TOTAL QUALITY ENVIRONMENTAL MANAGEMENT

the primer

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About the Global Environmental Management Initiative (GEMI)

GEMI is a group of 23 leading companies dedicated to fostering environmental excellence by business worldwide. Through the collaborative efforts of its members, GEMI intends to promote a worldwide business ethic for environmental management and sustainable development, to improve the environmental performance of business through example and leadership, and to enhance the dialogue between business and its interested publics. Below is a list of GEMI's current member companies:

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PREFACE

This primer is written for, and in a very real sense, by corporate environmental managers. To develop case materials, Abt Associates distilled the experiences of dozens of environmental managers and staffs who have provided the Global Environmental Management Initiative (GEMI) with invaluable information. The members of GEMI wish to thank the many people who helped prepare the primer.

This primer, in the true spirit of TQM, was a strong collaboration consisting of a cross-functional team including the members of GEMI, Abt Associates, JT&A, Inc., and the Environmental Policy Center.

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May, 1992

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INTRODUCTION

It was during the 1980s that world industry awoke to an operating philosophy long espoused by a visionary group of American business theoreticians. The philosophy, termed Total Quality Management, or TQM, had been embraced by the Japanese following World War II and is credited with the surge to world market dominance of that country's automobile and electronics industries in the 1970s.

Ironically, TQM had its origins in the United States during World War II, when American statistician W. Edwards Deming helped engineers and technicians use statistical theory to improve production quality. After the war, his theories largely dismissed by American corporations, Deming went to Japan, where he lectured top business leaders on statistical quality control, telling them they could rebuild their country if they followed his advice.

Since then, TQM has gained acceptance as a tool for improving corporate performance across all aspects of business, including environmental management. Today, many companies are learning that TQM can be an effective strategy to continuously improve their environmental performance.

TQEM DEFINED

The Global Environmental Management Initiative (GEMI) is generally credited as being the first organization to marry environmental management and Total Quality Management (TQM). This primer outlines methods of applying TQM to corporate environmental strategies, a process GEMI has identified as Total Quality Environmental Management, or TQEM.

This document is intended to help you get started, to show you how to use TQEM to continuously improve your environmental performance. In no way do these pages comprise a comprehensive training tool on Total Quality; for that, you will need to reference the many excellent books, papers, and courses already available.

This chapter explains the elements of a TQEM system. The next chapter describes how to build a TQEM system within a business. The final chapter sums up the benefits of incorporating a TQEM system in your company.

Basic Elements of TQEM

■ ***Identify your customers.*** Total Quality is based on the premise that the customer is always right. In fact, quality is defined by what the customer wants. Customers can be external (i.e., consumers, regulators, legislators, community and national environmental groups) or internal (such as other departments within the company, higher management levels).

■ ***Continuous improvement.*** The systematic, ongoing effort to improve business processes, continuous improvement changes the entire corporate perspective. The staff is motivated to seek innovative alternatives to outdated processes and policies. With continuous improvement there is no endpoint, only progress along a continuum.

■ ***Do the job right the first time.*** In TQEM it is essential to recognize and eliminate environmental problems before they occur. The best cure for a pound of environmental crises is an ounce of prevention. Focusing employee attention on the causes of environmental problems instead of the symptoms can reduce the cost of waste disposal, government reporting, and crisis control. By investing in prevention, a company can save on the long-term costs of compliance, resources, and unplanned liabilities.

The cost of quality is the cost that quality failures impose on your company. In environmental management, these costs are those of generating wastes that do not add to or may even reduce the value of your product or service to your customer.

■ ***Take a systems approach to work.*** TQEM teaches us to look at each part of environmental management as a system. The system includes all of the equipment and people who must work together to achieve the desired objective. Total Quality causes us to work across organizational boundaries, forming teams that represent all of the functions involved in making a system work as intended.

Interactions of people and decisionmaking procedures can be flow-charted and analyzed as a system. This focuses attention on what is wrong with the system, instead of forcing blame on an individual.

For example, in an emergency situation, a prompt and effective response results from people knowing what to do. The "first respondents" in an emergency depend on training, a reliable communications system, and well-maintained equipment. If any of these elements do not work as intended, the "system" will not work. This system includes not only people, but training, drills, and emergency equipment.

In a well-organized system, all the components (functions) work together to support each other. In a system that is well-led and managed, everybody wins. If by bad management the components become competitive, the system is destroyed. Everybody loses.

— W. Edwards Deming, *creator of TQM*

IMPLEMENTING A TQEM PROGRAM

A TQEM system does not happen overnight. Rather, the process becomes an evolution in the culture of the organization. Therefore, it is best to begin with small steps, building support and a record of success. However, as you take those steps, bear in mind that TQEM is a program of continuous improvement in which the entire system works together to meet or exceed customers' requirements and anticipate their future needs. In a TQEM culture, teams formed from diverse functions within the organization work on a common objective.

Assess Your Status

Where are you now? Examine your company's current situation in terms of both its environmental opportunities (and vulnerabilities) and its quality practices. Ask yourself the following questions:

- How good is your compliance record?
- Have there been recent negative experiences that build a case for stopping business as usual, such as permit violations, accidental releases, waste disposal liabilities?
- Are there opportunities to ameliorate performance that will improve the company's reputation with regulators, communities, and other external customers while reducing costs (e.g., in compliance)?
- Does your company have a strong commitment to quality and customer orientation, or will this require a complete reorientation in management's thinking?
- Has your research shown that other companies have markedly better environmental management systems?

- How committed is top management to improved environmental performance?
- How ready is top management to translate this commitment into action?
- If you do not have top management support, can you build it?
- Do you have middle management support to implement a TQEM strategy?
- Who are the skeptics? How can you gain their support?

The answers to these questions will help you understand where you need to build support, what training is needed, and where some of the improvement opportunities may be.

Identify Your Customers

■ ***External Customers.*** Focus on the customer groups that are most critical to your company and your program. Your improvement efforts should be directed toward your customers' highest priorities. For example, many TQEM programs initially focus on regulatory agencies as their primary external customers.

Although many managers believe that nothing can be undertaken until regulators are satisfied, it is important to go through the process of determining all the customers that you must satisfy to stay ahead of evolving customer demand. (Customers may be as diverse as local communities, or as specific as the PTA of the school down the street.)

■ ***Internal Customers.*** The functions and processes within your company are your internal customers and suppliers. To determine your internal customers, ask yourself whom you are trying to satisfy: for example, to whom does your organization justify its existence at budget time?

This is a critical step. Identifying your internal and external customers will help define your organization's products and services and your measures of performance.

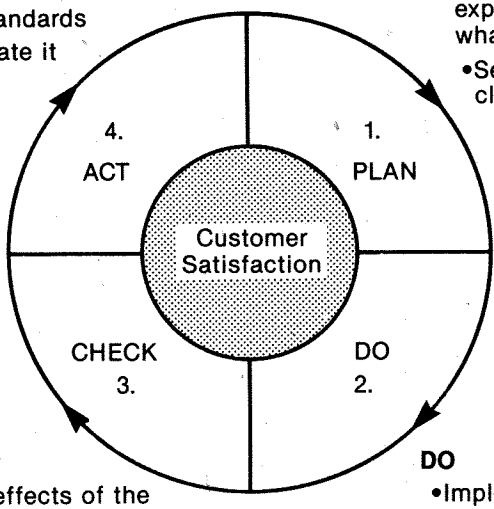
Learn to Use P-D-C-A

Once you have assessed your status, identified your customers, and set your improvement objectives, you need an action plan to begin the process of continuous improvement. One widely-used tool for developing an action plan is the P-D-C-A cycle.

The P-D-C-A Cycle

ACT
Study the results. Redesign systems to reflect learning.
- Change Standards
- Communicate it broadly
- Retrain

PLAN
- Understand gaps between customers' expectations and what you deliver
- Set priorities for closing gaps
- Develop an action plan to close gaps



CHECK
Observe the effects of the change or test.
- Analyze Data
- Pinpoint Problems

DO
- Implement changes
- Collect data to determine if gaps are closing

Step 5. Repeat Step 1, with knowledge accumulated.
Step 6. Repeat Step 2, and onward.

The P-D-C-A cycle is a systematic method for continual process improvement based on the principle that you need to understand a situation or process before you can improve it. Team members must be trained to appreciate the importance of the

planning and checking phases of the cycle; in total, the P-D-C-A cycle is an essential change in organizational thinking that emphasizes data-based action.

The following factors make up the P-D-C-A cycle:

1. ***Plan:*** Identify customers, the customers' requirements, and how well your systems provide results that meet their requirements. Build your improvement plan on data and measurements.

2. ***Do:*** Follow your plan. Avoid inserting changes at this point. If a major change becomes necessary, start again at Step 1 (Plan).

3. ***Check:*** Observe and measure the effects of the changes you instituted, preferably on a small pilot scale to minimize disruptions. Use statistical tools whenever possible to measure the results to determine if they prove or disprove your hypotheses.

4. ***Act:*** Make changes in the process to reflect what you have learned; this step translates the learning into a systemic improvement.

5. ***Repeat:*** Repeat the P-D-C-A cycle incorporating the knowledge gained. Continue the cycle, delivering ever greater quality from increasingly robust processes.

A stable system is one whose performance is predictable. It is reached by removing, one-by-one, the special causes of trouble, best detected by a statistical signal.

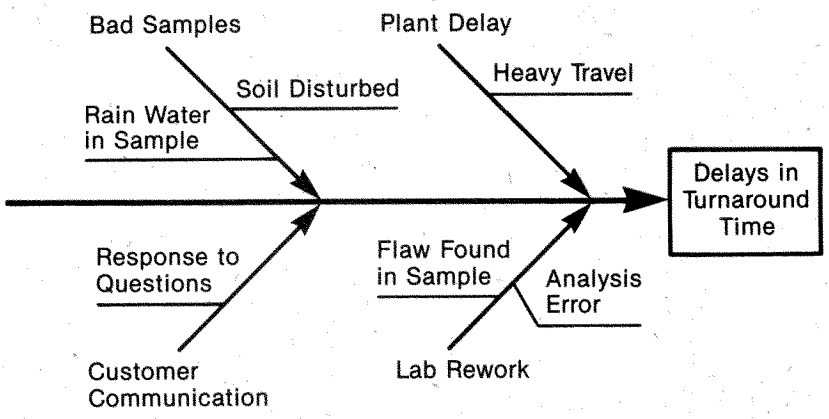
— W. Edwards Deming

Learn to Use TQEM Tools

A way to analyze and condense information, TQEM tools help you put data in an easily understood format that identifies and clarifies underlying causes. Use these tools to discover opportunities for pollution prevention and to measure the effectiveness of improvements you've already made, as well as to improve the work processes within your organization.

■ ***Cause and Effect Diagram.*** A qualitative summary of all potential causes of a problem. Each response to the question "why" becomes a branch on this "fishbone" diagram until the root cause, rather than the symptom, is identified. A fishbone is often useful in focusing a team on what data they need to collect to develop their improvement plan.

Cause and Effect Diagram

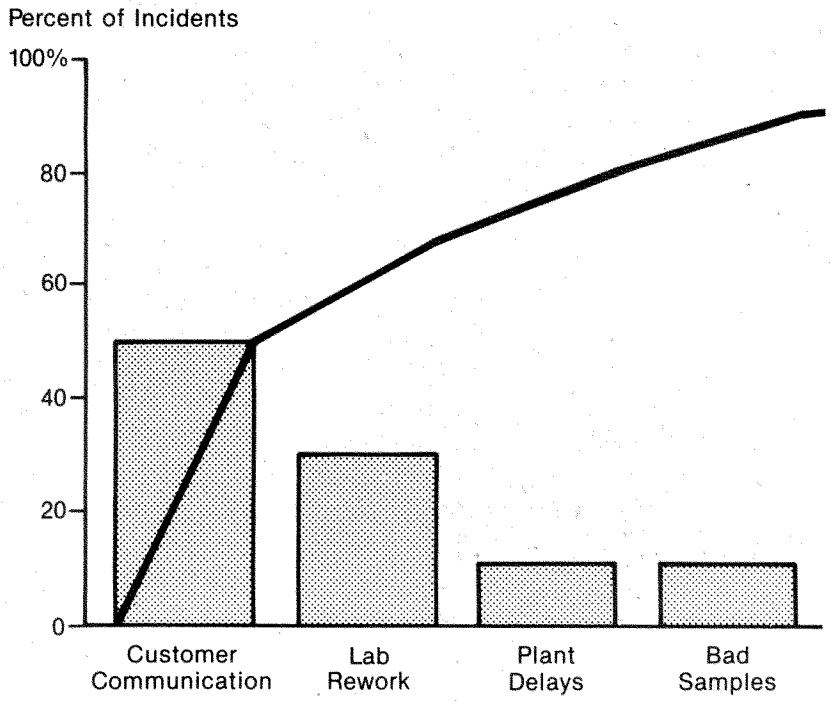


EXAMPLE:

A facility whose environmental managers complained that soil contamination analyses were taking too long to complete, assembled a team to (1) arrive at a specification for turnaround time and (2) analyze the reasons for the existing turnaround time. The team first agreed on the major causes of the delayed turnaround time; then, they constructed a diagram that listed the detailed causes contributing to each major factor.

■ ***Pareto Chart.*** A graphic tool that organizes data to identify and focus on major problems. A pareto chart takes data on a situation or process, ranks it in order, and thus focuses attention on opportunities to maximize improvement.

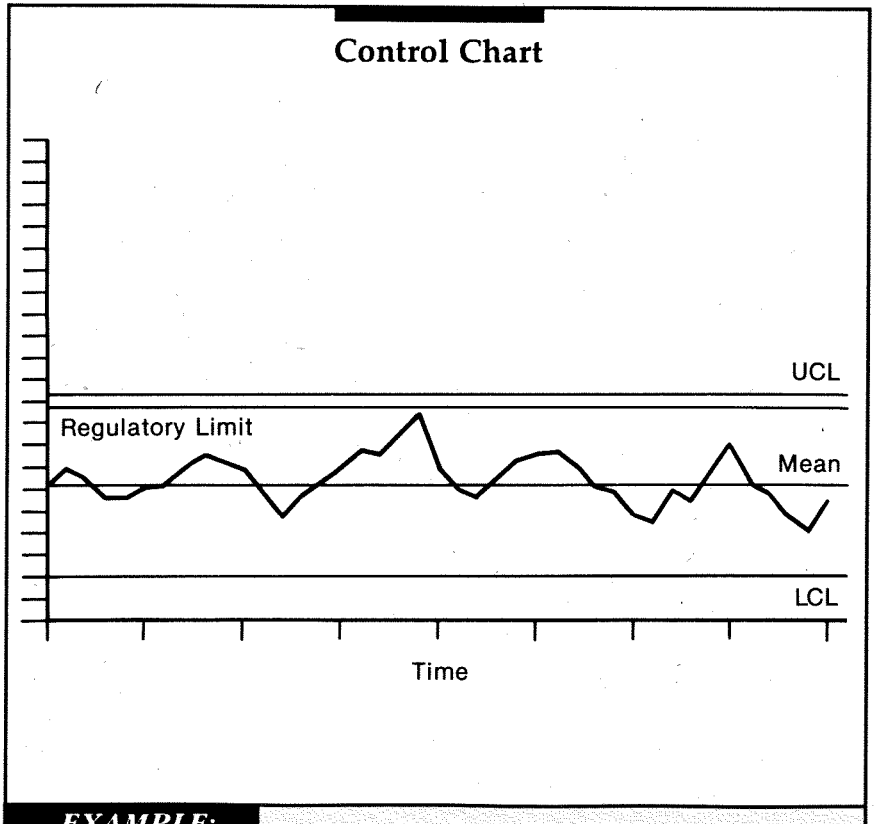
Pareto Chart



EXAMPLE:

The team working on the soil contamination analyses delays organized the data relating to the causes of those delays into a pareto chart that showed 80 percent of the turnaround delay could be attributed to two factors: a lack of communication between divisions within the company to anticipate information needs and a lack of a standard analytic format for lab technicians.

■ ***Control Chart.*** A statistical tool to determine how much variability in a process is inherent (common causes) and how much is due to unique events (special causes such as fires). A control chart defines the expected performance range (or control limits) of a process or system. Control charts can help you understand the variability exhibited by normal systems.

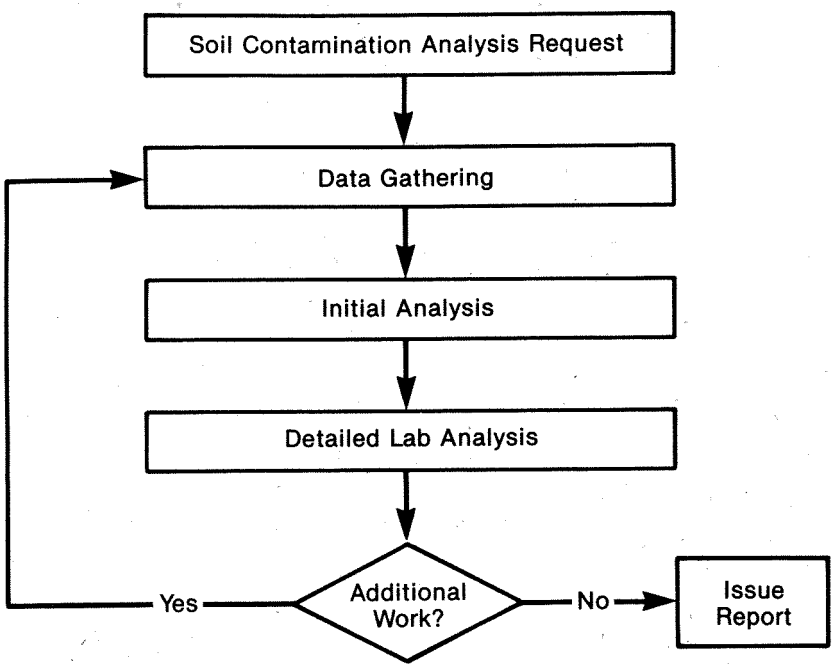


EXAMPLE:

Control charts can be used to determine the capability of a wastewater treatment system to operate within permit limits.

■ ***Flow Chart.*** A schematic showing the relationship between process steps that helps illustrate any significant deviations from the ideal process. A flow chart often follows a pareto analysis to define the process and decide where to make changes that will improve the process.

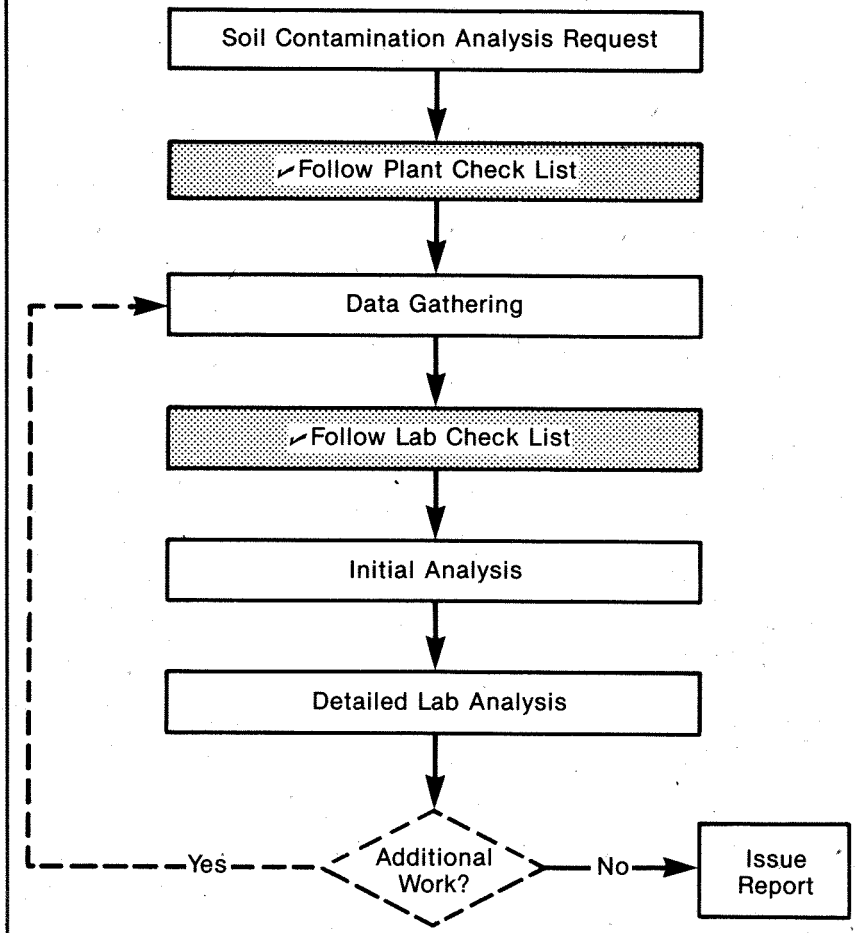
Flow Chart I
(Original Soil Contamination Analysis)



EXAMPLE:

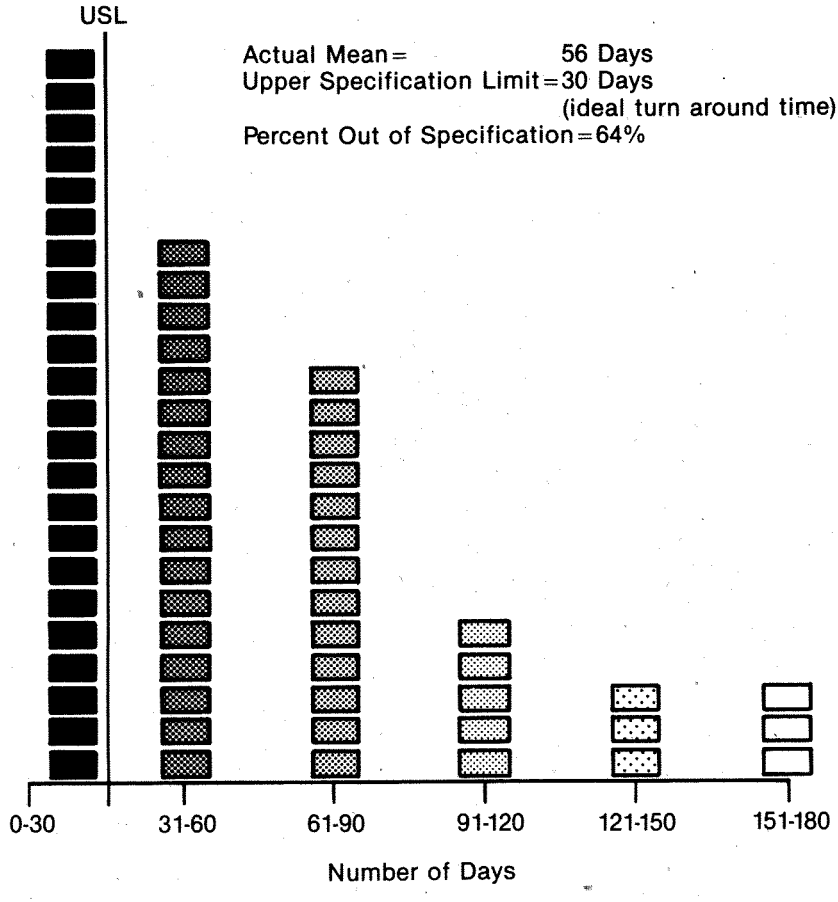
As a result of the two problems identified by the pareto chart in the example on page 10, the team working on the soil contamination analyses turnaround problem found that analyses often had to be reworked. The team flow-charted the soil analysis "system," determining ways to eliminate communication problems and developing a standard analytical format. They then flow-charted their new system and tested it.

Flow Chart II
(Improved Process)



■ ***Histogram.*** A graphic tool that displays the distribution, spread, and shape of a set of data from a process. If the collected data show that the process is stable and can be predicted, then the histogram can also be used to demonstrate the capability limits of the process.

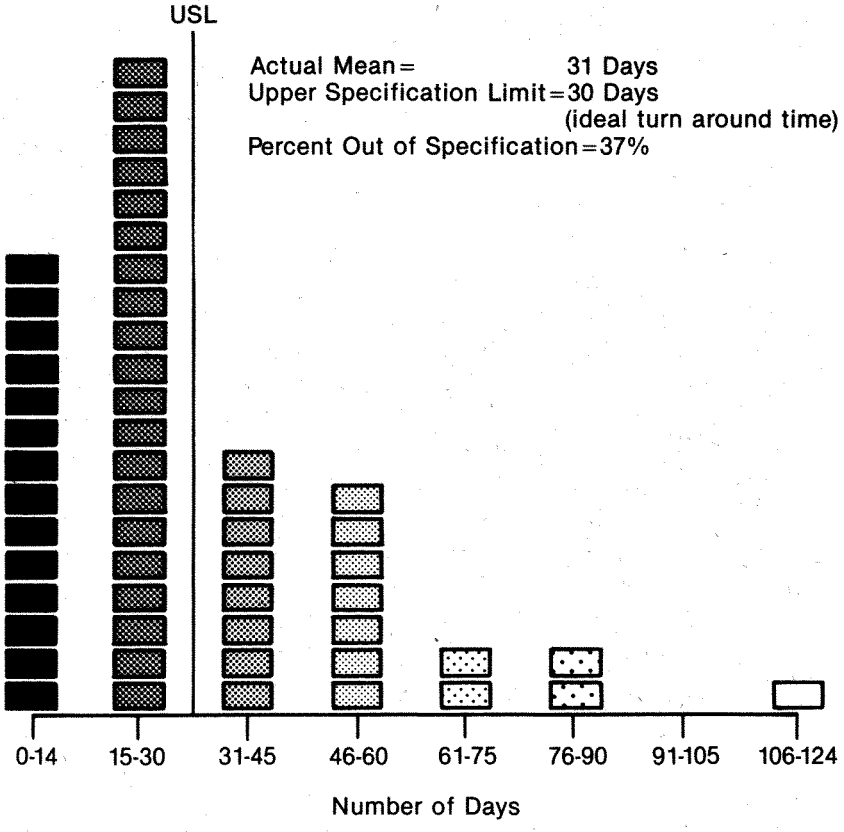
Histogram



EXAMPLE:

The team worked with everyone involved in the production and delivery of the soil contamination analyses to agree on a specification for turnaround time of 30 days. They then developed a histogram to determine the mean (56 days) and the dispersion (64 percent out of specification) of the actual turnaround time.

Histogram



EXAMPLE:

Shortly after beginning their improvement process, the soil contamination analyses team used a second histogram to measure how close they were to achieving their time-reduction goal. The histogram showed that they had reduced the mean delivery time from 56 to 31 days (just 1 day over the specification) and the dispersion had decreased from 64 to 37 percent.

■ ***Benchmarking.*** Benchmarking is simply comparing one of your processes to a "best-in-class" example, either within or outside your company. This helps you in two ways: all participants benefit from the other's experiences and the "best-in-class" comparison can provide powerful justification for your own investment in continuous improvement.

However, benchmarking takes time, both to find the appropriate "best-in-class" example and to compare processes, so use the following guidelines:

1. Define and rank customer values. Benchmarking should focus on characteristics that customers value most highly; therefore, research on customer preferences may be necessary.

2. Establish partnerships with outside research sources. Independent researchers and consultants with whom you build a long-term, confidential relationship can identify benchmarking targets and help your staff conduct the comparison.

3. Gain cooperation of benchmarking targets with *quid pro quo.* Benchmarking usually means sharing data. This exchange can take several forms. Among them is a compilation by an independent researcher that gives each company aggregate sets of data for comparison.

4. Adopt a procedure that assures a thorough comparison. A list of guidelines follows:

   - Focus benchmarking on well-defined customer values or significant problems.
   - Assemble a cross-functional benchmarking team capable of completing the comparison and utilizing its findings.
   - Map your own process and measure its inputs and outputs.
   - Collect secondary data from trade publications and other public sources.
   - Determine both similarities and differences in your comparison and trace the causes.
   - Use the comparison as impetus for continuous improvement.

MEASUREMENTS AND HOW TO USE THEM

Measurement in both the "plan" and "check" portions of the P-D-C-A cycle is a prime component of your continuous improvement TQEM process. Before you start your TQEM program, take baseline measures; this will establish a basis for comparison with subsequent measures to monitor improvements.

Whenever you implement a new environmental measurement system, or change an old one, you should simultaneously identify measures that will tell you if the system is delivering the desired results. A company can use measurements to, among other things, get feedback on how customers are responding to the changes. Measuring your customers' opinions of your product or service will, over time, tell you if your improvement efforts are really addressing your customers' needs.

Effective measurement begins with customer requirements and monitors performance in terms relevant to your internal and external customers.

Measurements may be both direct and indirect, but the real secret lies in selecting measures that truly monitor performance and improvement: you need to know how well you are meeting your customers' requirements even as you reduce your own costs and improve your workplace environment.

A company must customize its measurement procedures. For example, a measurement system may be based on broad categories such as regulatory audits, monitoring results, and inspections. Or, as is the case with most companies, you may prefer a more detailed measurement process that could include such diverse topics as:

- Percentage of trained personnel
- Total personnel
- Total production
- Total liquid and solid waste

- Total safety and environmental investments
- Total safety and environmental expenses
- Energy use
- Total safety and environmental personnel
- Frequency of environmental audits
- Existence of emergency planning and drills
- Environmental and safety incidents

The list is endless.

Use numerical measures and tools such as histograms, pareto charts, and statistical control charts whenever possible both to improve management oversight and to strengthen the credibility of the process.

Measuring progress and sharing results as TQEM evolves affects the process significantly by documenting accomplishments, identifying areas for improvement, inspiring pride and encouraging momentum, justifying the need for more resources, and providing information for other needs.

Summary

Business must resolve to continually improve environmental performance not just today, but tomorrow and into the future. TQEM gives you the tools to meet this challenge; you have but to use them thoughtfully and continually.

As you build your system, keep in mind that TQEM demands of its practitioners that they continually question "business as usual." That includes such fundamental questions as

- Are you staying in touch with your customers to be sure you're providing what they want?
- What is the company's impact on the environment? And how is this changing?
- How important is environmental performance to each set of customers?
- What future customer needs must the company satisfy? And, is a mechanism in place to anticipate both problems and needs?

Change is the one constant today: the process that works for you today may not meet tomorrow's requirements. Follow the road map provided by TQEM to anticipate the future for your environmental business. Always remember that the continuous improvement process that is TQEM can be summed up in less than a dozen words:

No matter how good you are, you can always be better.

APPENDIX A

GLOSSARY

■ ***Benchmarking:*** The technique of comparing one of your processes to a "best-in-class" example, either within or outside your company.

■ ***Cause and effect:*** A qualitative summary of all potential causes of a problem. Each response to the question "why" becomes a branch on this "fishbone" diagram until the root cause is identified.

■ ***Continuous improvement:*** The systematic, continual process of improving business processes.

■ ***Control chart:*** A statistical tool to determine how much variability in a process is inherent (common causes) and how much is due to unique events (special causes such as fires). A control chart defines the expected performance range (or control limits) of a process or system.

■ ***Cross-functional team:*** A team of experts from every element of the process who work together to continuously improve customer-driven processes.

■ ***Customer:*** Anyone — either within or outside your organization — to whom you supply a product or service.

■ ***Fishbone:*** Another term for "cause and effect."

■ ***Flow chart:*** A schematic showing the relationship between process steps that helps illustrate any significant deviations from the ideal process.

■ ***Histogram:*** A graphic tool that displays the distribution, spread, and shape of a set of data from a process.

■ ***Pareto chart:*** A graphic tool that organizes data to identify and focus on major problems.

■ ***P-D-C-A:*** A systematic data-based method for continual process improvement rooted in the principle that you need to understand a situation or process before you can improve it.

■ ***Root cause analysis:*** Another term for "cause and effect."

■ ***Shewhart cycle:*** Another term for P-D-C-A.

■ ***Specification limits:*** Performance standards set by internal or external customers.

■ ***TQEM:*** Total Quality Environmental Management

■ ***TQM:*** Total Quality Management

APPENDIX B

BIBLIOGRAPHY

Abt Associates Inc. *Consumer Purchasing Behavior and The Environment: Results of an Events-Based Study.* Cambridge, MA: Abt Associates Inc., 1990.

Abt Associates Inc. *Customer Research Data for the TQEM Handbook, Global Environmental Management Initiative.* Cambridge, MA: Abt Associates Inc., 1991.

Abt Associates Inc. *Environmental Management: From Compliance to Strategy.* Cambridge, MA: Abt Associates Inc., 1991.

Aguayo, Rafael. *Dr. Deming: The American Who Taught the Japanese About Quality.* New York, NY: Simon & Schuster, 1991.

Augsburger, Robert, et al. *Corporate Environmental Solutions Project: independent Study Project.* Stanford, CA: Stanford Graduate School of Business, 1991.

Deming, W. Edwards. *Out of the Crisis.* Cambridge, MA: Massachusetts Institute of Technology, Center for Advanced Engineering Study, 1982.

Deming, W. Edwards. *Quality, Productivity and Competitive Advantage.* Cambridge, MA: Massachusetts Institute of Technology, 1982.

Global Environmental Management Initiative. *Corporate Quality/Environmental Management: The First Conference.* Proceedings. Washington, DC: Global Environmental Management Initiative, 1991.

Goal/QPC. *Benchmarking.* 1991 Research Report. Methuen, MA: Goal/QPC, 1991.

Goal/QPC. *Cross-Functional Management.* 1990 Research Report. Methuen, MA: Goal/QPC, 1990.

Goal/QPC. *The Memory Jogger: A Pocket Guide to Tools for Continuous Improvement.* 1991 Conference Edition. Second Edition. Methuen, MA: Goal/QPC, 1985, 1988.

Ishikawa, Kaoru. *Guide to Quality Control.* White Plains, NY: Quality Resources, 1982.

Ishikawa, Kaoru. (D.J. Lu, trans.) *What is Total Quality Control? The Japanese Way*. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1985.

Juran, J.M. *Juran on Leadership for Quality: An Executive Handbook*. New York, NY: The Free Press, 1989.

King, Bob. *Better Designs in Half the Time: Implementing QFD Quality Function Deployment in America*. Third Edition. Methuen, MA: Goal/QPC, 1989.

Kleiner, Art. *What Does It Mean To Be Green?* Boston, MA: Harvard Business Review, August 1991.

Senge, Peter M. *The Fifth Discipline: The Art and Practice of the Learning Organization*. New York, NY: Doubleday/Currency, 1990.

Stalk, George, Jr., and T.M. Hout. *Competing Against Time: How Time-Based Competition is Reshaping Global Markets*. New York, NY: The Free Press, 1990.

Walton, Mary. *The Deming Management Method*. New York, NY: Putnam, 1986.

APPENDIX C

TQM STUDY PARTICIPANTS

We would like to thank the following companies for participating in our study of the uses of TQM in environmental management.

3M
Allied Signal Inc.
American Electric Power Company
Amoco Corporation
AT&T
Barnes Group, Inc.
Basin Electric Power Cooperative
Baxter Healthcare Corporation
Calcomp, Inc.
Central Illinois Public Service Company
Champion International Corporation
Cobe Laboratories, Inc.
Deere & Company
Dentsply Holdings, Inc.
Digital Equipment Corporation
Dow Chemical Corporation
Duke Power Company
E.I. du Pont de Nemours & Company
Eastman Kodak Company
Florida Power & Light Company
Foxboro Company
G. Heileman Brewing Company
General Chemical Corporation
General Dynamics Corporation
Genlyte Group, Inc.
Goulds Pumps, Inc.
ICI Americas, Inc.
John Fluke Manufacturing Company, Inc.
Johnson Yokogawa Corporation
Kansas Gas and Electric Company
Kawasaki Motors Manufacturing Corporation, USA
Kentucky Utilities Company
Kiewit Holdings Group, Inc.
Masco
Merck & Company
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