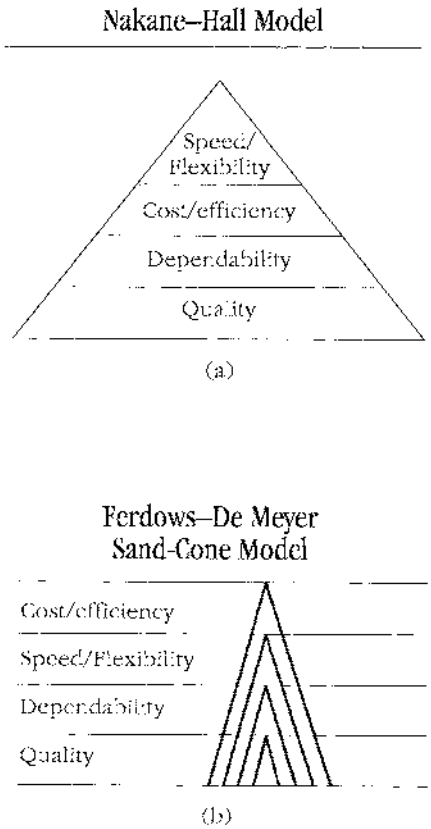
Nakane (1986) proposed a **cumulative model,** which suggested that quality was at the base of all improvements (Exhibit 1.4a). Once quality had reached a critical level, then dependability could be improved. Next, the company could improve cost efficiency and finally speed or flexibility. Each dimension of improvement was a slab of a building block. If the company emphasized cost reduction, that slab would grow too large for the slabs below it (quality and dependability) to support it. So, in the long term, the cost reductions could not be maintained. Conversely, if

the foundations were broadly built, management could focus attention on the next layer, improving it before having to further improve the foundations.

This pattern was followed by some of the more formidable Japanese competitors. After World War II these companies, urged on by General Douglas MacArthur, initiated quality programs. Known across the world for their shoddy consumer goods, the Japanese were not a significant competitive threat. As their quality improved, they moved up the pyramid to dependability and then cost efficiency with Just-In-Time systems. Improvements in each of these dimensions are so closely synchronized that the systems are often termed Just-In-Time/Total Quality Control. More recently, these companies have built a competitive edge in flexibility by bringing more new products to market sooner than their competitors.

Ferdows and De Meyer (1990) have proposed a **sand cone model** (Exhibit 1.4b). They also argue that quality is the basis of any subsequent improvement. Once a base of quality is constructed, management can build the sand cone

Exhibit 1.4



higher by focusing on dependability. But while improving dependability they have to continue to improve quality. The company should next focus on speed. Again, while improving speed, more sand has to be poured on the cone to improve both quality and dependability. Improving cost efficiency is the last to be improved and would require continuing improvements on each of the other three dimensions.

Put another way, to get a 10 percent improvement in costs, management should get a larger (15 percent) improvement in speed and a still larger improvement (20 percent) in dependability, with the largest improvement (30 percent) in quality. But this would only be so if the company was already pushing its performance on each of these characteristics to the limit. If there were obvious inefficiencies such as poor factory layouts or being locked into unfavorable contracts, then cost could be improved without concurrent improvements in other areas.

The two models are similar, but what is especially interesting is that both postulate that quality is fundamental to any improvement that can be expected to be long-lasting. And without quality having achieved a critical level, improvements on any of the other dimensions would not be sustainable.

It is instructive to look at the activities Ferdows and De Meyer considered to be part of an overall quality program:

- More planning responsibility for workers
- Zero defects
- Value analysis/product redesign
- Group technology
- Narrowed product lines/standardization
- Vendor quality
- Reconditioned physical plants
- Flexible manufacturing systems
- Process Statistical Quality Control
- Quality Circles

The primary focus of all these activities is the shop floor where the purpose is to make products that conform to a product design. But TQM represents a much broader group of strategies. These are more completely identified by other research, notably that completed by the MIT Commission on Industrial Productivity (1989).

◆ THE MIT COMMISSION FINDINGS

The MIT study completed in 1987 was one of the more influential in directing American management to the causes underlying declining competitiveness. The study found significant weaknesses in areas of research and product development, production, and cooperation within the organization, with suppliers and with customers.

Research and Product Development was lacking in two areas: **Design for Manufacturability** and **Project Management.** The Design for Manufacturability approach recognizes that products designed for ease of manufacture lead to fewer **internal failures** (defects occurring during the manufacturing process). American engineers did not consider in their design what could be done to make the product easier to manufacture or service. And the internal failure rate is strongly correlated with **external failure** rates (defects occurring once the product reaches the hands of the customer). A study of internal and external failure rates by Garvin (1988) supports this relationship. Project management refers to the systems, the organization structure, and the policies used to develop new products and new processes. In this area too, the MIT Commission study noted that Japanese engineers were more effective. They spent 50 percent less engineering time than their American counterparts in bringing a car from concept to market. One crucial difference was the assignment of a strong project manager at the design stage. This person would insist on clearly defined objectives and roles at the start of the project. In order to accelerate the time to market, the Japanese scheduled many of the development activities to take place simultaneously. This increased the requirements for communication between functional groups. It was the responsibility of the project manager to facilitate the flow of information.

Production placed less emphasis on process improvements than did the Japanese and the Germans. The Japanese allocated a larger percentage of the research and development efforts to improving the process technology than the Americans. They also organized their process improvement specialists so that they would be closer to where the improvements would take place. Typically, American companies would locate the technical experts in the process at the corporate office. Whenever a problem arose at a plant, it would request help from the corporate group. A technical expert would be sent to the plant when that person became available. Typically, the Japanese located their technical specialists at each plant. When a process problem occurred, the technical specialist was immediately available. The Japanese also encouraged their workers to tinker with the process to improve its efficiency. In contrast, the Americans, discouraged such tinkering unless the process was not functioning well. In Germany, the users were encouraged to work with the suppliers of machine tools and help in their development. The lack of interest in the production process led to American industry being less inclined to experiment with technically sophisticated equipment. As a result, the technological expertise and the infrastructure needed to support the machine tool industry are far better developed in countries like Japan and Germany.

The overseas competitors also worked more consistently at altering the processes designed to improve product quality and reliability. The Japanese closely monitor the performance of products in the hands of the customer. The product is redesigned to make it more usable, and the process is redesigned to ensure conformance to customer needs. British Steel has salesmen work with production engineers, describing what the customers want and what the competition

is doing to satisfy them. Contrast that to most American companies where marketing and manufacturing coexist with difficulty.

Cooperation with business allies, specifically with labor, with suppliers, and with customers, was weak. In the United States the relationship between labor and management has traditionally been hostile. Labor practices (discussed in detail in Chapters 11 and 12) such as **cross-training** and **participative management,** which have been employed successfully in other countries, have had trouble making headway in the United States. But, the Commission noted, these practices were beginning to spread. In dealings with suppliers American management takes an adversarial approach. Other countries such as Japan, Germany, and Italy have a more cooperative relationship. They share information about the market, consumer needs, and methods for cutting costs and maintaining quality. When Honda opened its facilities in Marysville, Ohio, it arranged a cooperative relationship with suppliers such as Inland Steel. Honda worked with Inland to improve Inland's product quality, and Inland suggested ways for Honda to improve the stamping process. Such close relationships result in improved quality as well as lower costs. These companies also maintain stronger links with their customers. This approach has profound implications for new product development, for most innovations originate from the users (von Hippel, 1988). Companies get ideas for enhancing existing products by seeing how the customer uses the product and by incorporating the changes customers suggest. Mansfield (1988) collected data showing that one-third of Japanese R&D projects resulted from users' suggestions. For American companies the figure was only one-sixth.

◆ THE NEW MANAGEMENT APPROACH

The United States' reduced ability to compete and the subsequent studies (some of which are described above) indicated that management needed to take a different approach. Teams of American managers went to Japan to see for themselves what was at the basis for Japanese success. They found that the Japanese attributed much of their success to two Americans– Deming and Juran– who had shown the Japanese how to improve product quality. Now Deming and Juran were asked to teach their fellow Americans.

The philosophy they preached was called Total Quality Management (TQM) by the Japanese and is described in detail in Chapter 2. Some of the more significant factors are themes you will see throughout this book:

- **Productivity** used to mean product shipped on time and workforce fully utilized. With a workforce having people specializing in certain tasks, the focus was on process engineers designing assembly lines that were balanced and on production planners making sure each workstation had enough work. The TQM approach is to ship good product on time. If the product does not meet quality standards, it will not be shipped, even though the delivery targets for the month will not be met. And if workers are idle, they are encouraged to

perform other tasks rather than make parts that will be inventoried because there is no demand for it as yet. The tasks may be housecleaning or participating on a process improvement team or learning new skills.

- **Innovation** used to mean engineers would sit in their lab creating new designs that were transferred to manufacturing, which had to design processes to make it. Manufacturing in turn would deliver the product to marketing which had to come up with ways to sell it. Innovation for a TQM organization starts with the customer. Engineers are encouraged to meet the customer to see how the product would be used and to harvest their suggestions. Cross-functional teams are formed to specify the quality characteristics of the product or service that will best meet the customer's needs. Since customers' needs change over time, bringing ideas more quickly to the market is crucial. The time from concept to market for new automobiles used to be five to seven years. Recently, Ford took the Mustang from concept to market in just 38 months.
- **Problem solving** in the old approach required management to detect the problem, affix the blame, punish the culprits, and fix the problem. The rewards were for solving the problem quickly and not necessarily in the most effective manner. This approach gave rise to a trial-and-error approach to problem solving. In order to reduce the occurrence of problems, management would introduce increasingly sophisticated control systems. That, in turn, created an adversarial environment as workers would try to outfox the control systems. With TQM, problem solving is everyone's job. When a worker identifies a problem, he or she is encouraged to solve it or form a team with the necessary skills. Workers are also trained to collect data and analyze them. Management's role is to coach and provide resources to fix the problem. The emphasis is on process. The underlying assumption is that a consistently applied good process will provide consistently good results.
- **Customer satisfaction** in traditional environments means that the specifications and standards for a task are prescribed. The worker does the job and is rewarded for meeting the standards. In a TQM environment the job is not done until the customer is satisfied. The onus is on the worker to find the needs of "the customer." The worker on the line is trained to think of "the customer" as the next person on the line. The job is done only after the customer inspects the items delivered and pronounces them satisfactory.
- **Change** in the old approach was often a reaction to a crisis. Management would deploy new methods and reorganize in order to achieve the big breakthrough needed to maintain profits. Change was massive and frequently driven from the top. With TQM all employees are encouraged to initiate change and learn to do what they are doing better. Key processes are benchmarked to identify performance gaps. There is a constant push to close the gap. If the gap is small, the focus is on incremental improvements. In the case of large gaps, a breakthrough project is defined. Employees are encouraged to take a proactive approach to problems

◆ TQM AND THE CORPORATE STRATEGY

Walter Kiechel of *Fortune* magazine (Reimann, 1992) notes that the problem for strategic planners is that many of their plans were never implemented. But he notes that TQM with its focus on implementation has resulted in significant changes to the organization. Kiernan (1993) developed a model of the Strategic Architecture in which he incorporated TQM as a way of executing strategy. The strategy itself is based on an analysis of the market and the customer's needs, and the sources of competitive advantage. After a generic strategy is synthesized and honed for execution, he suggests several core elements to enable execution. Aspects of TQM that are included are:

- Empowerment/Diffused Leadership
- Organizational Learning
- Innovation /Experimentation

Empowerment recognizes that all of the firm's employees need to work together to meet the challenges faced by the company in what Kiernan terms the posthierarchical organization. As an example, he describes empowerment at a Brazilian machinery manufacturer, Semco. The organization had 11 layers of management which has been reduced to only three. Workers are organized in self-managed teams. They are responsible for making most personnel decisions even including salaries, and they also set work schedules. To do this effectively, they are given financial and performance data, and they are trained to interpret it. The example is similar to happenings in many other companies—fewer layers of management and more information to the workers.

Organizational learning reflects the ability of the organization to learn new concepts and adapt them effectively to their unique business environment. It is fostered by encouraging teamwork, communication across functions, and a willingness to communicate with business allies to improve performance. Kiernan describes three approaches to facilitate learning:

- **Benchmarking** to look outside the organization and find who (not necessarily a competitor) is achieving better performance of a process.
- Customer **feedback,** particularly from the people in closest contact with the customer such as salespeople and field service technicians.
- Temporary job assignments between departments and also with business partners such as suppliers and customers.

The emphasis is on encouraging people to work in teams, learn from each other, and understand what needs to be done to introduce the change and make it part of the daily practice.

Innovation/Experimentation is an attitude organizations fuel through an inspiring vision and support of practices that celebrate experimentation and through

toleration of failures that can result. The successful innovators bring products/services to market quickly so that they can be tested quickly. The feedback is incorporated in the next design. 3M promotes a company policy requiring that at least 30 percent of its products be less than five years old. Sony and Mitsubishi set **sunset dates** when the product is introduced; this is when the product will be replaced by another product. By formally placing a stake in the ground, they encourage work to start immediately on replacement products. These products are categorized as improvement of the old version, a spinoff, and something totally new. Potentially, when the product is removed from the market, three new products may be introduced. Panasonic replaces products with new models on a 90-day cycle, and as a result, there has been a greater range of choices. Goldman, Nagel, and Preiss (1994) refer to a new level of **segmentation,** with companies targeting "**niches** within niches." Bicycling shoes used to cater to a niche within customers for sneakers. Today they have specialized for racing, riding, off-road, and track and are matched to pedal-and-shoe locking "systems."

◆ DOES TQM WORK?

There is plenty of anecdotal evidence to indicate that TQM can improve performance. David Kearns as chairman of Xerox Corporation initiated TQM when his company began losing market share to the Japanese. After six years, manufacturing costs were down, defective parts decreased from 8 percent to 0.3 percent, and Dataquest reported customers rated them No. 1 in product reliability and service. More importantly, Xerox regained market share from the Japanese without the help of any tariff or trade protection from the federal government. 3M at its St. Paul, Minnesota, plant over a two-year period cut waste in production by 64 percent, reduced customer complaints by 90 percent, and raised production by 57 percent. Profits skyrocketed.

Several surveys have also been done on TQM. One, conducted by the General Accounting Office (GAO), surveyed 20 of 23 companies that had received site visits to evaluate their application for the Baldrige National Quality award. The GAO examined company performance in terms of

- Employee relations
- Operating procedures
- Customer satisfaction
- Financial performance

Employee relations is a key indicator of workforce participation. The study focused on employee satisfaction, attendance, turnover, safety and health, and number of suggestions made to improve quality. The average rate improved on all measures. Not all companies, however, always reported an improvement. For example, one company found employee satisfaction had declined, but it attributed this finding to concern about a merger.

Operating procedures were measured along eight dimensions ranging from errors to cost savings to timeliness of delivery. Only two companies reported a decline in one of the dimensions. One of the negatives was a company reporting a 0.1 percent decline from a high percentage of 97 in on-time delivery. Another was a company reporting declining inventory turnover because of a weak industry demand; however, its turnover was better than the industry average.

Customer satisfaction was measured using overall customer satisfaction indicators as well as customer complaints and customer retention. Overall customer satisfaction did not decline for any company. One company did receive more customer complaints, but that was a result of implementing a new complaint-handling system. Customer retention also generally improved, with only two companies noting a slight decline. Four companies experienced no change, but they already had a high retention rate of 90 to 100 percent.

Financial performance was measured in terms of market share, sales per employee, return on assets, and return on sales. The annual average increase in market share was 13.7 percent. Two companies suffered a decline but had since recovered the lost market share. Sales per employee improved in all reporting companies by an annual average of 8.6 percent. Two companies, both of which were in intensely competitive industries, experienced a decline in return on assets and return on sales. The average annual increase was 1.3 percent in return on assets and 0.4 percent in return on sales.

The GAO report concluded that "total quality management is useful for small companies (not larger than 500 employees) as well as large (more than 500 employees) and for companies that sell services as well as for companies that produce and sell manufactured products."

Another report (Hiam, 1993) was commissioned by the Conference Board in 1993. This report reviewed 20 studies whose results were published between 1989 and 1992. The author concluded that, while TQM can work, some approaches for introducing TQM are better than others. In addition to the GAO study reviewed above, two studies were not industry specific and represented different viewpoints:

- Booz, Allen, and Hamilton studied approximately 30 service companies. They were studying the possibility that TQM is more applicable to manufacturing companies and that the response from service companies would be different.
- Sirota and Alper studied all of the employees at 30 companies. Theirs was the only one to include workers as well as managers.

The Booz, Allen, and Hamilton study of service companies listed seven common problems:

- Lack of leadership from the top
- Lack of an overall direction to guide the incremental improvements
- Use of a generic model rather than adapting the model to the company culture
- Quality metrics that were not focused on the customer
- Training with a narrow focus

- Lack of support for implementing the quality process after people have been trained
- Assigning quality to a separate department rather than making it part of the daily work

Interestingly, these problems could just as easily apply to manufacturing companies. The research concluded that if these problems were avoided, "TQM can be the right management approach for changing behavior and performance."

Sirota and Alper's study of employees at 30 companies identified 12 elements of corporate culture that had to be addressed if a TQM program were to reach goals of quality and customer satisfaction. They concluded that TQM programs that did not affect a change in the corporate culture but used a "tools and techniques" approach did not maintain a sustainable improvement. Responses to questions were compiled by category—management, exempt, or nonexempt.

Two questions, in particular, were considered to be key indicators because of the responses generated. One question was: Do you agree with the statement: "Prevention is truly emphasized in Company X; that is, we act to prevent quality problems from occurring rather than 'fire fighting'"? This question received the most negative responses. Forty-eight percent of the managers and 38 percent of the nonexempt employees disagreed. The other key question asked if employees feel top management is highly committed to quality. Only 42 percent of managers felt this was so, but 57 percent of the hourly employees agreed. Exempt employees were the most skeptical, with only 27 percent agreeing. The study concluded that "Most of the companies we work with are not making the types of cultural changes necessary to have a significant impact on their quality, customer service and performance."

The most comprehensive study was conducted by Ernst and Young and the American Quality Foundation; these results are described in more depth in Chapter 2. The study categorized companies by performance level, and then, based on a company's existing performance level, specific practices were prescribed as being more or less useful to a company.

Overall, these studies conclude that TQM has positive benefits. In no case did it appear that the introduction of TQM had caused harm. Most companies felt it worked, but some companies thought the results were only "so-so." In these cases, the cause could usually be traced to a lack of top management commitment to carry through a change in the corporate culture.

Although TQM is not specifically oriented toward raising the stock price, it could be argued that better financial performance in terms of profits and market share should be appreciated by the financial community. Heller (1994) conducted a study comparing the stock market performance of 150 companies initiating TQM and the Standard and Poors 500. He concluded that the group of TQM companies performed significantly better than the S&P 500. Between January 1993 and March 1994, the S&P 500 gained 4.6 percent, while the TQM companies gained 10.1 percent.

Recently, some studies have appeared to indicate a resurgence in American competitiveness. Two recent studies confirm these results. The *Wall Street Journal* of September 1994, based on research conducted by the Alexis de Tocqueville

Institution in Virginia, charted the share of profits in world markets of U.S., Japanese, and European companies. The chart showed that U.S. companies garnered more than 50 percent of the profits in world markets for industries ranging from electronic components to aerospace and data processing. But the United States still lagged in industries such as steel and machinery/engineering. Another study was the World Competitiveness Report compiled by the International Institute for Management Development. The study considers a wide range of elements, including the infrastructure, to assess competitiveness. In 1994 the study placed the United States first, ahead of Japan and Germany. Although this improvement cannot be directly related to TQM, it is indicative that a country whose companies have been focusing on TQM for so many years is demonstrating improvement with tangible measures.

◆ OVERVIEW OF THE BOOK

Quality has been a key element of competitiveness. Repeatedly, studies have shown the central role quality plays in improving market share and raising profitability. Today researchers of manufacturing policy describe quality as the foundation that must be laid before a company can compete successfully on cost, dependability, or flexibility. A TQM program is aimed at improving all of these elements, and the results can be striking. However, it requires a sustained level of commitment from top management. In addition to using "fact-based" tools and techniques, it requires a change in the corporate culture. The message is that TQM crosses many different functions and draws on techniques from several disciplines.

This book describes the tools and practices that are part and parcel of a TQM program. Undergirding these tools and practices are four concepts that will appear frequently in the book:

- **Customer focus**—the value of the work done is determined by the customer.
- **Continual improvement**—the quality of work can always be improved, and this can be done gradually or through breakthroughs.
- **Total participation**—the person closest to the task is the most qualified to suggest improved ways of working. That person should be encouraged to make and implement those suggestions as part of his or her daily work.
- A wide range of applicability—the concepts of TQM can be applied to service companies and manufacturing companies and can be used by large and small operations. Throughout this work you will see examples of applications in a wide variety of settings.

This chapter has focused on the importance of product quality as an essential element of the corporate strategy. Chapters 2 and 3 describe the broadening of the meaning of TQM to include service quality and finally to imply quality in management.

◆ Key Terms

Average Outgoing Quality Level (AOQL)
Control Chart
Dumping
Manufacturing policy
Dependability
Flexibility
Tradeoff model
Cumulative model
Sand cone model
Design for Manufacturability
Project Management
Internal failures
External failures
Cross-training
Participative management
Productivity
Innovation
Problem solving
Customer satisfaction
Change
Empowerment
Organizational learning
Benchmarking
Feedback
Sunset dates
Segmentation
Niches
Customer focus
Continual Improvement
Total participation

◆ Assignments

1. Find five companies that have won the Malcolm Baldrige National Quality Award. Compare their average performance for the five years before they won to the years after they won. *Note:* You will need to find companies like Xerox which won the Baldrige as a company. It would be difficult to obtain performance figures for divisions of large companies such as Cadillac.
2. Use the seven common problems identified by the Booz, Allen, and Hamilton study to create five questions you would ask the managers and workers at a company to assess if they had discarded the old approach to management in favor of the new TQM approach.
3. For the following industries look up a recent *Consumers Report Guide*, note the top performer (*Note:* this may not necessarily be identified as the Best Buy), and record the difference in price between their product and the average price of the competitors:
   - Large-screen televisions (31″ to 35″)
   - Small microwave ovens
   - Dishwashers
   - Electric toothbrushes
   - Lawn tractors (with gear drive)

Case Study

Provisions Inc.—The Cooked Meat Division

Provisions Inc. was a major supplier of beef, pork, and cooked meats to much of Canada. Founded in 1854 as a hog processing company with headquarters in Toronto, it gradually diversified into beef processing and cooked meat operations. Cooked meats consisted of hot dogs and a large variety of sausages such as bologna, salami, and liverwurst. In recent years, new variations had been added such as bologna with macaroni and cheese or with pickles and pimento. By 1985 Provisions Inc. had a 32 percent market share. It supplied stores ranging from supermarkets to small stores known as "Mom-and-Pop" stores. Its product could be found in stores in New Brunswick and Prince Edward Island through Vancouver in British Columbia.

Corporate headquarters for Provisions Inc. remained in Toronto. The three major divisions were known as the Beef, Pork, and Cooked Meats Divisions. Each Division had a national director who reported to the chief operating officer of the company. The director of the Cooked Meats Division was responsible for the production of cooked meats in four plants. These plants were located in Edmonton, Winnipeg, Toronto, and Montreal. Each plant had a Cooked Meat manager who reported to the director of Cooked Meats. Each manager was responsible for distributing product in a specific region. For example, Montreal's Cooked Meat manager was responsible for supplying Quebec and the Maritime Provinces.

Product was shipped to stores using a combination of rail and truck. When a particular plant did not manufacture enough to supply an area, the cooked meats would be shipped from other plants. In fact, this was a common occurrence for the shipments to the Maritime Provinces. The capacity of the Montreal plant was barely sufficient to fill the needs of the markets around Quebec. So, the product would be brought in by railcar from Toronto and occasionally from Winnipeg. At Montreal, these railcars would be unloaded and then were reassembled for shipment to the Maritimes. Upon arrival, they were unloaded and taken to a warehouse where they were assembled for trucks to carry to their final destination. Whereas most of Quebec received their cooked meats the day after they were prepared, grocery stores in the Maritimes would receive their shipments three to seven days after preparation.

Cooked meats typically had a shelf life of 10 to 14 days. Beyond that period, decay-causing bacteria could affect the taste of the food. With so many days being taken simply transporting the product, much of the product was sitting on the shelves beyond the recommended shelf life. Provisions Inc. had a policy for reimbursing the grocer for food that sat on the shelves beyond the recommended shelf life. But since grocers knew the product was not unhealthy, they continued to sell it until a Provisions Inc. salesperson arrived and provided fresh product in exchange. As a result, much of the product was sold close to or beyond the recommended shelf life.

To the new Cooked Meat director, this was clearly undesirable, and so he changed the distribution system. Now the product would be shipped directly from Toronto to the

Provisions Inc.—The Cooked Meat Division (Continued)

Maritimes without stopping for unloading and reassembling in Montreal. By adding more truck routes, he was able to ensure that the product reached the grocer two to three days after manufacture.

He expected these changes to be accepted with great enthusiasm. Customers got fresher product, and Provisions Inc. exchanged far fewer products for expired shelf life. Instead, he received a flood of complaints from consumers complaining of the lack of flavor in the "new" cooked meats and sales dropped significantly. What had gone wrong? What should he do next? Distribution to the northern areas of British Columbia was also taking several days. Based on what had happened to his initiatives in the Maritimes, he wondered what he should do there.

CASE QUESTIONS:

1. What should the Cooked Meat director have done differently before introducing the new system for distribution?
2. What should he do now?

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