MANAGING QUALITY IMPROVEMENT

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November 1984 WP#1607-84

ABSTRACT

The purpose of this paper is to provide a guide to managers and academics who wish to explore the topic of managing quality improvement. We begin by providing a brief overview and evaluation of three decision tools for quality management: Cost of Quality, Direct Measures of Quality, and Revenue and Cost of Quality. Next we describe the philosophy and techniques of the Japanese and the three quality management experts: W. E. Deming, J. M. Juran, and P. B. Crosby. Following this, we provide a framework for evaluating the different approaches to quality management. Finally, we suggest some guidelines for designing a program for managing quality improvement.

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PRELIMINARY DRAFT. COMMENTS WELCOME.

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In increasingly many industries and countries, quality improvement has become a top-priority objective of excellent companies and their most competent competitors. Initially, firms whose survival was threatened by the globalization of markets and the exceptional quality of products made in Japan led this renewed emphasis toward higher quality. Recently, however, astute companies in less dire circumstances have also been pushing for improved quality to raise revenues and reduce costs.

In a complex environment where virtually every employee, supplier, and distributor can affect the quality of the goods or services provided, the task of merely maintaining quality levels is an extremely challenging one. Given that maintaining quality levels is so difficult, many firms feel overwhelmed by the task of trying to improve quality to world-competitive levels. As a consequence, the demand for consulting services and education in the area of quality management has increased dramatically in the past few years. Quality experts such as W. Edwards Deming, Joseph M. Juran, and Philip B. Crosby have each developed a sizable quality consulting practice and sizable following among American managers. In addition, legions of American managers have travelled to Japan in the past few years to learn as much as

possible about quality management techniques in that country.

The purpose of this paper is to sift through the various quality management approaches mentioned above and provide a guide to managers and academics who wish to explore further the topic of managing quality improvement. We begin by providing a brief overview and evaluation of several decision tools and decision rules for quality management. Next we describe the philosophy and techniques of the Japanese and the three quality management "gurus" mentioned above. Following this, we provide a framework for evaluating the different approaches to quality management. Finally, we suggest some guidelines for designing a program for managing quality improvement.

1. DECISION TOOLS AND DECISION RULES FOR QUALITY MANAGEMENT

In this section, we discuss three decision tools for quality management: cost of quality (COQ), direct (physical) measures of quality (DMOQ), and revenue and cost of quality (RACOQ). We describe each tool along with the most natural decision rule to go with it and evaluate the strengths and weaknesses of each tool-rule combination.

Cost of quality is a well-documented and widely-used decision tool for quality management. Disseminated by the works of Feigenbaum [1983] and Juran [1974] among others, COQ constitutes required knowledge for every quality engineer certified by the American Society for Quality Control (ASQC). COQ is a managerial cost accounting system for categorizing, tracking, and aggregating

costs related to product and process quality. Its widespread acceptance stems partly from the close philisophical fit between COQ and standard cost accounting systems.

The principal categories of quality costs are failure costs, appraisal costs, and prevention costs. Failure costs represent the costs of having produced defective products. These include internal failure costs, such as the costs of scrap, rework, retest, downtime, and yield losses, as well as external failure costs, such as warranty claims, complaint adjustments, and returned material. Appraisal costs relate to the costs of appraising the quality of the firm's products and processes. They include the labor, material, and capital costs of evaluating the quality of incoming materials, work in process, finished goods, and production equipment. Prevention costs include the costs of quality management planning, training, data analysis, quality improvement projects, and any other activities related to preventing quality problems.

The decision rule used most frequently with the COQ measurement system is to choose quality levels so as to minimize the total cost of quality. Exhibit 1.1 illustrates the analysis associated with this decision rule. In that exhibit, the horizontal axis represents average product quality, measured by the percentage of items produced that are defective, and the vertical axis represents the average cost per unit of good output. Lundvall and Juran [1974] and Juran and Gryna [1980] claim that failure costs decrease as quality is increased, whereas appraisal and prevention expenses must be increased to reduce defect rates.

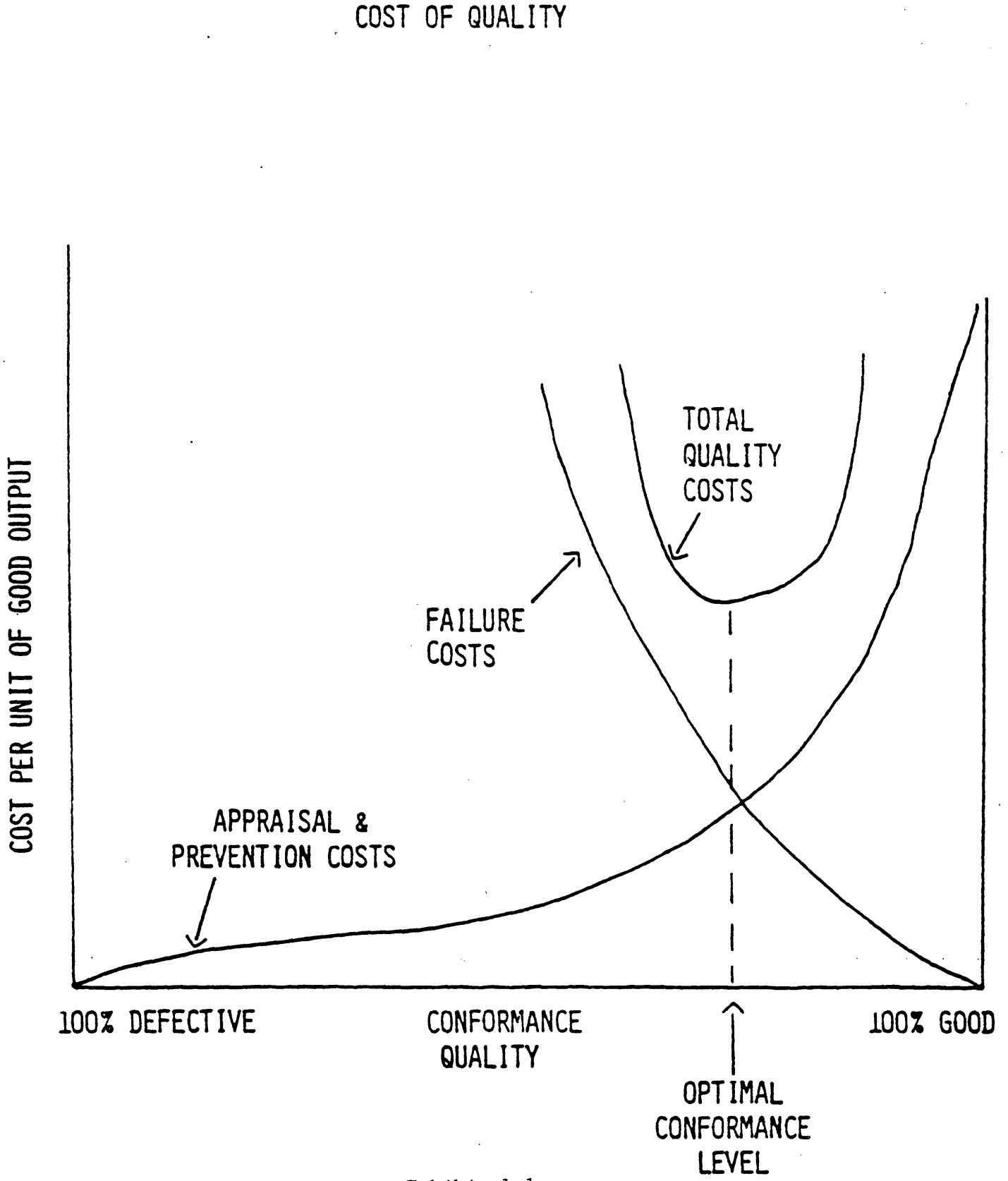

Exhibit 1.1

Determining the economic conformance level

(Source: Juran and Gryna (1980), p. 27.)

Therefore, there is a cost-minimizing level of quality, or economic conformance level, as indicated in Exhibit 1.1. Notice that zero defects is clearly not the optimal conformance level in this model.

Cost-of-quality accounting has several uses in addition to calculating the optimal conformance level. First, it can be used to estimate the financial magnitude of the firm's quality-related activities. Along this line, quality managers often use COQ numbers to call top management's attention to the financial importance of the quality function. COQ can also be used to identify quality improvement opportunities that have a high (dollar) payoff potential. A third use of COQ is as a yardstick for measuring quality improvement or measuring managerial performance over time. An attractive feature of COQ is that all measures are in dollar units and are therefore easily comparable with other outputs of cost accounting systems. For example, payoffs from investments in quality improvement can easily be compared with payoffs expected from other business activities uncer consideration by the firm.

We next explore direct (physical) measures of quality (DMOQ) as a second quality management decision tool. DMOQ is not a highly-developed or widely-acknowledged decision tool in the way that COQ is. Rather it is a term that we coined to denote essentially all nonfinancial, physical, or statistical measures of product or process quality that are used in quality management. Examples of these are defect rates, machine uptime, product throughput, process variability, first pass yield, material waste,

late deliveries, personnel turnover, and absenteeism.

The decision rule used with such direct measures of quality depends on the specific measure being used. If each measure is taken by itself, then the objectives will be to minimize defect rates, process variability, waste, delivery tardiness, employee turnover, and absenteeism, and to maximize yield, throughput, and uptime. Of course, such objectives may not be simultaneously achievable if there are tradeoffs inherent in the process of reaching the various goals. For example, in some processes, it may be possible to achieve higher rates of throughput if more material waste is tolerated. Such a situation illustrates one shortcoming of DMOQ relative to COQ: DMOQ measures cannot be aggregated and used for tradeoff analyses as COQ measures can.

However, DMOQ does have some advantages relative to COQ. Direct measures are easily quantified and understood by factory workers as well as managers. Direct measures often provide immediately useful information for quality improvement activities because they usually direct attention to some physical process that needs improvement rather than merely recording the magnitude of a category of problems. In this way, DMOQ may be thought of as providing a road map for quality improvement. Finally, some quality experts (notably Deming [1983]) claim that direct measures are superior precisely because they cannot be aggregated and used in tradeoff analyses as COQ numbers can. Deming believes that using COQ as a basis for decisions is a misleading and potentially harmful exercise because many quality-related effects that impact profits are ignored by COQ or are nearly impossible to identify

and quantify.

The first of these objections may be ameliorated by the use of revenue and cost of quality (RACOQ) accounting, the third quality management decision tool. To our knowledge, RACOQ is not a decision tool that is currently being used in industry. Rather, it is a conceptualization of a tool that might overcome some of the shortcomings of COQ and DMOQ. The basic idea of RACOQ is to estimate the revenue effects of quality as well as the cost effects in order to measure the impact of quality on firm profitability. Thus, the obvious decision rule to go with RACOQ is to maximize quality profitability (revenue minus costs).

Some of the elements that should go into revenue accounting for quality are price premia for higher quality goods, market share effects of quality, the deterrence of potential entrants who stay out of a market because of the quality position of the incumbent firm(s), goodwill and reputation effects of having high quality products, and lost revenue (opportunity costs) due to poor quality.

The principal drawback of trying to implement an RACOQ system is the near impossibility of measuring accurately the above-mentioned revenue effects of quality. A second difficulty is that one must distinquish and make tradeoffs between long-run and short-run effects on profits of improving quality. The Deming view, that it is impossible to get numbers accurate enough to be of value for decision-making, weighs heavily against attempting to implement RACOQ.

Despite these shortcomings, RACOQ should not be dismissed

immediately. Any estimates of the revenue effects of quality, no matter how crude, must be superior to assuming that these effects are zero (as COQ does implicitly). In addition, unlike COQ and DMOQ, RACOQ forces one to think strategically about quality-related decisions and pushes one to try to quantify the strategic effects that are identified.

Conceptually, therefore, RACOQ strictly dominates COQ as a quality decision tool, even if the revenue-side estimates are extremely crude. Relative to DMOQ, RACOQ has the disadvantage of aggregating quality information so as to hide the details of how quality improvement ought to proceed. However, RACOQ's advantage over DMOQ is its vantage point on strategic issues.

2. FOUR APPROACHES TO MANAGING QUALITY IMPROVEMENT

In this section, we describe the quality management approaches of Deming, Juran, Crosby, and the Japanese. For each of the three quality "gurus", our sources are their written works (Deming [1983], Juran [1974], Juran and Gryna [1980], Crosby [1979, 1984]). Obviously, there is no definitive Japanese approach to quality management as there is, for example, a Deming approach to quality management. Therefore, our description of "the" Japanese approach to quality management is a composite sketch taken from a variety of sources (Hayes [1981], Schonberger [1982], Garvin [1983], Tsuda [1984]). (For expository purposes, we may sometimes refer to "the" Japanese approach to quality management as though there were a single unified program authored

by a single person.)

For each quality management program, we look at the underlying philosophy of the author, the tools and techniques recommended, and the approach to implementing and orchestrating quality management and improvement. To get at program philosophy, we look at each author's viewpoint on why quality is important, how quality is to be defined, and what should be the objectives of the quality program. To get at tools and techniques, we look at each author's program in light of the framework in Section One on decision tools and decision rules for quality management. We also look at each author's attitude on statistical quality control (SQC) techniques. Finally, we examine the actions and activities recommended by each program as well as the recommended allocation of quality management and improvement responsibilities among the employees of the firm.

.The Deming Approach to Quality Improvement

W.Edwards Deming was originally trained as a statistician. He began teaching statistical quality control in Japan shortly after the end of World War II and he is acknowledged as a principal contributor to the Japanese ascendancy in quality control. In recognition of his contribution to the Japanese economy, the Union of Japanese Science and Engineering (JUSE) instituted the highly prestigious Deming Prize, awarded annually to the Japanese firm that demonstrates the most advancement of precision and dependability of product.

Deming does not give an explicit definition of quality, but one can infer a definition by noting his focus on the improvement of product and service conformance to specification by reducing uncertainty and variability in the design and manufacturing processes. To achieve this, he advocates a never-ending cyclic process of product design, manufacture, test and sales, followed by market surveys and then redesign, manufacture, test, sales, market survey, ad infinitum.

Deming claims that higher quality leads to higher productivity which leads to long-term competitive strength. The objective of the firm should be "to stay in business, to protect investment, to earn dividends, and to ensure jobs and more jobs" (Deming, p. 11). Long-term survival of the firm, not quarterly profit increases, is paramount. Improving quality provides the best path for meeting these goals. Deming offers little empirical validation for these claims and expects his students and clients to accept them as fact.

Deming believes that the top management of the firm has the overriding responsibility for improving quality. Tribus [1982a, 1982b] paraphrases Deming as follows: Workers work in a system; managers work on the system. The job of management is to improve the system with the help of the workers. Both Deming (pp. 31, 68) and Juran (Juran and Gryna [1980], pp. 315-316) believe that most (approximately 80%) quality problems are management-controllable, not worker-controllable. Therefore, blaming quality problems on workers who have no power to change the system is at best useless and probably counterproductive.

Although Deming uses the idea that quality improvement reduces costs to argue in favor of managing for improved quality, he rejects cost-of-quality accounting and the use of cost justification as a basis for the selection or measurement of quality improvement projects. Deming thinks that COQ technology is far too crude to capture all of the benefits (e.g. revenue side effects, inventory reductions, morale effects) of improving quality, so the use of COQ will lead to severe errors in quality-related decision-making.

Since Deming believes that improving quality always lowers costs and improves competitive position, he finds quality cost accounting to be superfluous. He favors the decision rule of optimizing direct measures of quality. To aid in developing useful direct measures of quality, Deming advocates the extensive use of statistical quality control techniques. He proposes that every employee in the firm be familiar with elementary SQC techniques such as Pareto analysis, Ishikawa ("fishbone") diagrams, histograms, control charts, and scatter plots. (See Ishikawa [1976] for an elementary treatment of these techniques.) All employees should use these techniques to analyze their own work for improvement opportunities. Quality and statistics experts in the firm should be familiar with more advanced statistical techniques such as sampling, distribution theory, cusum charts, sequential analysis, and design of experiments. (See, e.g., Burr [1976], Feigenbaum [1983], Grant and Leavenworth [1980] for treatment of these more advanced techniques.)

Deming identifies two sources of improvement of processes:

eliminating common causes of quality problems and eliminating special causes of quality problems. Common causes are problems that are systemic. Examples of these are poorly designed products, improper bills of materials, inadequate training programs, and inhospitable working conditions. Common causes can only be corrected by management. Special causes are problems that are identifiable with a specific individual, batch of materials, or machine. Statistical quality control techniques are useful for distinguishing between common causes and special causes, and for providing insight into how to eliminate the causes of quality problems.

How does one achieve quality excellence according to Deming? Deming's 14 point program constitutes the core of his recommendations to management. We will summarize the 14 points and then discuss them.

1. Create constancy of purpose toward improvement of product and service, with a plan to become competitive and to stay in business. Top management must articulate a consistent, credible, operational, and inspirational statement of purpose for the organization, This statement of purpose should allow employees, customers, suppliers, shareholders, lenders, and the public to understand what to expect from the firm. The statement should guide employees in their day-to-day tasks as well as their long-term projects.

2. Adopt the new philosophy: Poor quality is intolerable.

3. Cease dependence on mass inspection. Inspection is too late, costly, and ineffective. Require, instead, statistical evidence that quality is built in, to eliminate need for inspection on a mass basis.

4. End the practice of awarding business on the basis of price tag. Instead, depend on meaningful measures of quality, along with price. Eliminate suppliers that cannot qualify with statistical evidence of quality. Purchasing managers must learn to work together with vendors, recognizing the advantages of a single sourcing and long-term relationships.

5. Constantly and forever improve the system of production and service. Management must inculcate a culture that stresses constant striving for improvement. The status quo should never be considered satisfactory in product or process.

6. Institute modern methods of training on the job. Every employee should be trained in the basics of statistical quality control. Further training is beneficial until statistical methods show that defects are no longer caused by lack of training. Management must communicate clearly its expectations on what constitutes high quality job performance.

7. Institute modern methods of supervision of production workers. Foremens' responsibility must be focused on quality

performance, not accounting numbers. Quality improvement will automatically improve productivity. Management must be prepared to take immediate action on barriers to quality work. Conditions that restrict workers from doing their jobs with pride of workmanship must be eliminated.

8. Drive out fear. Every employee must be able to work without fear of expressing ideas, asking questions, asking for further instructions, or reporting quality problems.

9. Break down barriers between departments. Top management, marketing, sales, production, purchasing, research and development must all learn to work as a team. This is a prerequisite for excellence in quality improvement.

10. Eliminate numerical goals for the work force. Goals set by top management without the provision of a road map on how to meet the goals have effects exactly the opposite of those intended. Goals such as "zero defects," or "Do it right the first time" do nothing but generate frustration and resentment because they do nothing to help the employee do a better job.

11. Eliminate work standards and numerical quotas. No work standard includes even a trace of a system to help a person do a better job. Quota setting erects an adversarial relationship between the person who must meet the quota and the person who will check to see that the quota is met. Such relationships are not

conducive to cooperation for quality improvement.

12. Remove barriers that stand between the hourly worker and his right to pride of workmanship. If workers are allowed to take pride in their work, then quality will have priority and productivity will benefit. Management must remove systems, policies, and procedures that rob the hourly worker of his rights to be proud of his work, and to do a good job.

13. Institute a vigorous program of education and retraining. Productivity gains through quality improvement will mean that some jobs will need more people, some less. Education and training will help people fit into new jobs. Quality control departments must adjust to new responsibilities. Everyone must learn the rudiments of statistical theory and application.

14. Create a structure in top management that will push every day on the above 13 points. A mentality for constant and perpetual quality improvement must be engraved into the management system.

Deming's approach to quality management places much of the direct responsibility for quality improvement on management and the line workers and very little on quality professionals. Top management is expected to lead the push for quality and to develop a management system to enhance the improvement process. Top managers must be involved in all stages of the quality improvement

process. Every line worker is responsible for insuring the quality of his or her own work. Machine operators are to be trained in SQC so that they may monitor and control the system they work in and discover opportunities for improvement. Quality professionals are to give up the policing function and should focus on education and consulting for the workforce and management. Quality professionals should concentrate on improving the methods of defect prevention.

For most U.S. firms, adopting Deming's program would force radical changes on the organization. The firm would have to throw out numerical goals and quotas, change the incentive structure for the organization, discard COQ accounting, reallocate responsibilities for quality assurance, cultivate intolerance of defective materials and work, change policies for supplier relationships, and undertake significant new training programs. Deming demands that a major cultural upheaval take place in the organization. Considering how radically different a Deming organization is from most U.S. organizations today, Deming gives very little guidance on how to implement and orchestrate such massive changes. His 14 points describe how he thinks firms ought to be run, but give little assistance on how to get there.

The Juran Approach to Quality Improvement

Joseph M. Juran has made significant contributions in the fields of quality control and management. His Quality Control Handbook is widely read by quality professionals and he has

authored or co-authored 10 books (including the popular text, Quality Planning and Analysis [1980] with F. M. Gryna) and hundreds of articles. Dr. Juran also played a significant role in development of the Japanese competence in quality.

Juran defines quality as "fitness for use," and breaks this down further into quality of design, quality of conformance, availability, and field service. (See Exhibit 2.1.) In justifying the importance of the topic, he emphasizes humanity's dependence on the quality of goods and services produced in the world. The phrase "life behind the quality dikes" (Juran [1974], p. 4-2) brings this message across quite vividly.

Juran focuses his quality management program on two goals: increasing product and service conformance to specifications and reducing the cost of quality. Although he shows a high level of awareness of the importance of the revenue effects of quality (Juran [1974], Chap. 4), accounting for these effects in decision-making does not play a role in his program.

While Deming demands radical change from any organization that chooses to adopt his approach to quality management, Juran does not. In fact, Juran's program is designed to fit easily into a traditional U.S. management culture. The cost-of-quality measurement system is the key to understanding the difference between the two approaches. Juran states that the language of management is in terms of dollars whereas the language of the factory floor is in terms of physical units or "things." Juran's approach to bridging this gap is to develop a comprehensive cost-of-quality system that will translate important quality-related

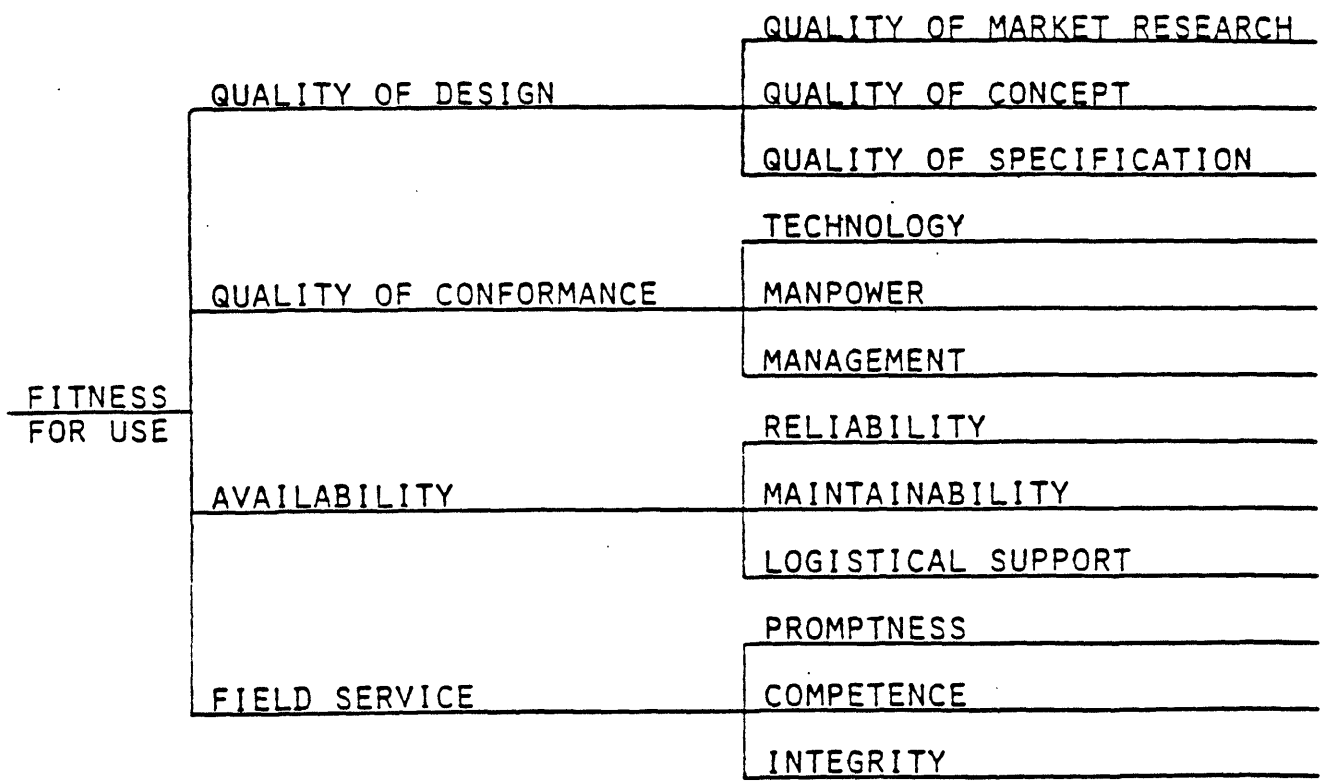

Exhibit 2.1

Juran's Definition of Quality

(Source: Juran (1974), p. 2-9)

information into monetary terms that can be easily understood by managers. This contrasts sharply with Deming, who requires that managers learn the language and tools of physical "things," and take on faith that improving direct measures of quality will have favorable financial impacts.

Since Juran's COQ system delivers relevant quality data to managers in the form they are used to, they need not change their philosophies or operating modes. Just as they use financial considerations to make decisions in other areas of the firm, managers can use finanacial considerations to make quality-related decisions. In this way, Juran's approach and COQ fit into the traditional managerial decision-making framework and culture. Furthermore, top managers do not have to accept the importance of quality as a "new religion" as advocated by Deming. Rather, they can base their quality-related decisions on the financial facts provided by accountants and quality professionals.

According to Juran (Juran [1964]), all managerial activity is directed at creation of good changes (breakthrough) or prevention of bad changes (control). Consequently, Juran's approach to quality management consists of three parts: the control sequence, the breakthrough sequence, and the annual quality program. The control sequence is designed to attack sporadic problems (analogous to Deming's special causes), the breakthrough sequence attacks chronic problems (common causes), and the annual quality program institutionalizes managerial control and review over the quality management process.

Juran states that sporadic problems must be attacked through

the quality control process. Quality control is defined as "the process through which we measure actual quality performance, compare it with standard, and act on the difference" (Juran and Gryna, p. 3). The steps in a quality control process are the same as any other feedback loop control process. These steps, the control sequence, are:

1. Choose the control subject: i.e., choose what we intend to regulate.
2. Choose a unit of measure.
3. Set a standard or goal for the control subject.
4. Choose a sensing device that can measure the control subject in terms of the unit of measure.
5. Measure actual performance.
6. Interpret the difference between actual and standard.
7. Take action (if any) on the difference.

Tools for attacking sporadic problems include tolerance reviews, foolproofing, and standard statistical process aids such as frequency distributions, histograms, and control charts.

The program for attacking chronic quality problems is called the breakthrough sequence. Reduction of chronic problems, longstanding adverse situations, requires a managerial breakthrough. This managerial breakthrough is comprised of two parts: a breakthrough in attitudes, followed by a breakthrough in knowledge. The entire breakthrough process is outlined below.

Step 1. Prove that a breakthrough is needed and create an attitude favorable for embarking on an improvement program.

Factual information on quality, cost, or delivery parameters, actual or potential loss of sales income due to quality, or the product quality of competitive firms is collected to familiarize management with the extent of the firm's quality problems. This information also shows management the benefits possible from an improvement program and helps to justify the resources requested for the program. These benefits should be expressed in monetary terms, the universal language of upper management.

Step 2. Identify the vital few projects. In this step, a pareto analysis of the chronic quality problem areas is conducted to determine which are (financially) the most important.

Step 3. Organize for a managerial breakthrough in knowledge. The investigation of a chronic quality problem can be aided by organizing a steering arm and a diagnostic arm. The steering arm is formed of representatives from various departments involved in the program. The steering arm provides definition and agreement on the specific aims of the improvement program, ideas on possible causes of the problem, authority to experiment, information and advice on overcoming the resistance to change inherent in proposing new approaches, and action on implementing the solution to the problem.

The diagnostic arm is brought together to determine the causes, not the remedies, of a problem. The group is usually comprised of professional specialists, although line supervisors also do diagnosis. The diagnostic arm provides the manpower

required for the investigation, the diagnostic skills, and the objectivity of analysis.

Step 4. Conduct the analysis to determine the cause of the problem and a remedy.

The diagnostic arm studies the symptoms surrounding the defects, hypothesizes on the causes of these symptoms, and tests the hypotheses.

Step 5. Determine the effect of proposed changes on the people involved and find ways to overcome the resistance to change. The "art" of dealing with resistance to change includes (a) establishing the need for the change in terms that are important to the people involved rather than on the basis of the logic of the change, (b) using participation to get ideas on both the technical and social aspects of the change, and (c) trying to gain agreement on the change.

Step 6. Convince the necessary departments to take action to institute the changes. This step involves action in two parts. First, the approval of management for instituting the solution must be gained with a presentation built around a factual (and monetary) approach. Second, the solution is installed in a way that will make it effective.

Step 7. Institute controls to hold the new level of performance. The last step of the breakthrough process is to

follow the progress on the problem solution to assure that the solution continues to be effective and that unforeseen problems are resolved.

The annual quality program is a vehicle for top management involvement in the quality improvement process. Each year, long-term and short-term quality policies and objectives are reviewed and modified as needed. A report for top management is prepared by the quality department to show the quality accomplishments of the past year. These accomplishments are compared with the previously-set objectives.

The most striking point about this annual program is that it is supposed to be the vehicle for top management involvement in the quality area, but it is carried out almost exclusively by the quality professionals who prepare the reports for management's review and approval. The role of top management is a passive one. This is characteristic of the entire Juran program. The primary responsibility for quality management and quality control rests with the quality department. Active support and participation of top management for quality improvement is useful, but not essential for the functioning of the quality programs because all proposed activities are cost-justified (i.e., positive net-present-value projects). Management needs only to be motivated to reduce costs and increase profits to make the Juran program work.

Quality professionals play a dominant role in the quality improvement process. (This is one reason why most quality professionals prefer the Juran approach.) Juran describes

detailed responsibilities for quality control engineering, quality assurance, inspection, reliability, and corporate quality groups. In contrast, hourly workers have no formal role to play in Juran's quality management process. Both the breakthrough sequence and the control sequence are coordinated, staffed, and implemented by middle managers and quality professionals.

To summarize the Juran program: Sporadic problems require the full control sequence, whereas chronic problems require managerial breakthroughs in attitudes and knowledge. The annual quality program allows management involvement in quality policies and objectives. COQ accounting plays an important role in identifying, selecting, monitoring, and controlling quality improvement projects. Quality professionals are the champions of quality improvement.

The Crosby Approach to Quality Improvement

Philip B. Crosby, author of Quality is Free and Quality Without Tears, developed the Zero Defects program and founded the Crosby Quality College in Winter Park, Florida. He was corporate vice president for quality at ITT for fourteen years, after working his way up from line inspector. Over 15,000 executives have attended his Quality College.

According to Crosby, quality is important because it reduces costs and increase profits. The goal of his program is to control and increase the firm's profits through improved quality. Like Deming and unlike Juran, Crosby believes that increasing quality

always reduces costs. Crosby insists that quality be defined as conformance to requirements. This definition is concrete, operational, and quantifiable.

Crosby's program relies heavily on both cost-of-quality accounting and direct measures of quality. COQ is used to show management the magnitude of quality-related costs and to identify profitable opportunities for corrective action. DMOQ are also used to identify quality improvement opportunities as well as to measure actual accomplishments. The most important direct measure of quality is the defect rate. Crosby calls the goal of zero defects in all operations an "absolute of quality management" (Crosby [1984], Chapter 8.).

Another tool for measuring quality progress is the quality management maturity grid. (See Exhibit 2.2.) This grid has five stages of maturity: uncertainty, awakening, enlightenment, wisdom, and certainty; and six measurement categories: management understanding and attitude, quality organization status, problem handling, cost of quality, quality improvement actions, and a summation of company quality posture. This grid, which is easy to understand, can be used for several purposes: it can convince managers that there is opportunity for improvement; it can help measure progress in improvement of quality management; and it can provide guidance on what areas need improvement. Many managers find the grid to be a useful tool for evaluating the state of their quality management operation.

The heart of Crosby's approach to quality management is his 14 step Quality Improvement Program. This program outlines a

The Quality Management Maturity Grid

Quality Management Maturity Grid

Rater _____ Unit _____

Measurement Category	Stage I: Uncertainty	Stage II: Awakening	Stage III: Enlightenment	Stage IV: Wisdom	Stage V: Certainty
Management understanding and attitude	No comprehension of quality as a management tool. Tend to blame quality department for "quality problems"	Recognizing that quality management may be of value but not willing to provide money or time to make it all happen	While going through quality improvement program learn more about quality management, becoming supportive and helpful	Participating. Understand absolutes of quality management. Recognize their personal role in continuing emphasis	Consider quality management an essential part of company system
Quality organization status	Quality is hidden in manufacturing or engineering departments. Inspection probably not part of organization. Emphasis on appraisal and sorting.	A strong quality leader is appointed but main emphasis is still on appraisal and moving the product. Still part of manufacturing or other	Quality department reports to top management. All appraisal is incorporated and manager has role in management of company	Quality manager is an officer of company. Effective status reporting and preventive action. Involved with consumer affairs and special assignments	Quality manager on board of directors. Prevention is main concern. Quality is a thought leader
Problem handling	Problems are fought as they occur. No resolution, indadequate definition, lots of yelling and accusations	Teams are set up to attack major problems Long-range soluctions are not solicited	Corrective action communication established. Problems are faced openly and resolved in an orderly way	Problems are identified early in their development. All functions are open to suggestion and improvement.	Except in the most unusual cases, problems are prevented
Cost of quality as % of sales	Reported unknown Actual 20%	Reported 3% Actual 18%	Reported 8% Actual 12%	Reported 6.5% Actual 8%	Reported 2.5% Actual 2.5%
Quality improvement actions	No organized activities. No understanding of such activities	Trying obvious "motivational" short-range efforts	Implementration of the 14-step program with thorough understanding and establishment of each step	Continuing the 14-step probram and starting Make Certain	Quality improvement is a normal and continued activity
Summation of company quality posture	"We don't know why we have problems with quality"	"Is it absolutely necessary to always have problems with quality?"	"Through management commitment and quality improvement we are identifying and resolving our problems"	"Defect prevention is a routine part of our operation"	"We know why we do not have problems with quality"

Exhibit 2.2

Crosby's Quality Management Maturity Grid

(Source: Crosby (1979), pp. 32-33.)

process for increasing quality management maturity and improving quality. We outline the steps of the program below.

Step 1. Management Commitment The first and most important step is to convince top management of the need for quality improvement. Top managers must realize that their personal commitment to participation in the program is essential for success.

Top management should issue a quality policy that states that everyone is expected to "perform exactly like the requirement or cause the requirement to be officially changed to what we and the customer really need." Likewise, top management must believe that quality improvement is a practical way to achieve profit improvement through cost reduction.

Step 2. Quality Improvement Team. Representatives from each department are brought together to form the Quality Improvement Team. This team coordinates the fourteen step program. The quality department provides assistance to this team on an as needed basis.

Step 3. Quality Measurement. In order to monitor quality performance throughout the firm and provide a baseline for measuring improvement, direct measures of quality must be developed for every part of the firm. These quality measures are used to document areas where improvement is possible and corrective action is necessary.

Step 4. Cost of Quality Evaluation. Initial estimates of all defect-related costs are made by the comptroller's office. The quality improvement team and the quality department assist in the classification of costs. These cost measurements indicate areas for profitable corrective action and provide input for the Quality Management Maturity Grid.

Step 5. Quality Awareness. Involvement of all employees begins at this stage. Trained supervisors communicate the results of the cost-of-quality measurements. Management must credibly demonstrate its new concern for quality improvement. The new quality attitude is publicized widely within the firm.

Step 6. Corrective Action. This step allows all employees to see that action will be taken in response to quality problems. Opportunities for correction that have come to light in previous steps are brought to supervisors' attention during meetings for this purpose. Problems that cannot be resolved are passed on up the ladder. Task forces are used where necessary.

Step 7. Establish an Ad Hoc Committee for the Zero Defects Program. A few members of the quality improvement team are selected to investigate how to apply the Zero Defects program at the company. The entire team learns about the Zero Defects concept from the quality manager.

Step 8. Supervisor Training. A formal orientation to the quality improvement program is conducted with all levels of management. Managers must demonstrate their understanding of the program by explaining it to others. (This step deviates from the time-sequenced nature of the rest of the steps. Crosby states that supervisor training should have been occurring at every step in the program.)

Step 9. Zero Defects Day. In a single day, the firm establishes Zero Defects as the performance standard for everyone. By making a special day of it, it is ensured that the "new attitude" receives the appropriate emphasis and is remembered.

Step 10. Goal Setting. To get employees to learn to set and meet goals and to accomplish tasks as a team, employees establish goals for themselves. These 30-, 60-, and 90-day goals are specific and achievable.

Step 11. Error Cause Removal. Employees are asked to use simple one-page forms to report any problems that prevent them from performing error-free work. The appropriate functional group must acknowledge the problem within twenty-four hours, and they are responsible for developing an answer. This system allows employees to see immediate response taken to their problems and encourages the reporting of future problems. (Note: This is not a suggestion program; it is a problem reporting program.)

Step 12. Recognition. Awards programs are developed to recognize those who meet their goals or perform outstanding acts. The prizes are not financial. Crosby believes that people work for recognition. Recognition should be public and noisy, but not demeaned by having a price tag on it. People appreciate recognition of performance. A recognition program encourages employees to support the program whether or not they, as individuals, receive rewards. (In contrast, Deming cautions firms against developing award programs. While management may seek to reward employees who make outstanding efforts to improve quality, Deming believes that most programs reward individuals on a statistically random basis. At best, such a system will do nothing for the firm, since employees will learn that awards are based on a random selection. At worst, employees who attempt but fail to receive awards will become discouraged and reduce their efforts towards improving quality.)

Step 13. Quality Councils. Quality department employees and Quality Improvement Team chairpersons from different divisions need to be brought together regularly to discuss actions necessary to upgrade and improve the quality programs being installed.

Step 14. Do It Over Again. Since the typical program takes twelve to eighteen months to implement, turnover and changing situations will erase some of the education effort of the early steps. Therefore, to make sure that quality improvement is perpetual, and new quality attitudes are ingrained in all

employees, the program should be repeated indefinitely.

Relative to Deming and Juran, Crosby places a strong emphasis on the process of changing the corporate culture and attitudes. His 14 step program gives clear guidance for building a quality improvement attitude in the organization. Conversely, Crosby places little emphasis on statistical quality control techniques relative to Deming and Juran. Crosby is much more people- and organization-oriented than tool-oriented.

With respect to the role of quality professionals in the organization, Crosby falls between Deming and Juran. Crosby recommends that the quality organization exist "to the degree necessary to ensure that the acceptance and performance standards for the firm's products are met and to ensure that the cost of quality goals for each operation are achieved" (Crosby [1979], pp. 56-57.). Quality departments should "measure and report conformance, demand corrective improvement, encourage defect prevention, teach quality improvement, and act as the conscience of the operation." (Crosby [1979], p. 233). However, the quality organization should not do the job for others. Crosby cautions against the quality organization becoming involved in the creation, production, marketing or management of a firm's product. Finally, Crosby emphasizes that the quality organization is not responsible for quality problems; the departments that made the mistakes are.

Active top management participation is crucial to Crosby's program. Believing that workers' performance reflects the

attitudes of management, Crosby demands that top managers revise their attitude towards quality. Zero Defects must become their personal standard of conformance. Top management should "take affirmative steps to ensure that the employees understand that the quality policy of the company is to 'perform exactly like the requirement or cause the requirement to be officially changed to what we and our customer really need'" (Crosby [1979], p. 57).

Crosby does not give a large role to the hourly work force in his program. He believes that since worker performance reflects the attitudes of the management, a quality improvement program should be directed at management. The only role for hourly workers in Crosby's program is to fill out simple one-page forms describing problems that prevent them from performing error-free work (Crosby [1979], p. 117).

The Japanese Approach to Quality Improvement

The success of Japanese manufacturers in worldwide quality competition is now a well-documented fact. (See, e.g., Abernathy, et al [1981], Garvin [1983], Robinson [1980].) The Japanese have been working towards excellence in quality since 1949 when Deming made his first trip to Japan. Naturally, the Japanese have adapted what they learned from Deming and Juran to suit their own needs and tastes, so that most Japanese companies have quality improvement programs that differ from both the Deming program and the Juran program. Although quality policies vary significantly among Japanese firms, there do seem to be some common practices

and philosophical beliefs. We summarize some of those common elements here. Our treatment relies heavily on Chapter 3 in Schonberger [1982].

According to Schonberger (pp. 48-49.) a key precept of Japanese quality management is: "The responsibility for quality rests with the makers of the part." That is, the production department should have the primary responsibility for the quality of manufactured products. Philosophically, this precept is in complete agreement with Crosby and Deming.

Schonberger (p. 52) states that the principal goals of Japanese quality management are to develop and sustain a habit of improvement and to work toward perfection. These goals fit well with the Japanese working definition of quality: uniformity around the target. This definition of quality (Sullivan [1984]) rejects the yes-or-no character of the conformance to requirements definition. Instead, quality is measured as a continuous variable, and improving uniformity around the target requires an ongoing process of reducing variability and tightening frequency distributions.

Schonberger identifies seven basic principles, five facilitating concepts, and five techniques and aids that compose the core of Japanese total quality control.

Basic Principles

1. Process Control. Process control means checking the process as work is being done so as to detect problems as soon as they occur. Processes that are in control produce products that

need no inspection.

2. Easy-to-See Quality. Physical plant arrangement and display boards tell workers, management, customers, and visitors what quality factors are measured, what the recent performance is, what the current quality improvement projects are, who has won awards for quality, etc. The purpose of this practice is to document for everyone - managers, workers, inspectors, customers - the state and rate of quality improvement.

3. Insistence on Compliance. In many Western firms, quality control inspectors frequently give in to pressure from manufacturing to pass parts and subassemblies that do not fully meet quality standards. Top managers in Japanese firms tell manufacturing that quality comes first and output second. Defective items are not accepted.

4. Line Stop. Each worker has the authority to stop the production line in order to correct quality problems. This gives quality responsibility to the line workers.

5. Correcting One's Own Errors. In a major departure from Western practice, the worker or work group that made bad parts performs the rework to correct errors. This practice emphasizes worker responsibility for quality and allows workers to learn from their errors.

6. 100% Check. Inspection of every item, not just a sample of items, is applied rigidly to finished goods and, where feasible, to component parts. This practice is aided by the policy of having every worker check his own work.

7. Project-by-Project Improvement. Japanese employees are

expected to constantly maintain a set of ongoing quality improvement projects. The idea behind this practice is to help instill the habit of constant and perpetual improvement.

Facilitating Concepts

1. Quality Control as a Facilitator. The QC department, much reduced in size, because the production department has primary responsibility for quality, promotes the removal of defect causes, keeps track of quality accomplishments, monitors operations to see that standard procedures are followed, joins the purchasing staff to monitor supplier plant procedures, and coordinates QC training. It may also perform some of the more complex or technical inspections.

2. Small Lot Sizes. Small lot sizes are not only the key for just-in-time production, but they are vital for assuring that problems are discovered early.

3. Housekeeping. Japanese factories are neat and clean. Good housekeeping helps provide an environment conducive to improved work habits, quality, and care of facilitites. Housekeeping responsibility resides with those who have responsibility for quality - the foremen and workers, not a janitorial staff.

4. Less-Than-Full-Capacity Scheduling. This practice makes it easier to meet daily schedules, reduces strain on workers and equipment, and makes it feasible to stop the line for quality problems.

5. Daily Machine Checking. While Western manufactureres tend to abuse their equipment, Japanese production workers pamper their machines. This results in long-lived, trouble-free, productive equipment.

Techniques and Aids

1. Exposure of Problems. The Japanese want to identify and eliminate causes of current or potential problems as early as possible. Management and workers look for problem causes before there is evidence of trouble, and management may deliberately stress the system for the purpose of exposing problems.

2. Foolproof Devices. Because human beings will always make mistakes, whenever possible, Japanese firms design production systems to automatically eliminate many of the most likely errors.

3. N = 2. In this approach to inspection of stable processes, it is assumed that the process has remained stable if the first and last items are good. Random sampling may be more costly and may not be fully representative of the production run.

4. Tools of Analysis. Exposed problems are analyzed by frequency distributions of measured quality variables, defect frequency rates and trends, process control charts, and Ishikawa diagrams. Supervisors and workers are trained in the use of these tools.

5. Quality Control (QC) Circles. QC circles are groups of employees who volunteer to meet regularly to discuss means of quality improvement. These circles should be considered as a good

way of wringing some of the last defects out of a production system.

These principles, concepts, and techniques provide a foundation for the smooth-running quality operations in many Japanese firms. With respect to the use of decision tools, the Japanese appear to follow the Crosby philosophy most closely. That is, final objectives and goals are expressed in terms of direct measures, e.g., zero defects (Hayes [1981, pp. 61-62.]) but quality cost analysis is used to select quality improvement projects (Garvin [1984]). Although they do use quality cost analyses, the Japanese probably do not use a formal COQ system. Tsuda [1984] is wary of relying too heavily on a COQ-type analysis. He uses the term "uncountable costs" to refer to costs that are difficult to quantify.

The allocation of quality management responsibilities among the firm's employees is summed up succinctly by a diagram (Exhibit 2.3) of Tsuda [1984]. The diagram shows that top management's primary responsibilities are to work for breakthroughs, i.e., drastic improvements in product or process. Secondarily, they have responsibilities for more routine improvement activities. Middle managers devote themselves primarily to improvement, but have some responsibilities for breakthroughs and for maintenance of quality levels. Line workers are primarily responsible for maintaining quality performance but have some improvement responsibilities. This scheme probably matches most closely with Deming's, but expresses the idea of allocation of quality management responsibilities much better than Crosby, Juran, or Deming.

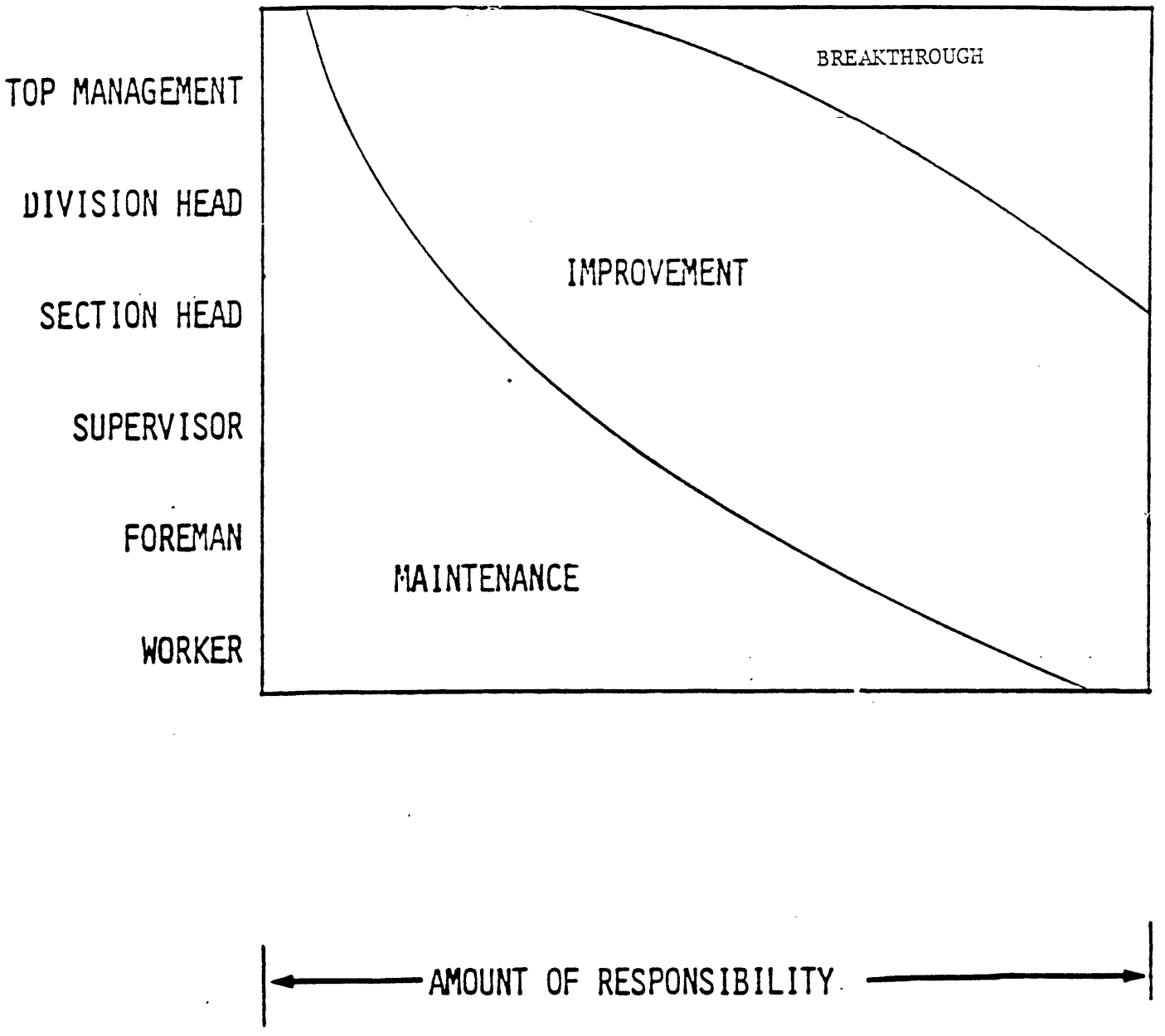

Exhibit 2.3

Japanese allocation of quality management and improvement responsibilities

(Source: Tsuda (1984))

We conclude this section with Exhibit 2.4, a synopsis of some of the key points of each of the four approaches to quality management.

ension	DEMING	JURAN	CROSBY	JAPANESE
finition of ility	Conformance to Specif.	Conformance to Specif.	Conformance to Specif.	Uniformity around target
Worry out Quality	Competitive Position	Profits Quality of Life	Profits	Quality of Life
l of Progam	Improve Compet. Position	Decrease COQ	Decrease Costs	Continual Improvement
lity Goal	Zero Defects	Minimize COQ	Zero Defects	Zero Defects
Select jects	Pareto Analysis Defects	Cost Analysis	Cost Analysis	Cost Analysis
Measure provement	Direct Measurements	COQ data	COQ data & Direct Meas.& Maturity Grid	Direct Measurements
e of QC t.	Low	Extensive	Moderate	Low
e of Top agement	Leadership, Participation	Varied	Must Stress Zero Defects	Breakthroughs & Improvement
e of kers	Maintenance & Improvement	Little	Little	Maintenance & Improvement
Emphasis	None	Very high	moderate	low
atistical alysis	High use	For lower Management	Mixed	High use

EXHIBIT 2.4

Synopsis of the Four Approaches to Quality Improvement

3. A FRAMEWORK FOR EVALUATING AND SELECTING A QUALITY IMPROVEMENT PROGRAM

We have found three dimensions on which it is useful to compare quality improvement programs: decision tools and decision rules, managerial style, and management of the transition to excellent quality management. In this section we briefly review where each of the four quality management approaches stands on each of these dimensions and propose guidelines for selecting from among the approaches.

With respect to quality management tools and rules, Deming believes in the exclusive use of DMOQ; Juran makes extensive use of COQ; and Crosby and the Japanese use COQ for selecting quality improvement projects and DMOQ for setting quality objectives and measuring progress. In our opinion, a crucial determining factor in choosing quality management decision rules is management's belief regarding the relationship between quality and costs. If the top management of a firm believes that Exhibit 1.1 realistically captures the cost-quality relationship, then minimizing COQ is the logical decision rule and optimizing direct measures of quality will not be globally optimal for the firm. On the other hand, if one believes that increasing quality always reduces costs (i.e., "quality is free"), then cost justification of quality improvement activities is superfluous and optimizing direct measures of quality is a sensible approach.

Ideally, one would like to reconcile these two conflicting models of the relationship between cost and quality. We know of no empirical work that addresses this question. However, Fine

[1984] presents some yet-to-be-empirically-validated theoretical work that reconciles the two views. That work posits that Exhibit 1.1 is an accurate model of the static quality optimization problem, but that quality improvement enhances learning about the production process and affects the cost structure so that zero defects is the long-run cost-minimizing quality level.

In the absence of conclusive evidence that the two conflicting world views meet "in the long run," we recommend the following: If the senior management of the firm believes that improving quality always reduces costs, then use the DMOQ system. This system is straightforward and easily implementable by all employees. If the top management does not hold the belief that "quality is free," then all quality improvement projects should be cost-justified and COQ is the decision tool to use. In this latter case, attempts to implement even the rudiments of an RACOQ system could improve quality decision-making significantly.

Managerial style is the second dimension on which we wish to compare the four approaches to quality management. We define managerial style as the philosophy behind the management of human resources of the firm. Much has been written on this subject, but we will confine ourselves to a very simple model that allows only two fundamental managerial styles: authoritarian and participative. We view the authoritarian style as being closely aligned with the Theory X style of McGregor [1960], and the rational-economic assumptions of Schein [1980]. On the other hand, the participative style of management is aligned with Theory Y of McGregor and the self-actualization assumptions of Schein. Exhibit 3.1 briefly summarizes the Schein and McGregor works. (See Bridge [1984] for more on these constructs.)

THEORY X ASSUMPTIONS

People are inherently lazy and must, therefore, be motivated by outside incentives.

People's natural goals run counter to those of those of the organization, hence they must be controlled by external forces to ensure that they work toward organizational goals.

Because of their irrational feelings, people are basically incapable of self-discipline and self control.

People can, however, be divided roughly into two groups - those who fit the assumptions outlined above and those who are self-motivated, self-controlled, and less dominated by their feelings. This latter group must assume the management responsibilities for all the others.

THEORY Y ASSUMPTIONS

Human motives fall into a hierarchy of categories. Beginning with the most basic, they are (1) basic physiological needs; (2) needs for survival, safely, and security; (3) social and affiliative needs; (4) ego-satisfaction and self-esteem needs; (5) needs for self-actualization, that is, making maximum use of all one's talents and resources. As the most basic needs (for food, drink, sleep) are satisfied, they release energy for satisfaction of the higher level needs. Even someone we might consider "untalented" seeks a sense of meaning and accomplishment in his or her work if other needs are more or less fulfilled.

The individual seeks to be mature on the job and is capable of being so, in the sense of exercising of a certain amount of autonomy and independence, adopting a long range time perspective, developing special capacities and skills, and exercising greater flexibility in adapting to circumstances.

People are primarily self-motivated and self-controlled; externally imposed incentives and controls are likely to be threatening and to reduce the person to a less mature adjustment.

There is no inherent conflict between self-actualization and more effective organizational performance. If given a chance, employees will voluntarily integrate their own goals with those of the organization.

McGregor's Assumptions

Exhibit 3.1a
(Source: Schein [1980], p. 53)

RATIONAL-ECONOMIC MODEL

Employees are primarily motivated by economic incentives and will do whatever affords them the greatest economic gain.
Since economic incentives are under the control of the organization, the employee is essentially a passive agent to be manipulated, motivated, and controlled by the organization.
Feelings are, by definition, irrational and, therefore, must be prevented from interfering with a person's rational calculation of self-interest.
Organizations can and must be designed in such a way as to neutraize and control people's feelings and, therefore, their unpredictable traits.

SELF-ACTUALIZATION MODEL

(same as McGregor's "Theory Y")

Schein's Assumptions

Exhibit 3.1b
(Source: Schein [1980], pp. 53,68)

Deming's program is designed for a participative management style. Deming stresses management's duty to give employees meaningful work that gives them a sense of pride and self-esteem. People are viewed as primarily being self-motivated and self-controlled. Deming's viewpoint fits McGregor's description of Theory Y assumptions about human nature: "There is no inherent conflict between self-actualization and more efficient organizational performance. If given the chance, employees will voluntarily integrate their own goals with those of the organization" (Schein [1980], p.68).

The need for a participative management style in Deming's quality improvement program makes it difficult for many firms to adopt his approach. Firms with authoritarian management styles will encounter dramatic needs for change in their managerial style and their assumptions about human nature when they try to adopt Deming's program.

Deming's emphasis on the need for a "new" (i.e. participative) management style for a firm seems, at times, to overwhelm the quality aspects of his program. For example, several of the points in his Fourteen Points for Quality Improvement are oriented primarily towards the participative management style. (Examples include:

#10. Eliminate numerical goals for the work force,

#11. Eliminate work standards and numerical quotas, and

#12. Remove barriers that stand between the hourly worker and his right to pride of workmanship.) Firms that wish to change their management tools but not their management style have difficulty accepting Deming's program for quality improvement.

Juran's program embodies elements of both the authoritarian

and participative styles. The program fits the authoritarian style in that employees are expected to be motivated by the economic rewards that will result if they meet the objectives set by the Annual Quality Program. In addition, the primary emphasis of management is on efficient task performance. The morale of employees is secondary.

A description Schein (p.54) gives of the authoritarian style fits Juran's program very well. He summarizes the managerial strategy of such firms as being built around five principal functions of managing: (1) planning, (2) organizing, (3) staffing, (4) directing, and (5) controlling. Both the Annual Quality Program and the hierarchical organization of the quality department are examples of these five principles.

Juran's quality improvement program also exhibits some elements of a participative management style. He claims that a very small proportion of all defects are operator-controllable, and most of those that are caused by the operator are not willful. He believes that people by nature want to do a good job and de-emphasizes the idea that management can improve worker performance through improving motivation.

This mix of authoritarian and participative management styles make Juran's quality improvement program adaptable to almost any firm. On the basis of management style, no firm should find it difficult to implement Juran's quality program.

Crosby's quality program presents a management style that is closest to an quthoritarian style. All employees are told what is expected of them ("Zero Defects"), and the only input to management expected from lower level employees is identification of obstacles that prevent workers from meeting top management's

demands.

Crosby emphasizes that worker performance is tied directly to top management attitudes, and that if top management changes its attitudes, worker performance will change. This belief matches perfectly with Schein's description of an assumption held in an organization that adheres to the rational-economic world view: "The employee is essentially a passive agent to be manipulated, motivated, and controlled by the organization"(Schein, p. 53).

Emphasis on the individual rather than the group, a characteristic of the authoritarian style, is also evident in Crosby's awards programs for those who meet their goals or perform outstanding acts. (This contrasts with Deming's emphasis on group, rather than individual, performance. The Deming Prize in Japan is awarded for team effort by all members of the firm.)

Although Crosby's program embodies an authoritarian managerial style, firms with participative management styles should not have difficulty implementing his quality program. The management style of Crosby's program is not its crucial element. Crosby's program will accomodate a range of management styles. His program could be adapted easily by a firm with a participative management style because the strength of his program is neither its management decision tools nor the management style that it prescribes. The principal strength of Crosby's program is the attention it gives to managing the transition of the firm to quality consciousness; the emphasis on management style is secondary.

The Japanese management style is primarily participative. The practices of permitting workers to stop the production line at their discretion, to use statistical techniques to control and

improve the operations they work on, and to establish priorities and select projects through quality circles fit perfectly with the participative style of management. In addition, Japanese employees are expected to align their personal objectives with the objectives of the firm and they are expected to be mature, independent, and flexible.

However, one element of the Japanese system, the practice of stressing the system to discover defects, fits more closely with the authoritarian style of management. Underlying this practice is an assumption that workers must be pressured to improve the system. Mere enthusiasm is not enough.

A predominantly authoritarian firm would probably have some difficulty implementing the Japanese approach to quality management. Corporate cultures can usually only be changed in a slow evolutionary manner so that converting the firm to Japanese quality management would take time.

In evaluating the effects of managerial style on the implementability of the different approaches to quality management, we think that managerial style issues would not preclude any firm from adopting the Juran or Crosby approach to quality management. However, firms that are predominantly authoritarian may have trouble adapting to the Deming or Japanese managerial styles. Such a change is obviously not impossible. We hypothesize that authoritarian firms are more likely to be successful in changing their managerial style when a clear threat (e.g., high quality competition is threatening to bankrupt the firm) is present. However, a strong top management commitment to change, even in the absence of a threat, may be sufficient.

The third dimension for distinguishing among the four

approaches to quality improvement is the management of the firm's transition to having a well-run quality management system. Implementing any of the quality improvement programs discussed requires organizational change. Achieving such change can be quite difficult, and it is useful to see what guidance each author provides for helping this implementation.

Deming provides virtually no advice on how to manage the firm's transition to becoming the type of company he describes. Deming is especially vulnerable to this criticism because of the major changes, in management style and decision rules, that he prescribes. Deming's 14 points are a description of how the firm should look after his program has been implemented. For Deming's program, the absence of a road map for managing the transition state is a significant deficiency.

Juran does not address the management of the transition state very well, but he does not demand great change in the firm. His program is suited to all management styles, and the COQ managerial decision system fits well with the cost-minimizing, accounting-based decision systems traditionally used by most firms.

Although more direction on managing the transition state would definitely benefit Juran's program, the lack of significant change in either managerial style or decision systems for planning and controlling quality make it quite likely that a firm could successfully undertake the program without further guidance.

Crosby's program could be viewed as being a classic example of how to manage transition. (See Bridge [1984] for more on this.) His fourteen step program meets almost every criterion set by Beckhard and Harris [1977] for managing complex changes in organizations.

Crosby's program starts with a plan and strategy for gaining top management commitment. The thoroughness of this plan is demonstrated by Crosby's development of prepared speeches and tapes that can be used to gain this top management commitment. Throughout the entire program, Crosby is sensitive to building and maintaining top management commitment. For example, cost-of-quality measurements are introduced as a tool to gain support for the program.

Besides the commitment of top management, Crosby seeks the commitment of union representatives, the controller's office, manufacturing and engineering personnel, and many others. He presents much advice for winning the commitment of each of the groups.

Crosby's mechanism for managing the transition state is very explicit. Representatives from each department are brought together to form a Quality Improvement Team that will, with guidance from the quality department, manage the transition. The process or activity plan that is outlined by Crosby is extremely thorough, and it is very difficult to fault the attention Crosby gives to managing the transition state.

Managing the transition to a Japanese quality management system would probably be as difficult as managing the transition to becoming a Deming organization. Ouchi [1981] treats some of the relevant issues for managing such a change. To our knowledge, there is no Japanese tutorial on how to change one's organization to be like a Japanese organization.

4. Conclusions

As a result of the exercise of exploring the four approaches to quality management, we have developed several potentially useful guidelines for evaluating and selecting among quality improvement programs.

First, with respect to decision tools and decision rules for quality management, COQ is probably essential if top management does not believe that improving quality reduces costs. If top management does believe the quality-reduces-costs hypothesis, then DMOQ is probably superior. Second, with respect to choosing a quality improvement program, managerial style is important. Firms that do not face a severe threat or do not have very high levels of management commitment should avoid programs that require significant changes in management style. Finally, management of the transition to high quality achievement is a crucial activity. Firms that wish to adopt the Deming or Japanese approach to quality management will have to supplement these programs with processes for managing the transition to new quality practices and attitudes.

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