HOMEWORK


2. What are the possible obstacles for TQM implementation in your company? Explain how you might overcome them.

3. Write a manufacturing problem which is in need of a solution in your company.
A Note on Quality: The Views of Deming, Juran, and Crosby

During the 1980s concerns about American competitiveness steered many U.S. companies to a new interest in quality. The three leading "quality gurus" were W. Edwards Deming, Joseph Juran, and Philip Crosby. Each was an active consultant, lecturer, and author, with years of experience. Deming and Juran were in their eighties and had been enormously influential in Japan; Crosby was in his sixties and had worked previously at ITT as vice president of quality. Each had developed his own distinctive approach to quality management.

Deming

W. Edwards Deming was widely credited with leading the Japanese quality revolution. The Japanese began to heed his advice on statistical process control (SPC) and problem-solving techniques in 1950, but 30 years passed before American businesses began to respond. By then, Deming's message to managers was blunt: "The basic cause of sickness in American industry and resulting unemployment is failure of top management to manage."

Known to dismiss client companies that did not change, he stated, "I give 'em three years. I've got to see a lot happen." Best efforts were not enough; a program was needed, and it had to be adopted wholeheartedly:

Everyone doing his best is not the answer. It is necessary that people know what to do. Drastic changes are required. The responsibility for change rests on management. The first step is to learn how to change.  

What Deming then expected from his clients was summarized in a 14-point program (see Exhibit 1).

To begin, managers had to put aside their preoccupation with today to make sure there was a tomorrow. They had to orient themselves to continuous improvement of products and services to meet customers' needs and stay ahead of the competition. They had to innovate constantly and commit resources to support innovation and continuous quality improvement. They had to build quality in. They had to break down department and worker-supervisor barriers. They had to rid themselves of numerical targets and quotas and instead had to concentrate on improving processes, giving workers clear standards for acceptable work, as well as the tools needed to achieve it. Finally, they had to create a climate free of fear, which block cooperative identification and solution of problems.

If management committed itself to this new order, Deming argued, productivity as well as quality would improve. Contrary to conventional wisdom in the United States, quality and productivity were not to be traded off against each other. Rather, productivity was a by-product of quality and of doing the job right the first time:

Improvement of the process increases uniformity of product, reduces rework and mistakes, reduces waste of manpower, machine-time, and materials, and thus increases output with less effort. Other benefits of improved quality are lower costs, ... happier people on the job, and more jobs, through better competitive position of the company. 

Because management was responsible, in Deming's view, for 85% of all quality problems, management had to take the lead in changing the systems and processes that created those problems. For example, consistent quality of incoming materials and components could not be expected when buyers were told to shop for price or were not given the tools for assessing a supplier's quality. Management had to develop long-term relationships with vendors, work with vendors to improve and maintain quality, train its own purchasing department in statistical quality control, require statistical evidence of quality from vendors, and insist that specifications be complete, including an understanding of how the material actually worked in manufacturing. Once management had changed purchasing systems and procedures, buyers could then not only be expected but also able to do their job in a new way. When top management had seriously committed to quality, lower-level personnel would be more likely to take action on problems that were within their control.

Accordingly, Deming delineated two means of process improvement: changing the "common causes" that were systemic (and were thus shared by numerous operators, machines, or products) and removing the "special causes" that produced nonrandom variation within systems (and were usually confined to individual employees or activities). Common causes included poor product design, incoming materials unsuited to their use, machines out of order, improper bills of materials, machinery that would not hold tolerances, poor physical conditions, and so on. Special causes included lack of knowledge or skill, worker inattentiveness, or a poor lot of incoming materials. Management was responsible for common causes, and operators were responsible for special causes:

The discovery of a special cause of variation and its removal are usually the responsibility of someone who is connected directly with some operation. ... In contrast, there are common causes of defects, of errors, of low rates of production, of low sales, of accidents. These are the responsibility of management. ... The worker at a machine can

3. Deming, Quality, p. ii.
4. Ibid., p. 1.
do nothing about causes common to all machines. . . . He cannot do anything about the light; he does not purchase raw materials; the training, supervision, and the company’s policies are not his.5

The key tool that Deming advocated to distinguish between systemic and special causes—and indeed, the key to quality management in general—was statistical process control (SPC). Developed by Walter Shewart while at Bell Labs in the 1930s and later refined by Deming in a well-known paper, “On the Statistical Theory of Errors,” SPC was required because variation was an inevitable fact of industrial life. It was unlikely that two parts, even when produced by the same operator at the same machine, would ever be identical. The issue, therefore, was distinguishing acceptable variation from variation that could indicate problems. The rules of statistical probability provided a method for making this distinction.

Probability rules could determine whether variation was random or not, that is, whether it was due to chance. Random variation occurred within statistically determined limits. If variation remained within those limits, the process was a stable one and in control. As long as nothing changed the process, future variation could be predicted easily, for it would remain indefinitely within the same statistical limits.

Data of this sort were normally collected and plotted on control charts kept by the operators themselves. Such charts graphically plotted actual performance readings (e.g., the outside diameters of pistons) on graphs that also depicted the upper and lower control limits for that characteristic, which were statistically determined (see Figure A).

As long as the readings, taken on a small sample of units at predetermined intervals (such as every half hour), fell between limits or did not show a trend or “run,” the process was in control and no intervention was required, despite the obvious variation in readings. Readings that either fell outside the limits or produced a run indicated a problem to be investigated.

The practical value of distinguishing random from nonrandom variation was enormous. Operators now knew when to intervene in a process and when to leave it alone. Further, because readings were taken during the production process itself, unacceptable variation showed up early enough for corrective action, rather than after the fact.

Once a process was in control, readings that fell outside the limits indicated a special cause. When the cause of such nonrandom variation

was found and removed, the system returned to its stable state. For example, if a particular lot of goods showed yields that were below control limits, further analysis might determine that raw materials peculiar to that lot were the cause. The removal of such special causes, however, did not improve the system (i.e., raise yield levels), but simply brought it back under control at the preexisting yield.

To improve the system itself, common causes had to be removed. Simply because a system was in statistical control did not mean it was as good as it could be. Indeed, a process in control could produce a high proportion of defects. Control limits indicated what the process was, not what it should or could be. To move the average (yield, sales, defects, returns, etc.) up or down—and thus also move the control limits up or down—typically required the concerted efforts of engineering, research, sales, manufacturing, and other departments. To narrow the range of variation around the target point could consume even more effort. In both instances, control charts would readily document the improvements in the process.

Deming viewed training in the use of control charts as essential if workers were to know what constituted acceptable work. He was adamant that quotas, piecework, and numerical goals be eliminated. Instead, workers had to be shown good work and given the tools to do it. Such tools would also allow them to monitor their own work and correct it in real time, rather than find out about problems days or weeks later.

Control charts were but one part of the statistical approach to quality. Because 100% testing was inefficient, sampling techniques had been developed to provide a scientific basis on which to accept or reject production lots based on a limited number of units. Although sampling and control charts could indicate problems, they could not by themselves identify their causes. For that purpose, other statistical techniques were needed, such as Pareto analysis, Ishikawa or “fishbone” cause-and-effect diagrams, histograms, flow charts, and scatter diagrams.

By 1986 Deming’s lectures concentrated more on management than SPC, but SPC remained at the core of his approach. Many U.S. firms sought him out, and some, such as the Ford Motor Company, adopted his approach throughout the company with great success. Deming, who still worked out of the basement of his home with his secretary of 30 years, was hardly sanguine about the prospects for American business. He believed that it would take 30 years for Americans to match the progress of the Japanese and that the United States was still falling behind. With the specter of a lower U.S. standard of living, he concluded, “We should be pretty scared.”

Juran

Joseph M. Juran’s impact on Japanese quality was usually considered second only to Deming’s. At 82, he had enjoyed a varied and distinguished career that included stints as a business executive, government administrator, lecturer, writer, and consultant. After years of independent activity, he established the Juran Institute in 1979 to serve as a base for the seminars, consulting, conferences, and videotapes long associated with his name. His clientele included Texas Instruments, Du Pont, Monsanto, and Xerox.

Juran defined quality as “fitness for use,” meaning that the users of a product or service should be able to count on it for what they needed or wanted to do with it. For example, a manufacturer should be able to process a purchased material or component to meet the demands of its customers while achieving high yields and minimal downtime in production; a wholesaler should receive a correctly labeled product, free from damage during shipment and easy to handle and display; and a consumer should receive a product that performed as claimed and did not break down—or, if it did, receive prompt and courteous adjustment of the claim.

Fitness for use had five major dimensions: quality of design, quality of conformance, availability, safety, and field use. Quality of design was what distinguished a Rolls Royce from a Chevrolet and involved the design con-

7. The key parameters of fitness for use, as well as their dimensions, vary somewhat in Juran’s writings over a 35-year period. Their comprehensiveness and their spanning the entire product life cycle, however, are constants. The present discussion draws most heavily on Joseph M. Juran and Frank M. Gryna, Jr., Quality Planning and Analysis (New York: McGraw-Hill, 1980).
cept and its specification. Quality of conformance reflected the match between actual product and design intent and was affected by process choices, ability to hold tolerances, workforce training and supervision, and adherence to test programs. Availability referred to a product's freedom from disruptive problems and reflected both reliability (the frequency or probability of failure) and maintainability (the speed or ease of repair). Safety could be assessed by calculating the risk of injury due to product hazards. Field use referred to a product's conformance and condition after it reached customers' hands and was affected by packaging, transportation, storage, and field-service competence and promptness.

To achieve fitness for use, Juran developed a comprehensive approach to quality that spanned a product's entire life—from design through vendor relations, process development, manufacturing control, inspection and test, distribution, customer relations, and field service. Each area was carefully dissected, and approaches were proposed to specify and quantify its impact on the various elements of fitness for use. A broad range of statistical techniques was included to assist in the analysis.

Juran's approach to reliability provides a representative example. His reliability program began by establishing reliability goals. It then apportioned these among product components; identified critical components; identified possible modes, effects, and causes of failures; and developed solutions for those most critical to successful product operation and safety. Juran also discussed the setting of realistic tolerances, design reviews, vendor selection, and testing of designs. Statistical methods for improving reliability included analysis of various types of failure rates, analysis of relationships between component and system reliability, and setting of tolerance limits for interacting dimensions. The aims of these activities were quantified reliability goals, a systematic guide for achieving them, and a measurement and monitoring system for knowing when they had been achieved.

Although Juran's analytical methods could identify areas needing improvement and could help make and track changes, they were in the language of the shop floor: defect rates, failure modes, not within specification, and the like.

Juran recognized that such measures were not likely to attract top management attention; for this reason, he advocated a cost-of-quality (COQ) accounting system. Such a system spoke top management's language—money. Quality costs were costs "associated solely with defective product—the costs of making, finding, repairing, or avoiding defects." They were of four types: internal failure costs (from defects discovered before shipment); external failure costs (from defects discovered after shipment); appraisal costs (for assessing the condition of materials and product); and prevention costs (for keeping defects from occurring in the first place). (See Exhibit 2.) In most companies, external and internal failure costs together accounted for 50% to 80% of COQ. When these were converted to dollars or presented as a percentage of sales or profits, top management usually took notice.

COQ not only provided management with a dollar cost for defective products, it also established the goal of quality programs: to keep improving quality until there was no longer a positive economic return. This occurred when the total costs of quality were minimized (see Exhibit 3). Two assumptions were built into this analysis: that failure costs approached zero as defects became fewer and fewer, and that prevention and appraisal costs together approached infinity as defects were reduced to lower and lower levels. COQ minimization therefore occurred at the point where additional spending on prevention and appraisal was no longer justified because it produced smaller savings in failure costs.

This approach had important practical implications. It implied that zero defects was not a practical goal, for to reach that level prevention and appraisal costs would have to rise so substantially that total costs of quality would not be minimized. As long as prevention and appraisal costs were cheaper (on a per-unit basis) than failure costs, Juran argued, resources should continue to go to prevention and testing. When prevention activities started to pull COQ unit costs up rather than down, however, it was time to maintain quality rather than attempt to reduce it further.

To reach and maintain this minimum cost of quality, Juran proposed a three-pronged ap-

approach: breakthrough projects, the control sequence, and annual quality programs. In the early stages, when a firm's failure costs greatly exceeded its prevention and appraisal costs, there were significant opportunities for breakthrough projects, aimed at chronic problems. Problems, such as the need to revise tolerances, were ignored because they were neither dramatic nor thought to be solvable. The "breakthrough sequence" involved identifying the "vital few" projects, selling them to management, organizing to analyze the issues and to involve the key people who were needed for implementation, and overcoming resistance to change (see Exhibit 4). Juran claimed that most breakthrough analyses found that over 80% of the problems (e.g., defect rates, scrap rates) were under management control and fewer than 20% were caused by operators.

After successive breakthrough projects, a firm reached the point of optimal quality—in Juran's formulation, the bottom of the COQ curve. The organization then needed to employ the control sequence to preserve its gains. This sequence was actually a large feedback loop. The first step was to choose an objective to control, then to define a unit of measure, set a numerical standard or goal, create a means of measuring performance, and mobilize the organization to report the measurements. After these preparatory steps, an action cycle was repeated over and over: actual performance was compared with standard, and action was taken (if needed) to close the gap.9

The control sequence was also used to attack sporadic problems—sudden, usually dramatic changes in the status quo, such as a worn cutting tool. Eliminating sporadic problems only returned processes to their historical levels; to improve them to optimum levels, breakthrough teams were needed because chronic problems were involved. Juran's contrast between these two types of problems is illustrated in Figure B.

Both the control and breakthrough processes demanded sophisticated analysis and statistics. The comprehensiveness of Juran's program (it ran from vendor relations through customer service and covered all the functions in between) required high-level planning and coordination as well. For this reason, Juran argued that a new group of professionals—quality control engineers—was needed. This department would be involved in high-level quality planning, coordinating the activities of other departments, setting quality standards, and providing quality measurements. Juran also believed that top management had to give overall leadership and support to quality improvement for it to succeed.

Juran's major vehicle for top management involvement was the annual quality program. Akin to long-range financial planning and the annual budget process, this program gave top management quality objectives and was especially important for internalizing the habit of

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quality improvement to ensure that complacency did not set in.

Crosby

Philip B. Crosby started in industry as an inspector. He eventually rose through the ranks at several companies to become vice president of quality at ITT. In 1979 he left ITT to found Philip Crosby Associates, Inc., along with the Crosby Quality College, which by 1986 approximately 35,000 executives and managers had attended. General Motors owned over 10% of Crosby stock and had set up its own Crosby school, as had IBM, Johnson & Johnson, and Chrysler.

Crosby directed his message to top managers. He sought to change their perceptions and attitudes about quality. Typically, top managers viewed quality as intangible or else to be found only in high-end products. Crosby, however, spoke of quality as “conformance to requirements” and believed that any product that consistently reproduced its design specifications was of high quality. In this sense, a Pinto that met Pinto requirements was as much a quality product as a Cadillac that conformed to Cadillac requirements.

American managers must pursue quality to help them compete, Crosby argued. In fact, he believed that if quality were improved, total costs would inevitably fall, allowing companies to increase profitability. This reasoning led to Crosby’s most famous claim—that quality was “free.”

Ultimately, the goal of quality improvement was zero defects, to be achieved through prevention rather than after-the-fact inspection. Crosby had popularized the zero defects movement, but it had actually originated in the United States at the Martin Company in the 1960s, where Crosby was employed. The company had promised and delivered a perfect missile, with limited inspection and rework, and its managers had concluded that perfection was possible if, in fact, it was expected. The company then developed a philosophy and program to support that goal.

Crosby elaborated on this approach. He believed that the key to quality improvement was changing top management’s thinking. If management expected imperfection and defects, it would get them, for workers would bring similar expectations to their jobs. But if management established a higher standard of performance and communicated it thoroughly to all levels of the company, zero defects was possible. Thus, according to Crosby, zero defects was a management standard and not simply a motivational program for employees.

To help managers understand the seriousness of their quality problems, Crosby provided two primary tools: cost of quality measures and the management maturity grid (see Exhibit 5). Costs of quality, which Crosby estimated to be between 15% and 20% of sales at most companies, were useful for showing top management the size of its quality problem and the opportunities for profitable improvement. The management maturity grid was used for self-assessment. It identified five stages of quality awareness: uncertainty (the company failed to recognize quality as a management tool); awakening (quality was recognized as important, but management put off taking action); enlightenment (management openly faced and addressed quality problems by establishing a formal quality program); wisdom (prevention was working well, problems were identified early, and corrective action was routinely pursued); and certainty (quality management was an essential part of the company, and problems occurred only infrequently). For each of these five stages, Crosby also examined the status of the quality organization, problem-handling procedures, reported and actual costs of quality as percentages of sales, and quality improvement actions.

Once companies had positioned themselves on the management maturity grid, Crosby offered a 14-point program for quality improvement (see Exhibit 6). It emphasized prevention over detection, and focused on changing corporate culture rather than on analytical or statistical tools. The program was designed as a guide for securing management commitment and gaining employees’ involvement through actions such as Zero Defects Day. Crosby believed every company should tailor its own defect-prevention program; nevertheless, the goal should always be zero defects. In this process top management played a leadership role; quality professionals played a modest but important role as facilitators, coordinators, trainers, and technical assistants, and hourly workers were secondary.

Exhibit 1  Deming’s 14 Points

1. **Create constancy of purpose for improvement of product and service.** Management must change from a preoccupation with the short run to building for the long run. This requires dedication to innovation in all areas to best meet the needs of customers.

2. **Adopt the new philosophy.** Shoddy materials, poor workmanship, defective products, and lax service must become unacceptable.

3. **Cease dependence on mass inspection.** Inspection is equivalent to planning for defects; it comes too late and is ineffective and costly. Instead, processes must be improved.

4. **End the practice of awarding business on price tag alone.** Price has no meaning without a measure of the quality being purchased. Therefore, the job of purchasing will change only after management establishes new guidelines. Companies must develop long-term relationships and work with fewer suppliers. Purchasing must be given statistical tools to judge the quality of vendors and purchased parts. Both purchasing and vendors must understand specifications, but they must also know how the material is to be used in production and by the final customer.

5. **Constantly and forever improve the system of production and service.** Waste must be reduced and quality improved in every activity: procurement, transportation, engineering, methods, maintenance, sales, distribution, accounting, payroll, customer service, and manufacturing. Improvement, however, does not come from studying the defects produced by a process that is in control but from studying the process itself. Most of the responsibility for improvement rests with management.

6. **Institute modern methods of training on the job.** Training must be restructured and centered on clearly defined concepts of acceptable work. Statistical methods must be used for deciding when training has been completed successfully.

7. **Institute modern methods of supervising.** Supervisors must be empowered to inform upper management about conditions that need correction; once informed, management must take action. Barriers that prevent hourly workers from doing their jobs with pride must be removed.

8. **Drive out fear.** Because of the tremendous economic losses caused by fear on the job, people must not be afraid to ask questions, to report problems, or to express ideas.

9. **Break down barriers between departments.** Members of the research, design, procurement, sales, and receiving departments must learn about problems with raw materials and specifications in production and assembly. Each discipline must stop optimizing its own work and instead work together as a team for the company as a whole. Multidisciplinary quality-control circles can help improve design, service, quality, and costs.

10. **Eliminate numerical goals for the work force.** Targets, slogans, pictures, and posters urging people to increase productivity must be eliminated. Most of the necessary changes are out of workers’ control, so such exhortations merely cause resentment. Although workers should not be given numerical goals, the company itself must have a goal: never-ending improvement.

11. **Eliminate work standards and numerical quotas.** Quotas focus on quantity, not quality. Therefore, work standards practically guarantee poor quality and high costs. Work standards that state percentage-defective or scrap goals normally reach those targets but never exceed them. Piecework is even worse, for it pays people for building defective units. But if someone’s pay is docked for defective units, that is unfair, for the worker did not create the defects.

12. **Remove barriers that hinder the hourly workers.** Any barrier that hinders pride in work must be removed, including not knowing what good work is, supervisors motivated by quotas, off-gauge parts and material, and no response to reports of out-of-order machines.

13. **Institute a vigorous program of education and training.** Because quality and productivity improvements change the number of people needed in some areas and the jobs required, people must be continually trained and retrained. All training must include basic statistical techniques.

14. **Create a structure in top management that will push every day on the above 13 points.**

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a. Deming’s words are in bold headings. The remainder of each paragraph paraphrases his discussions.
Exhibit 2  Juran's Categories of Quality Costs

**Internal failure costs** = costs from product defects before shipment to the customer. They include the following:
- *Scrap* – net losses in labor and material resulting from defective goods that cannot economically be repaired or used.
- *Rework* – costs of correcting defective products to make them usable.
- *Retest* – costs of reinspection and retesting of products that have been reworked.
- *Downtime* – costs of idle facilities, equipment, and labor due to defective products.
- *Yield losses* – costs of process yields lower than could be attained through improved process control.
- *Disposition* – the time of those involved in determining whether nonconforming products are usable and what should be done with them.

**External failure costs** = costs associated with defects found after shipment to customer. They include the following:
- *Complaint adjustment* – costs of investigating and responding to complaints due to defective products, faulty installation, or improper instructions to users.
- *Returned material* – costs associated with receiving and replacing defective products returned from the field.
- *Warranty charges* – costs of services and repairs performed under warranty contracts.
- *Allowances* – income losses due to downgrading products for sale as seconds and to concessions made to customers who accept substandard products as is.

**Appraisal costs** = costs associated with discovering the condition of products and raw materials. They include the following:
- *Incoming materials inspection* – costs associated with determining the quality of vendors' products.
- *Inspection and test* – costs of checking product conformance throughout design and manufacture, including tests done on customers’ premises.
- *Maintaining accuracy of test equipment* – costs of operating and maintaining measuring instruments.
- *Materials and services consumed* – costs of products consumed in destructive tests; also materials and services (e.g., electric power) consumed in testing.
- *Evaluation of stocks* – costs of testing products in storage to assess their condition.

**Prevention costs** = costs associated with preventing defects and limiting failure and appraisal costs. They include the following:
- *Quality planning* – costs of creating and communicating plans and data systems for quality, inspection, reliability, and related activities—includes the costs of preparing all necessary manuals and procedures.
- *New products review* – costs of preparing bid proposals, evaluating new designs, preparing test and experimentation programs, and related quality activities associated with launching new products.
- *Training* – costs of developing and conducting training programs aimed at improving quality performance.
- *Process control* – costs of process control aimed at achieving fitness for use, as distinguished from productivity (a difficult distinction to make in practice).
- *Quality data acquisition and analysis* – costs of operating the quality data system to get continuing data on quality performance.
- *Quality reporting* – costs of bringing together and presenting quality data to upper management.
- *Improvement projects* – costs of building and implementing breakthrough projects.

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Note: This is a summary and rewording of Juran and Gryna, *Quality Planning*, pp. 14–16.
Note on Quality

Exhibit 3  Minimizing the Costs of Quality

Note:  This figure is adapted from Juran and Gryna, Quality Planning, p. 27.
Exhibit 4  Juran’s Breakthrough Sequence

1. **Breakthrough in attitudes.** Managers must first prove that a breakthrough is needed and then create a climate conducive to change. To demonstrate need, data must be collected to show the extent of the problem; the data most convincing to top management are usually cost-of-quality figures. To get the resources required for improvement, expected benefits can be monetized and presented in terms of return on investment.

2. **Identify the vital few projects.** Pareto analysis is used to distinguish the vital few projects from the trivial many and to set priorities based on problem frequency.

3. **Organize for breakthrough in knowledge.** Two organizational entities should be established—a steering group and a diagnostic group. The steering group, composed of people from several departments, defines the program, suggests possible problem causes, gives the authority to experiment, helps overcome resistance to change, and implements the solution. The diagnostic group, composed of quality professionals and sometimes line managers, is responsible for analyzing the problem.

4. **Conduct the analysis.** The diagnostic group studies symptoms, develops hypotheses, and experiments to find the problem’s true causes. It also tries to determine whether defects are primarily operator controllable or management controllable. (A defect is operator controllable only if it meets three criteria: operators know what they are supposed to do, have the data to understand what they are actually doing, and are able to regulate their own performance.) Theories can be tested by using past data and current production data and by conducting experiments. With this information, the diagnostic group then proposes solutions to the problem.

5. **Determine how to overcome resistance to change.** The need for change must be established in terms that are important to the key people involved. Logical arguments alone are insufficient. Participation is therefore required in both the technical and social aspects of change.

6. **Institute the change.** Departments that must take corrective action must be convinced to cooperate. Presentations to these departments should include the size of the problem, alternative solutions, the cost of recommended changes, expected benefits, and efforts taken to anticipate the change's impact on employees. Time for reflection may be needed, and adequate training is essential.

7. **Institute controls.** Controls must be set up to monitor the solution and see that it works and to keep abreast of unforeseen developments. Formal follow-up is provided by the control sequence used to monitor and correct sporadic problems.

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Note: This summary is adapted from Juran and Gryna, *Quality Planning*, pp. 100-129, and Juran, *Managerial Breakthrough*, pp. 15-17.
<table>
<thead>
<tr>
<th>Measurement Categories</th>
<th>Stage I: Uncertainty</th>
<th>Stage II: Awakening</th>
<th>Stage III: Enlightenment</th>
<th>Stage IV: Wisdom</th>
<th>Stage V: Certainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management understanding and attitude</td>
<td>Fails to see quality as a management tool.</td>
<td>Supports quality management in theory but is unwilling to provide the necessary money or time.</td>
<td>Learns about quality management and becomes supportive.</td>
<td>Participates personally in quality activities.</td>
<td>Regards quality management as essential to the company’s success.</td>
</tr>
<tr>
<td>Quality organization status</td>
<td>Quality activities are limited to the manufacturing or engineering department and are largely appraisal and sorting.</td>
<td>A strong quality leader has been appointed, but quality activities remain focused on appraisal and sorting and are still limited to manufacturing and engineering.</td>
<td>Quality department reports to top management, and its leader is active in company management.</td>
<td>Quality manager is an officer of the company. Prevention activities have become important.</td>
<td>Quality manager is on the board of directors. Prevention is the main quality activity.</td>
</tr>
<tr>
<td>Problem handling</td>
<td>Problems are fought as they occur and are seldom fully resolved; “fire-fighting” dominates.</td>
<td>Teams are established to attack major problems, but the approach remains short term.</td>
<td>Problems are resolved in an orderly fashion, and corrective action is a regular event.</td>
<td>Problems are identified early in their development.</td>
<td>Except in the most unusual cases, problems are prevented.</td>
</tr>
<tr>
<td>Cost of quality as percentage of sales</td>
<td>Reported: unknown Actual: 20%</td>
<td>Reported: 5% Actual: 18%</td>
<td>Reported: 8% Actual: 12%</td>
<td>Reported: 6.5% Actual: 8%</td>
<td>Reported: 2.5% Actual: 2.5%</td>
</tr>
<tr>
<td>Quality improvement actions</td>
<td>No organized activities.</td>
<td>Activities are motivational and short term.</td>
<td>Implements the 14-step program with full understanding.</td>
<td>Continues the 14-step program and starts Make Certain.</td>
<td>Quality improvement is a regular and continuing activity.</td>
</tr>
<tr>
<td>Summation of company quality posture</td>
<td>“We don’t know why we have quality problems.”</td>
<td>“Must we always have quality problems?”</td>
<td>“Because of management commitment and quality improvement programs, we are identifying and resolving our quality problems.”</td>
<td>“We routinely prevent defects from occurring.”</td>
<td>“We know why we don’t have quality problems.”</td>
</tr>
</tbody>
</table>

Note: This chart is adapted from Crosby, *Quality is Free*, pp. 32-33.
Exhibit 6  Crosby’s 14-Point Program

1. **Management commitment.** Top management must become convinced of the need for quality improvement and must make its commitment clear to the entire company. This should be accompanied by a written quality policy, stating that each person is expected to “perform exactly like the requirement, or cause the requirement to be officially changed to what we and the customers really need.”

2. **Quality improvement team.** Management must form a team of department heads (or those who can speak for their departments) to oversee quality improvement. The team’s role is to see that needed actions take place in its departments and in the company as a whole.

3. **Quality measurement.** Quality measures that are appropriate to every activity must be established to identify areas needing improvement. In accounting, for example, one measure might be the percentage of late reports; in engineering, the accuracy of drawings; in purchasing, rejections due to incomplete descriptions; and in plant engineering, time lost because of equipment failures.

4. **Cost of quality evaluation.** The controller’s office should make an estimate of the costs of quality to identify areas where quality improvements would be profitable.

5. **Quality awareness.** Quality awareness must be raised among employees. They must understand the importance of product conformity and the costs of nonconformity. These messages should be carried by supervisors (after they have been trained) and through such media as films, booklets, and posters.

6. **Corrective action.** Opportunities for correction are generated by Steps 3 and 4, as well as by discussions among employees. These ideas should be brought to the supervisory level and resolved there, if possible. They should be pushed up further if that is necessary to get action.

7. **Zero defects planning.** An ad hoc zero defects committee should be formed from members of the quality improvement team. This committee should start planning a zero defects program appropriate to the company and its culture.

8. **Supervisor training.** Early in the process, all levels of management must be trained to implement their part of the quality improvement program.

9. **Zero Defects Day.** A Zero Defects Day should be scheduled to signal to employees that the company has a new performance standard.

10. **Goal setting.** To turn commitments into action, individuals must establish improvement goals for themselves and their groups. Supervisors should meet with their people and ask them to set goals that are specific and measurable. Goal lines should be posted in each area and meetings held to discuss progress.

11. **Error cause removal.** Employees should be encouraged to inform management of any problems that prevent them from performing error-free work. Employees need not do anything about these problems themselves; they should simply report them. Reported problems must then be acknowledged by management within 24 hours.

12. **Recognition.** Public, nonfinancial appreciation must be given to those who meet their quality goals or perform outstandingly.

13. **Quality councils.** Quality professionals and team chairpersons should meet regularly to share experiences, problems, and ideas.

14. **Do it all over again.** To emphasize the never-ending process of quality improvement, the program (Steps 1–13) must be repeated. This renews the commitment of old employees and brings new ones into the process.

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Note: This summary is adapted from Crosby, *Quality is Free*, pp. 132–139, 175–259.