CENTER FOR QUALITY of MANAGEMENT

A NONPROFIT ORGANIZATION

Document MI 0020

THE 7-STEP PROBLEM SOLVING METHOD

CENTER FOR QUALITY of MANAGEMENT

THE 7-STEP PROBLEM-SOLVING METHOD

Document ML0020
Revised October 1997

ACKNOWLEDGMENTS

The Center would like to thank the following people for their contributions to the development of this manual:

- 1st draft of this manual — February 1991 by Richard L. Lynch and Ira Moskowitz of Analog Devices, Inc., adapted from lectures by Professor Shoji Shiba and material from Hitoshi Kume (1985) and JUSE (1987), with the assistance of Rose Carosi, Elizabeth Derwin, Alice Latimer, John Sheridan, Art Schneiderman, Carl Roberts, and Goodloe Suttler, of Analog Devices; Mike Bradley, Windsor Hunter, and John Petrolini of Teradyne; Dave Walden of Bolt Beranek and Newman Inc.; and Alan Graham of the Massachusetts Institute of Technology.
- 1st minor revision — March 1991 by Richard Lynch and Ira Moskowitz.
- 2nd revision — August 1994 by Ted Walls, with substantial assistance from Teradyne, including use of their in-house version of the *Seven Steps Manual*; editing by Stella Tarnay; and design and layout by Cecilia Oh.
- 3rd revision — December 1996 by Adelaide Juguilon of Center for Quality of Management, with substantial assistance from Phil Gulley, Linda Ridlon, Toby Woll and Marty McDonald.

The Center is headquartered in Cambridge, Massachusetts, with chapters in Sunnyvale, CA, Louisville, KY, Cincinnati, OH, Böblingen, Germany, and Helsinki, Finland. We encourage you to contact the Center if you would like to learn more about the Center and its current activities. Additionally, any comments or questions about this manual are very welcome.

We can be reached at:

Center for Quality of Management, a division of GOAL/QPC
12B Manor Parkway
Salem, NH 03079
Tel: (603) 890-8800
Fax: (603) 870-9122
CQM_Mail@cqm.org
http://www.cqm.org

FOREWORD

In the months following Center for Quality of Management's inception in 1990, over fifty executives from member companies went through an intensive six-day course on Total Quality Management by Shoji Shiba. Although aimed at executives, about 30% of the course dealt with problem solving — both the process of solving problems as well as the responsibilities for diagnosing quality improvement efforts. During this same period, Professor Shiba gave two problem-solving workshops at Analog Devices. This time the audience was managers and quality improvement teams engaged in problem-solving activities at three member companies.

The reaction at these sessions was almost universal: our companies have done an inadequate job of helping people solve problems. The evidence is painful:

- Teams work for years on problems with little to show for it. Problems thought to be solved keep popping back up.
- Teams jump to solutions without any data analysis to show that the root cause of the problem has been identified.
- Teams evaporate after failing to identify the problem. Attendance at meetings is poor.
- Groups *within* the same company do not know that another group has already solved a similar problem.

Those that solve problems effectively in the business world are rewarded with more customers and higher profits. Those that don't squander opportunities and dissatisfy customers — and frustrate the teams and individuals who work to deliver the product or service.

Some people have the rare gift to solve problems intuitively. However, many of the problems in today's work environments defy even this uncommon ability. Further, intuition cannot be taught to the entire work force. Help comes in the form of a standardized, disciplined approach to exploring problems, understanding root causes, and implementing solutions that stick.

Professor Shiba has demonstrated to us at the Center how to solve problems more effectively by following a 7-Steps. This manual describes that step-by-step method and explains how individuals, teams and organizations learn from the experience.

Center for Quality of Management encourages the use of this manual by all interested in continually improving known processes. The manual is the result of the collaborative efforts of individuals from the Center's membership in the Boston area. Without the rapid pace of learning achieved by several companies implementing quality methods and sharing their learnings through the Center, this manual could never have evolved so quickly.

Note to the reader: Figure numbers have been added to this version of the manual in order to allow figures to be referenced in group discussions. The figures are not always specifically referred to in the text.

I. INTRODUCTION

THE 7-STEP PROCESS

PDCA	#	STEP	SOME POTENTIAL QUALITY TOOLS AND METHODS
PLAN	1.	*Theme Selection*	BLOCK DIAGRAMS, RUN CHART, GRAPHS, BRAINSTORMING, LP METHOD, THEME SELECTION MATRIX, FLOWCHARTS, BENCHMARKING
	2.	*Data Collection and Analysis*	CHECKSHEETS, GRAPHS, PARETO DIAGRAMS, MILESTONE CHARTS, HISTOGRAMS, VOICE OF THE CUSTOMER INTERVIEWING TECHNIQUES
	3.	*Causal Analysis*	ISHIKAWA DIAGRAM, RELATIONS DIAGRAM, SCATTERGRAM, PARETO DIAGRAM, FLOWCHART, TREE DIAGRAM, MATRIX DIAGRAM, BRAINSTORMING
DO	4.	*Solution Planning and Implementation*	ISHIKAWA DIAGRAM, 4Ws & 1H MATRIX, BRAINSTORMING, MATRIX DIAGRAM, TREE DIAGRAM, CONTINGENCY PLANNING (PDPC), SOLUTION SELECTION MATRIX, BENCH-MARKING, 9-STEP PROJECT PLANNING SYSTEM
CHECK	5.	*Evaluation of Effects*	PARETO DIAGRAMS, GRAPHS, RUN CHART, HISTOGRAMS, SCATTERGRAMS
ACT	6.	*Standardization*	FLOWCHART, CONTROL CHART, TREND CHART, 4Ws & 1H MATRIX, GRAPHS
	7.	*Reflection*	4Ws & 1H MATRIX, BRAINSTORMING, LP METHOD, PARETO DIAGRAM, THEME SELECTION MATRIX

The WV Problem-Solving Model and the 7-Steps

The WV model (figure 1) shows how problem solving alternates between the "level of thought" and the "level of experience." Teams or individuals can employ the model to solve daily work problems.

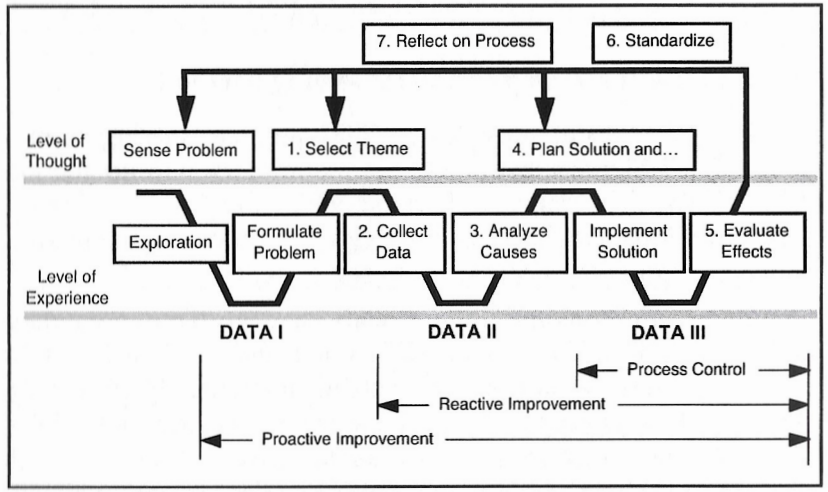
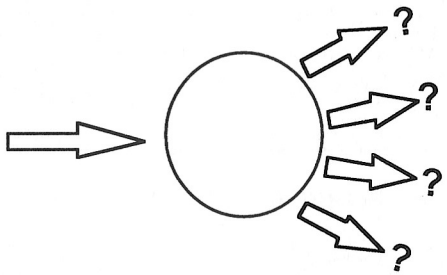


figure 1

Problem solving starts from the level of thought, where we sense that something is wrong but do not know what the problem is. To learn more, we must explore the situation. Once enough qualitative language data (Data I) have been collected to formulate the problem, we move to the level of thought again. Here we identify the real problem in the first step of the 7-Step Problem Solving Method, selecting the theme. Once the problem is identified, we go down to the level of experience again by collecting and analyzing a combination of qualitative and quantitative data (Data II) specific to the theme. Once the critical data have been collected, we can analyse the causes of the problem stated in the theme. With root causes isolated, we plan tentative solutions and, again moving toward the level of experience, implement them. By collecting quantitative or numeric data (Data III) on the

Proactive Problems



(Typical of new product development and strategic decision making)

figure 4

Characteristics of Problem Types

	Description of Problems	Order of Magnitude*	Strategy for Solution	Orientation for Solution
Control	Standardized process/against standard	∞ (infinite)	By mechanization	Standard orientation
Reactive (7-Steps)	Correct/against plan	10^3–10^5	By mass movement	Weakness orientation
Proactive	Future/ unrestricted	10^1–10^2	By focused group work	Opportunity orientation

* The number of times this type of problem may occur

figure 5

the organization can apply the method. A standardized methodology that is simple, easy to apply and fun for teams to use makes that goal realizable. Even more important, it is likely that such a methodology will be repeated, which will foster development of the skill that continuous improvement requires.

Reactive problem-solving differs in its orientation from control and proactive problem-solving. **Control** problems require an orientation toward maintaining the standard. **Proactive** problems require an orientation toward finding new opportunities. Reactive problems require an orientation toward the weaknesses that undermine the successful operation of standardized processes. This "weakness orientation" is a critical part of reactive problem solving.

It is important to know that the 7-Step Problem Solving Method is a step-by-step process of problem solving that enables executives, managers, quality improvement teams and workers to get to the root of a problem and respond effectively. It has been a cornerstone in Japan's competitive success from the 1970s to the present. The 7-Step methodology is an important contribution to the art of problem solving because

- the 7-Steps allow more people to participate in problem solving;
- the 7-Steps are used in solving many different types of problems;
- the methodology helps to focus on the most important problem;
- it allows teams to develop more effective solutions;
- by following a standardized approach, the 7-Step methodology fosters organizational learning.

The 7-Step Method is used for solving problems where the solution is not obvious. It utilizes the PDCA cycle (see next page) in a specialized way to define and understand a problem, devise a reactive strategy, check on its results and refine it in a continuous cycle of improvement.

Any individual or team needing to solve problems can use the methodology. Quality improvement teams most commonly use the 7-Steps to respond to a known defect or weakness such as late deliveries, yield loss, or product failure.

Managers can use the 7-Steps process to make sure teams are focusing on the most important problems and have chosen a good solution. They will also find the 7-Steps helpful as they coach

teams to improve their problem-solving skills.

The 7-Step Method is also useful in refining a product development process or in diagnosing quality improvement efforts.

History of the 7-Step Problem Solving Method

The 7-Steps had its origins in the works of the late Walter Shewhart, an engineer at Bell Laboratories. He formulated what is known as the "Shewhart cycle" or "Plan-Do-Check-Act" (PDCA) cycle to describe the process for experimental design: plan the experiment, do it, check the results, and act on the results to improve the process. Later, Dr. W. E. Deming used PDCA to describe the basic feedback loop for any kind of improvement. The PDCA model works well for problems whose solutions are obvious. However, it loses effectiveness when the problem is not readily understood. The Union of Japanese Scientists and Engineers (JUSE) addressed this gap in the late 1960s and early 1970s as part of the Quality Control Circle movement in Japan. They developed the 7-Step Method for a more systematic diagnosis of the fundamental causes of problems and a more rigorous way to implement solutions. JUSE also simplified and standardized the format of data-gathering and statistical tools for quality improvement. The founders of The Center for Quality of Management and those involved in its courses learned the method from Shoji Shiba, a professor from the University of Tsukuba whom they met while visiting JUSE. Professor Shiba was the driving force behind the Center's efforts to teach members the 7-Steps. Since he began, more than forty CQM companies have begun using the 7-Step Problem Solving Method actively.

Using the Manual: An Overview

This manual is intended as both lap guide and reference text. Its purpose is to aid individuals and teams throughout the actual problem-solving process and in preparing the QI Story.

The contents of the manual are organized into five sections. In this first introductory section, you get an overview of the 7-Step Problem Solving Method and the manual, and recommendations for team preparation before launching into the 7-Steps. In section II we provide guidelines for building effective teams. Section III describes the actual **step-by-step** methodology for problem solving, and the QI Story is discussed in section IV, with supplementary guidelines and a sample story presented in appendix B.

Sections II through IV of the manual include a few stylistic conventions. To clarify the intent of the elements, please refer to the following key.

 = some tools that can be used in the step

A, B, C, etc. = actual Instruction items for completing the step

☞ = key recommended options for completing an Instruction item

Hints = helpful comments from practitioners who have used the method or taught others how to use it

Appendices in section V contain in-depth information and tools that will be helpful once you start the process of the 7-Step Method. They include a glossary, worksheets, and the 4 M Checklist.

As you work your way through this manual, you may also find other CQM manuals helpful, particularly *Managing Teams* and *Diagnosing Teamwork Through the QI Story*. These and other suggested readings are listed in the Bibliography. Most are available from the Center for Quality of Management.

II. TEAM GUIDELINES

The 7-Step Problem Solving Method is most often applied in a team setting. The following are some general guidelines for running effective teams. An in-depth discussion of the team process is available in the CQM manual *Managing Teams*.[2]

Preparation

Quality improvement is part of everyone's job. It's not an extra job. Therefore, management must create an environment that empowers the work force. Focused and disciplined teamwork should be encouraged and actively promoted as a principal means of solving problems throughout the organization. Also, teams cannot be expected to solve problems without the proper tools. To maximize their contributions, individuals should receive some formal education and training in quality tools before participating on a team. More important, they must be coached "on the job" to improve their problem-solving skills. Finally, team members are expected to diffuse their QI Story so that others can learn from their experience.

Team Leader

One person should be designated team leader. The team leader should

- make sure the composition of the team is suited to solve the problem (i.e., the right functions are involved and the size of the team is manageable);
- identify a team recorder for minutes/documentation;
- lead each step as it occurs;
- keep the team on track.

Facilitator

The facilitator is someone trained in the 7-Steps and quality tools who is not part of the group performing the exercise. The facilitator's role is to help coach new teams. As organizations improve their problem-solving skills, team leaders and managers can take on this coaching role.

Sponsor

Someone from management who is interested in solving the problem to be addressed. The sponsor will be responsible for diagnosing the QI Story.

Team Members

Team members should have direct knowledge about some aspect of the problem being solved. Four to seven members is best. If you have more than eight, the group should be divided into separate teams. One way is to break up into two or more teams in the same room. If possible, team members should skim the entire manual before the actual session.

In addition, it is *essential* that each team member have a full understanding of semantics. To prepare, read the section "Understanding Semantics" in the CQM Language Processing manual; read Hayakawa's *Language in Thought and Action*[1]; or solicit appropriate training.

Team Checklist

The team should

- have a clearly defined, written theme;
- use a metric that correlates to the theme;
- have a measurable, quantitative goal;
- operate as a team;
- publish minutes of each meeting;
- maintain high attendance at meetings;
- use PDCA and follow the 7-Steps;
- have 4–7 members;
- have a team leader and trained facilitator;

- allow membership to be voluntary;
- focus on facts; emphasize data collection (not opinion, judgment, and abstraction);
- own both the problem and the solution;
- be able to implement the solution themselves;
- learn about team recognition opportunities;
- deliver the 7-Steps QI Story to management after the problem is solved.

III. THE 7-STEP METHOD STEP BY STEP

General Instructions

The essence of the 7-Steps is that it is a standardized process for improvement. If everyone follows the same 7-Steps process, uses a common vocabulary and follows standard formats, it is easy for others to learn from the experience. Employees do not have to waste time trying to translate what you did into their language.

The following section provides explicit step-by-step instructions, useful tips on what to do, and pitfalls to avoid. **Please follow these steps exactly**. They have evolved over a period of eight years and have benefited from the experience of over 100,000 users. Skipping or modifying steps will dilute or distort the final structure of the problem, and will impede communication and organizational learning.

Ideally, a team should be able to execute the 7-Steps in three to four months. By following this methodology, problems are defined in such a way that the team focuses on local problems, collects their own data, and focuses on specific solutions to eliminate the root causes. In some cases, the solution can be time dependent (e.g., a piece of equipment must be purchased that has a long lead time). In other cases, the team may spend more time on the problem identification, going through several iterations of the first few steps.

Although the 7-Steps process must be followed faithfully, there are many opportunities for teams to use their creative abilities. For example, teams and individuals need to be resourceful when it comes to data collection, identifying root causes and proposing solutions. There are no formulas that provide these answers. In short, the 7-Steps provide guidelines. People make decisions.

STEP 1. THEME SELECTION

The purpose of Theme Selection is to recognize the importance of the problem and to define the problem clearly. A good theme also sets a serious tone and creates a sense of urgency and commitment.

Some Tools: Block Diagrams, Run Charts, Graphs, Brainstorming, LP Method, Theme Selection Matrix, Flowcharts & Benchmarking

INSTRUCTIONS

A. Identify the general problem that the team is addressing.

- Collect any examples (facts) that help describe the problem.
- Identify the pain caused by the problem.
- Team should consider the theme that works best for the problem *they* need to solve

  Upper management may suggest a theme for the team to consider, but it is up to the team to select an approach that will work for them.

  For this first phase of step 1, you may wish to refer to the Theme Selection section of *Managing Teams*. It provides in-depth guidelines for managing the group process through this step.
- Explore many problems at the outset. This can be accomplished by **brainstorming** or using the **LP Method**.
- Use the **Theme Selection Matrix** (figure 6) to choose the best problem to explore. You may substitute your own, perhaps more appropriate, criteria

THEME SELECTION MATRIX

	URGENCY	ESTIMATED EFFECT	DATA AVAILABILITY	----------	IMPLEMENTATIOIN	TIME (3 MONTHS)
Problem 1						
Problem 2						
Problem 3 • •						
Problem N						

Instructions: List the major problems encountered in the first column. Then use the scoring grid below to identify the priorities. You may want to use a point system (e.g., 5, 3, 1) to quantify these results.

⊙ VERY HIGH

○ HIGH

△ MEDIUM

figure 6

across the horizontal axis.

Use as much data as necessary to identify the most important problem. Refer to existing data that you have access to — past reports, Pareto diagrams, LPs, VOC studies, etc.

- ☞ Address methods or machines, not human behavior.
- ☞ Consider the company's and division's goals in your theme selection (figure 6) . These activities must be useful and important to the organization.

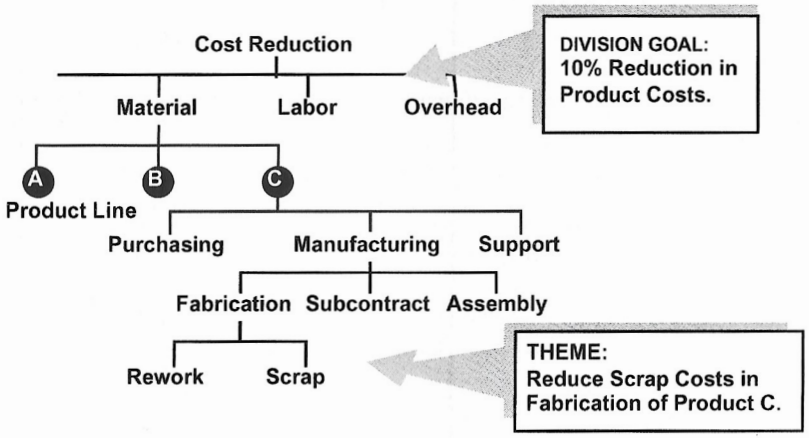


figure 7

- ☞ Address one of the "five evils": defects, delays, mistakes, waste, and accidents.

When teams attack problems that do not have an identifiable evil they must develop a logic which turns the problem into a weakness. This can be done by collecting benchmark data that shows that competitive or world-class standards are not being met.

Once the gap between the desired performance and

actual performance is understood, the 7-Steps can be used to reduce that gap. Avoid problems that focus on accidents. They are more difficult to address than the other four evils.

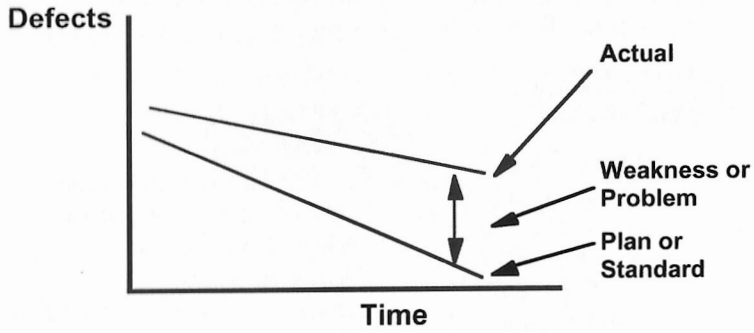


figure 8

Remember, there should be a high probability of success within a reasonable time frame (one way to help ensure success is to limit the scope of the project). Everyone wants to feel good about their efforts. Team members tend to lose their motivation if the project takes too long. It may be advisable to tackle larger projects as several smaller themes.

Hint:

The 7-Steps process is most effective on problems with an existing documented process that people understand. Many teams begin working on a problem and soon find that a process is not documented, or understood, or does not even exist.

B. Write the theme, addressing the problem you have chosen.

☞ Make your theme measurable.

A problem expressed in *quantifiable* terms is better than unspecific words. If the theme is not measurable it will be difficult to show improvement objectively.

EXAMPLE

Poor: The mail system needs improvement.
Better: Reduce the amount of time it takes for mail to reach sale men in the field (from two weeks to ____)

EXAMPLE

Poor: Reduce customer frustration.
Better: Reduce the number of days required to respond to customer inquiries.
Poor: Reduce employee dissatisfaction.
Better: Reduce the employee turnover rate.

☞ Consider at what "level" to tackle the problem. It is better to start a few levels down the ladder of abstraction.

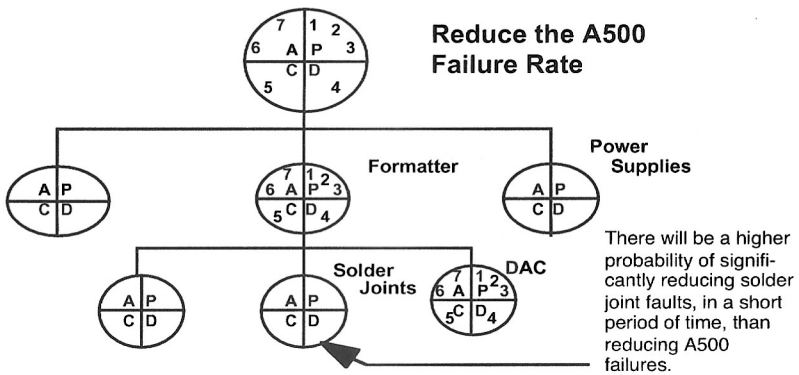


figure 9

☞ Spend the right amount of time on the problem definition. Poor themes cause teams to flounder and get poor results.

☞ Think "market-in," not "product-out." The theme should be customer focused. The next customer may very well be an internal one.

☞ The theme should be weakness oriented.

EXAMPLE

Poor: Improve yield at system test.
Better: Reduce defects at system test.

The best application of the 7-Step Method is problems and deviation from a given standard. Focusing on a weakness fosters continuous improvement by drawing attention to problems. The tendency has been to focus on what is done well. Words such as *improve* and *increase* lead us to look at what is being done right (95% yield, 98% on-time).

EXAMPLE

Poor: Mistakes in order entry.
Better: Reduce mistakes occurring in the order entry system.

☞ The theme must be one complete sentence. The theme should be clear and precise so that everyone understands it.

☞ Make the theme action oriented. Begin the theme with action words such as reduce, decrease, etc. This

conveys the feeling of motion toward a solution or better state.

- ☞ Avoid the use of abstract words, acronyms and location-specific lingo.

EXAMPLE

Poor: Reduce the FLTS/BD on SMT mods tested at FDY west BTE.
Better: Reduce the faults per board on the surface mounted technology modules tested at the foundry west, board test engineering department.

EXAMPLE

Poor: Eliminate errors...
Better: Reduce errors...

- ☞ Do not use absolutes.

  Words such as *eliminate* can convey the meaning that something is either present or not. If the evil is not eliminated the team may not feel successful even though good results are achieved.

EXAMPLE

Poor: Reduce mistakes at order entry due to input errors.
Better: Reduce order entry mistakes.

EXAMPLE

Poor: Reduce order entry mistakes by developing training procedures.
Better: Reduce order entry mistakes.

- ☞ Do not state judgments and opinions.
- ☞ Do not state the root cause in the theme. This is jumping to step 3, Causal Analysis.
- ☞ Do not state the solution in the theme. This is jumping to step 4, Solution Planning and Implementation.

Remember that theme development is an iterative process. The next two steps may refine your theme. Do not spend too much time initially developing your theme. You can refine it later.

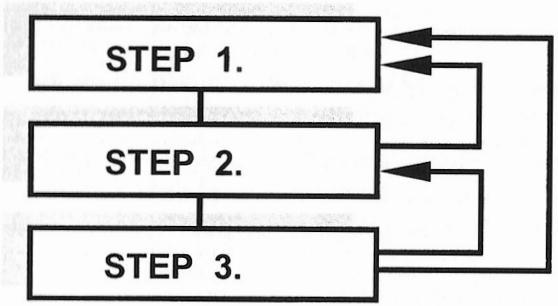


figure 10

C. Visualize the problem.

- ☞ Use a **block diagram** or a **flowchart** to show the area being addressed and location of the customer in the process.

  Teams have found that constructing a high-level block diagram will help explicitly identify the customer and help the team understand the inputs and outputs of the process. It also helps the team understand the scope of the problem and narrow the focus of the work they will do.

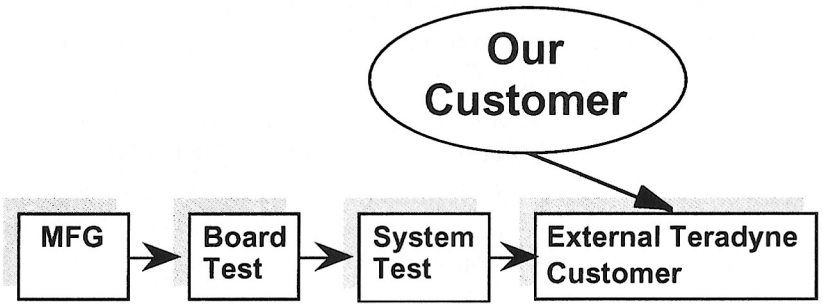


figure 11

☞ Use a **graph** or a **run chart** to show the magnitude and importance of the problem over time.

Document the background of the problem — use flowcharts, show high-level data, define terms, show pictures, and summarize past improvement efforts.

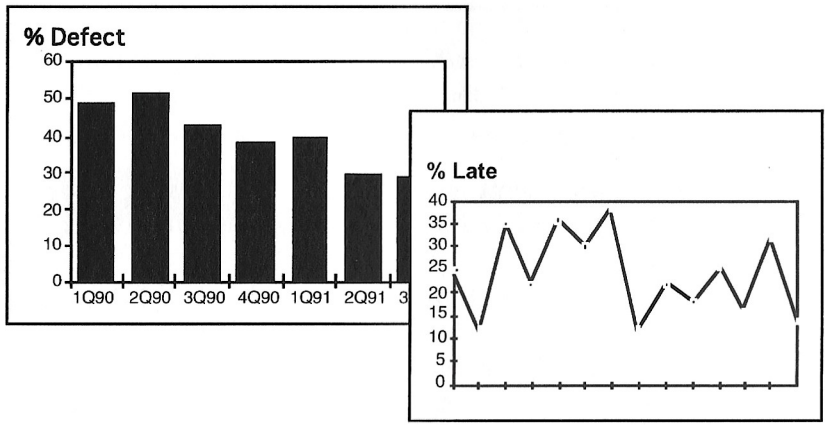


figure 12

D. Verify that the data you need to collect can be generated and will be available frequently.

Data every week will be more helpful than once per quarter.

E. Develop a planned schedule for the QIT's 7-Steps.

Key Factors Affecting Work Schedule

CHARACTERISTICS		LENGTH OF PDCA CYCLE → Short	Medium	Long
THEME	Underlying Cycle-Time of Process	less than 1 week	1 - 4 weeks	more than 4 weeks
	Defects Per Cycle	more than 20	10 - 20	fewer than 10
	Process Documentation	written	written and verbal	not written
	Data Collection and Analysis	automated	partially automated	manual
	Data Source	within control of the team	within partial control of team	outside control of the team

figure 13

Hint: *It is difficult at this stage to predict the exact schedule for the 7-Steps. It will help the team if they can bound the scope of the work. Is this a 3-month, 6-month, or 9-month project?*

☞ The team and sponsor should work together to make a reasonable estimate as to how to allocate time on each step.

The team may need to modify this initial schedule as they continue through the 7-Steps. Try to quantify an *initial* target or goal. You may revise it after you have collected some data in step 2.

F. Develop step 1 of the QI Story and review with your sponsor.

(The QI Story is discussed in section IV. Explicit guidelines and a sample QI Story are located in appendix B.)

Hint: *It is helpful to do this as your team concludes each step along the way versus waiting until the end. The report is also a convenient way to review, with your sponsor, a summary of the team's work.*

STEP 2. DATA COLLECTION AND ANALYSIS

The purpose of Data Collection and Analysis is to investigate the specific features of the problem from a wide range of different viewpoints. In other words, in step 2, the team discovers factors that are the most important things to investigate for root causes in step 3.

Some Tools: Checksheets, Graphs, Pareto Diagrams, Milestone Charts, Histograms & Voice of the Customer Interviewing Techniques

INSTRUCTIONS

A. Develop a *checksheet* to collect data.

INCORRECT:

Delivery Date	On-Time	Late
1-21-91	100	5
1-22-91	95	2

BETTER:

Customer Name	Date Ordered	Date Promised	Date Delivered	# Days Late	Product
Apex	1-5-91	1-21-91	1-23-91	2	Xyz

figure 14

☞ Verify that the desired data is being collected. Make modifications to the checksheet as necessary.

It usually takes several iterations on the sheet and training of those providing the data before the correct data is being collected.

☞ Think about what all the possible causes may be, and maybe do an Ishikawa diagram. This will help avoid the collection of wrong data.

☞ Design a checksheet with enough categories — avoid discovering later that you wish you had other relevant data.

Data Collection Checksheet/Late Deliveries from Division X

Customer Name	Date Ord.	Date Prom.	Date Del'd	# Days Late	Product	Mat'l Type	$ Value	Week in Quarter
Apex	1-5-91	1-21-91	1-23-91	2	XYZ	B2	2K	32

Collected By: _____

figure 15

B. Collect data

☞ Go to the site and collect your own data first.

You will see reality firsthand and be able to substantiate the credibility of the data, and see what data is easily available versus difficult to obtain. This will also help you revise the theme if necessary.

☞ Spot-check the data to prove its validity.

☞ Assist in designing the data collection scheme.

This will become useful if you want to train others

concerning what data you want and how you want it.

☞ Do not rely on existing data or historical information.

Reports can be misleading, different definitions may be used or the existing data may be valid only for another purpose (e.g., product cost for inventory valuation).

☞ Collect data on as many variables as possible.

It may be helpful to ask questions such as: "What is the evil?" "Where does it occur?" "When does it occur?" "Whom does it affect?"

☞ Collect data that represents many different viewpoints.

This will uncover as many variations in the results as possible, and will allow the team to stratify the data.

☞ Collect only as much of the data as you need (just enough to capture 50–100 defects).

Often a sample will be sufficient. Collecting too much data (quantity of data) may slow your progress.

C. Develop a broad *checksheet* which can be used to organize the data and generate many *Pareto diagrams*.

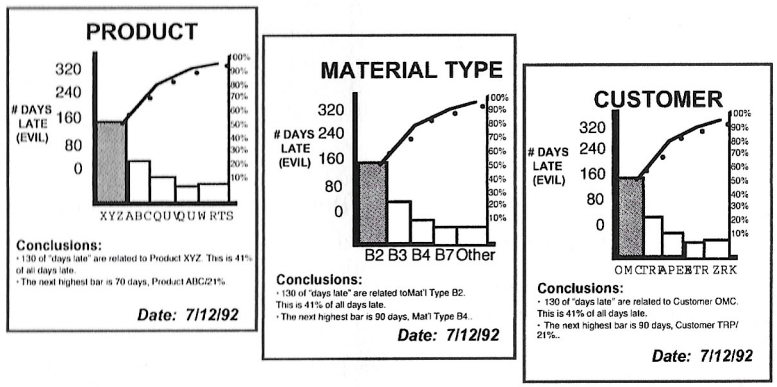


figure 16

D. Once the data has been collected, stratify the data in many forms. Do multiple *Paretos*.

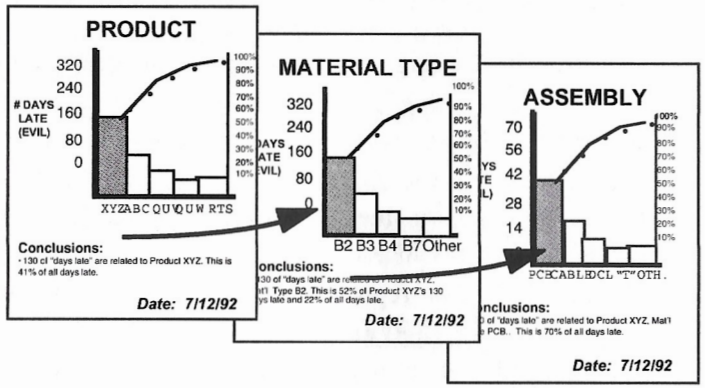


figure 17

- ☞ Be certain to put the team's conclusion(s) at the bottom of the Pareto.
- ☞ Highlight the "bar" on the Pareto that the team will investigate further.

Hint: *If the bars on the Pareto are flat, you have not cut the data enough. Try looking at it in a different way until a major problem surfaces.*

- ☞ Use the highlighted bar of the first Pareto diagram as a starting point to develop the next Pareto, and so on.

E. Plan ahead for step 5.

You will need data to confirm the results of the implemented solution or experiment. This preparation in step 2 will assist

in shortening the cycle-time of data generated in step 5.

- ☞ Consider the schedule of the product or service planned for step 5 verification.

  If the expected cycle-time of data generated at step 5 is longer than planned, think creatively: do an experiment; run an internal test rather than waiting for field data; apply the solution to historical situations to determine the probability of success.

F. If appropriate, based on your analysis, revise your theme.

G. Complete step 2 of the QI Story and review with your sponsor.

H. Now that the scope of the project and the theme has been finalized, prepare a milestone chart (figure 18).

- ☞ You may have your own way of creating a milestone chart. If not, figure 18 may serve as a model.

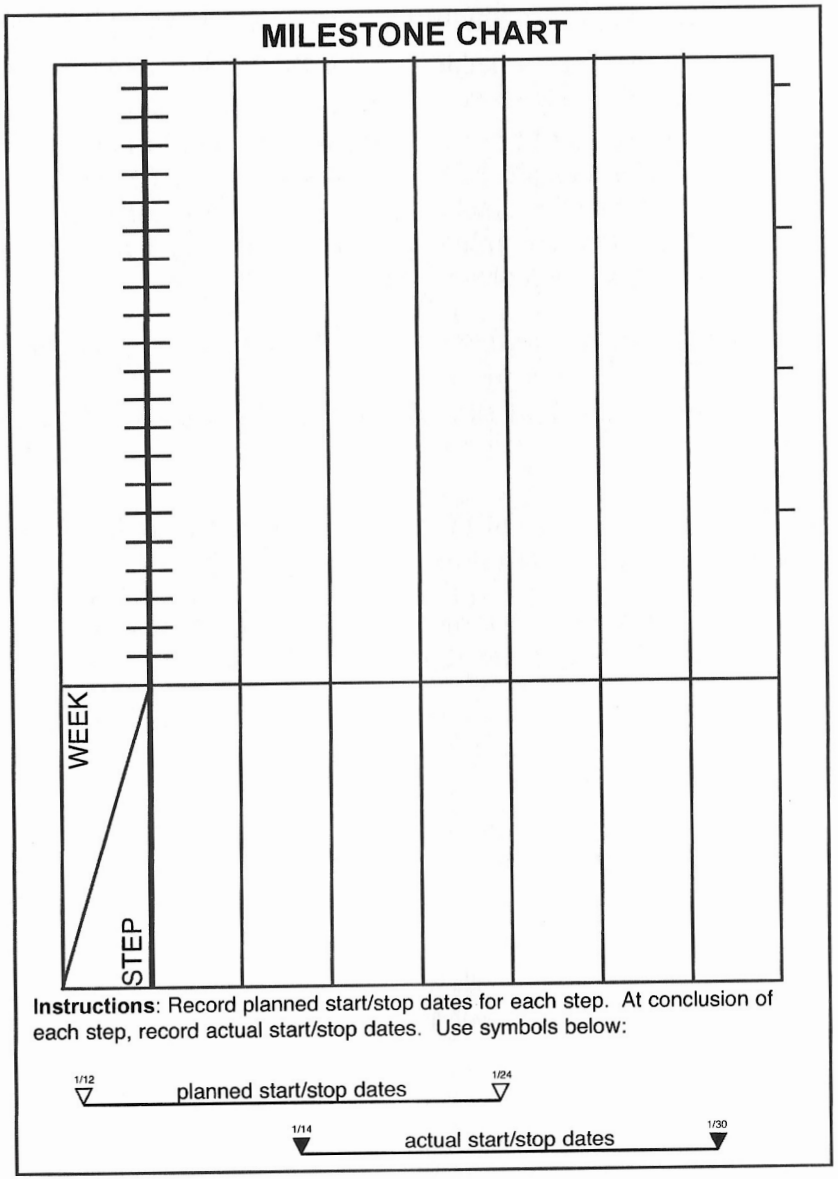


figure 18

STEP 3. CAUSAL ANALYSIS

The purpose of Causal Analysis is to find the main causes of the problem.

Some Tools: Ishikawa Diagram, Relations Diagram, Scattergram, Pareto Diagram, Flowchart, Tree Diagram, Matrix Diagram, & Brainstorming

INSTRUCTIONS

A. Involve people who know the process.

- Talk to and involve people closest to the work to discover the "real" problem.
- Use the brainstorming technique to generate many ideas. It helps to document the "real" versus the "ideal" process.

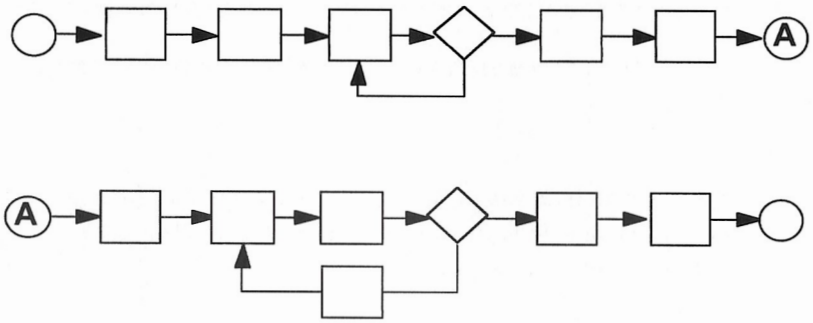
B. Do or refer to a *flowchart* of the process.

A flowchart (see page 38) will assist in highlighting potential causes, and may point out other areas of concern. It will also assist in identifying possible root causes.

C. Construct an Ishikawa or "*fishbone*" diagram.

The Ishikawa diagram (figure 19) is used to find root causes, will aid in communication and will document activities for future reference. The highest bar of the Pareto, chosen earlier by the team, establishes the "why" question for the head of the fishbone. (A possible checklist for each starting "bone" of the Ishikawa is in appendix D.)

Step 3. Causal Analysis (cont.)



1. Make as many Ishikawas as the problem dictates. Explore all causes as thoroughly as possible.

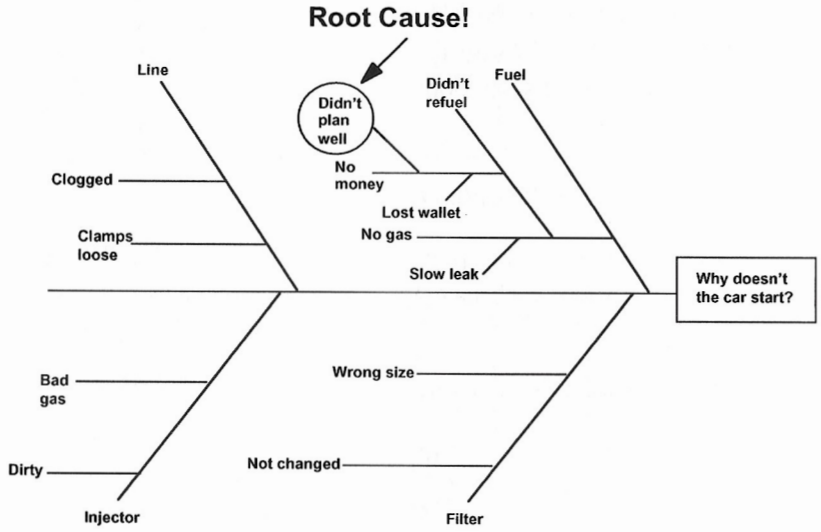


figure 19

Step 3. Causal Analysis (cont.)

2. Make the effect (the "head" of the fishbone) as specific as possible. If it is too abstract, the causes in the fishbone will be extremely large and the root causes difficult to discover.

Hint: *A good fishbone is not necessarily the busiest. You can compress or eliminate the data that is extraneous to the effect. A good diagram is one in which the remaining causes are important and have been explored thoroughly.*

3. Use the **brainstorming** technique to generate many theories of causes.
4. Answer the question, "Why did this evil occur?" Ask it repeatedly (usually five times) until you reach the root cause.

EXAMPLE

Problem: The car did not start
Why? Fuel problem
Why? Fuel tank was empty
Why? Did not refuel
Why? Ran out of money to buy gas
Why? Did not plan well, bank was closed

5. Do not assume you know the cause. If you are wrong, you will spend more time on the problem in the long run.

Hint: *Many teams have found that constructing a process classification-style Ishikawa diagram is extremely helpful (figure 20).*

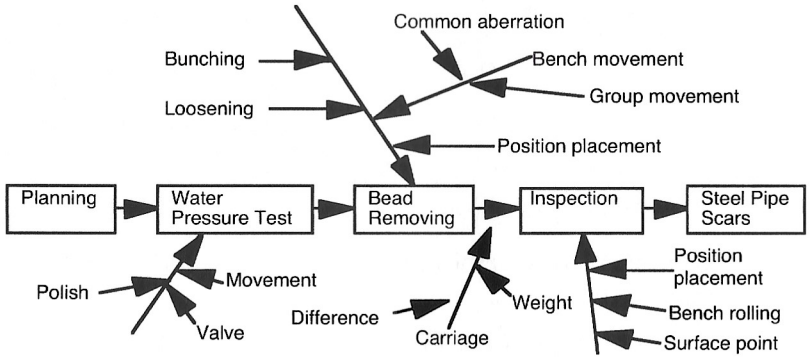


figure 20

6. Get your facts. Base your decisions on data. This will avoid bias.
7. Make sure the root cause is controllable. It is impossible to fix a cause outside your control. If the root cause is beyond the control of the team, review with the sponsor (figure 21).
8. Be sure to circle the probable causes as indicated by the team's voting.
9. Make a conclusion for each Ishikawa.
10. Reaching conclusion about the main causes is not a guessing game or democratic process. Simply voting to identify root causes does not prove anything. It is necessary to verify the root cause you have selected. Verification of root causes requires statistical analysis.

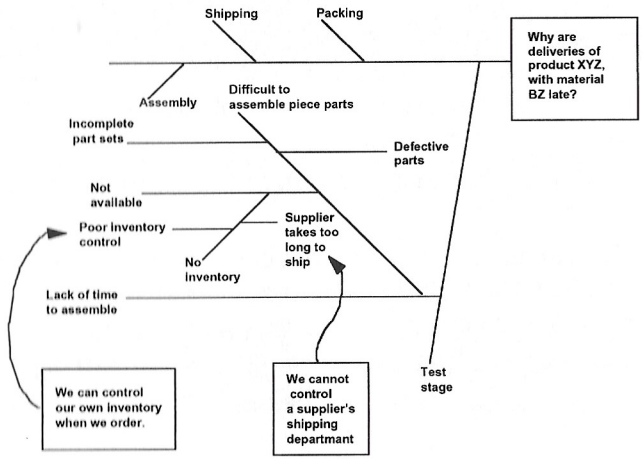
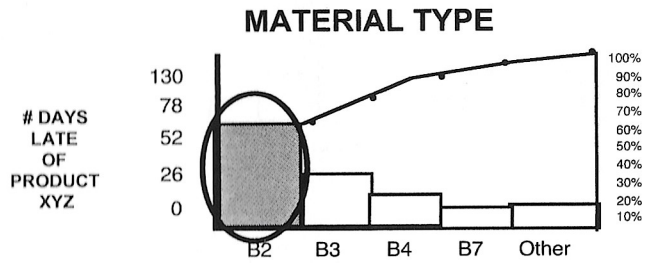


figure 21

D. Recycle back to step 2.

Step 3 often begins with theories. You must have data to prove those theories.

☞ Be certain that you are addressing the largest (or selected) bar on the Pareto (figure 22).



Conclusions:
- 68 of "days late" are related to Product XYZ, Mat'l Type B2. This is 52% of Product XYZ's 130 days late and 22% of all days late.

Date: 7/12/92

figure 22

- ☞ If your team cannot reach consensus on the root cause, you must go back and collect additional data.
- ☞ Verify the relative importance of the root causes by collecting more data.

  For example, run a **scattergram** of the root cause and effect.
- ☞ Be patient. Finding the root cause will not usually be easy.

  If it were easy, why would you be going through this process? Being impatient may very well lead to assuming the wrong root cause.

E. Complete step 3 of the QI Story and review with your sponsor.

- ☞ Remember to recognize the contributions of all the people who might have been involved, even if only for a short time.
- ☞ Remember to update your milestone chart.

STEP 4. SOLUTION PLANNING AND IMPLEMENTATION

The purpose of Solution Planning and Implementation is to take action that will eliminate the causes of the problem.

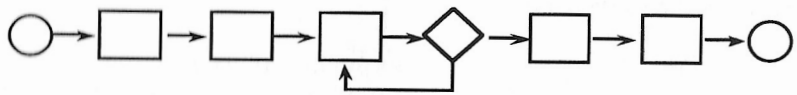
Some Tools: Ishikawa Diagram, 4W & 1H Matrix, Brainstorming, Matrix Diagram, Tree Diagram, Contingency Planning (PDPC), Solution Selection Matrix, Benchmarking & 9-Step Project Management System

INSTRUCTIONS

A. Develop a solution that prevents the recurrence of the root cause.

- ☞ Be certain that the solution focuses directly on the root cause identified in step 3.
- ☞ If necessary, develop several possible solutions (alternatives).

Before



Revision

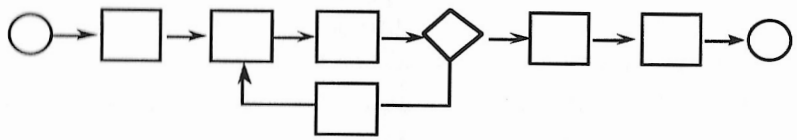


figure 23

- ☞ Examine the advantages and disadvantages of each possible solution.
- ☞ Consider improving the existing process before revamping the entire process.

  This may yield faster results, and will reduce the rise of introducing new errors.
- ☞ Determine whether any of the solutions will produce negative side effects (e.g., a change in a specification will require some material to be scrapped). If so, develop additional solutions or devise remedies for the side effects.
- ☞ Consider the effect this change will have on other processes. Have you considered your suppliers, customers, and other related processes?
- ☞ If necessary, create a **Solution Selection Matrix** (figure 24) to show how each solution addresses the major root cause.
- ☞ Obtain group consensus on the recommended solution.
- ☞ Make sure the solution is something the team can implement.

B. Run an experiment.

Step 4 normally is an **experiment** to **test** the planned solution, providing it is not too time consuming. You will confirm this experiment in step 5 and, if successful, standardize in step 6. Running an experiment is especially helpful if the solution is either difficult to do or the results are difficult to assess due to an infrequent feedback system.

- ☞ In describing the solution, explain what it is, not the details on how to do it.

SOLUTION SELECTION MATRIX

SELECTION CRITERIA

PRIMARY ROOT CAUSE: _____

ALTERNATIVE SOLUTIONS	FEASIBILITY	EFFECTIVENESS			TOTAL SCORE
1.					
2.					
3.					
.....					
n^{th}					

SCORING VALUES ⊙ = HIGH ○ = MEDIUM △= LOW

SCORING VALUES SCALES			
	3 OR 5	2 OR 3	1

figure 24

These details should be included in the new procedure documentation, manuals, policies, etc.

☞ Be sure to document an action plan that addresses the **4W & 1H** (figure 25).

What *(will be done)*	Where *(will it be done)*	When *(will it be done)*	Who *(will do it)*	How *(will it be done)*

figure 25

C. Use a time line to describe the implementation schedule.

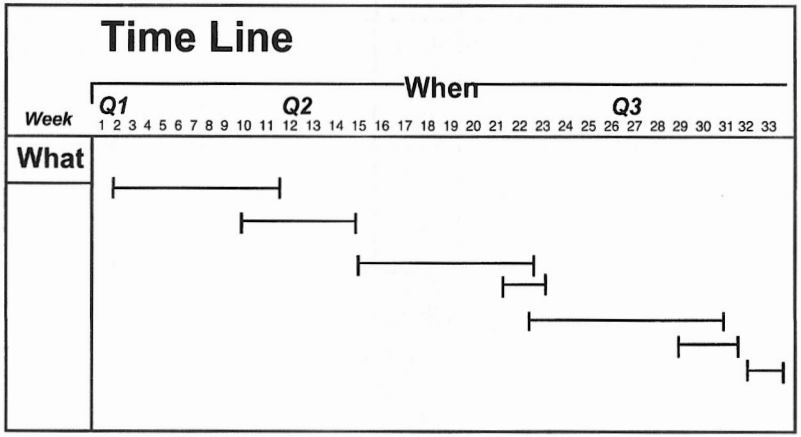


figure 26

☞ Establish deadlines. Think through the plan.

☞ Make changes as necessary to the milestone chart from step 2.

☞ Get knowledgeable and affected individuals involved in the planning stage.

This improves the likelihood of a successful solution and helps the team better understand the possible roadblocks to implementation. The individuals involved will be better prepared for any required changes, helping ensure buy-in and cooperation.

D. Determine the measurement which will confirm that the solution actually worked.

Step 5 confirms the results, but this is the time to think about the feedback loops and measurement system that will measure the effect of the solution.

E. Complete step 4 of the QI Story and review with your sponsor.

☞ Remember to update your milestone chart.

Step 5. Evaluation of Effects

The purpose of Evaluation of Effects is to make sure that the solution will correct the problem.

✎ Some Tools: Pareto Diagrams, Graphs, Run Chart, Histograms, & Scattergrams

Instructions

A. Collect data.

- ☞ Use the same method and format as in step 2.
- ☞ Confirm the results with the customer if it is practical to do so.

  You will reinforce the market-in philosophy, and validate internal results. This may point out unforeseen negative side effects of the solution. It also communicates to the customer your progress toward problem resolution.

B. Evaluate the results.

- ☞ Compare the data from before and after the implementation of the solution using both **Paretos** and **run charts**.

  Refer back to the "Before" Pareto created in step 2. The bar the team chose to address was highlighted at that point. By recreating that Pareto with new data after the implementation, and highlighting the bar the team chose before, the effects of the solution can be shown. Continue to monitor results over time.

- ☞ Assess and list potential side effects, both negative and positive.

  This will help identify interactions and possible consequences of implementing the solution, potential new measurements to be monitored, and possible unplanned wins.
- ☞ If there are other effects during the implementation period, list them (e.g., a hurricane or snowstorm shut the plant down or a new product was introduced during the project period).

  Keep these factors in mind when comparing the total effect.
- ☞ Evaluate the intangible results of the solution (satisfaction, motivation and skill development of the people involved in the solution).
- ☞ Whenever possible, convert the data into monetary impact for senior management.
- ☞ If the evaluation bears out that the solution was successful (target has been or will be reached), go on to step 6.

  If not, go back to step 4 and revise the solution or go back to step 3 to see if the real root cause was missed. Apply the PDCA philosophy.

C. Complete step 5 of the QI Story and review with your sponsor.

- ☞ Remember to update your milestone chart.

STEP 6. STANDARDIZATION

The purpose of Standardization is to ensure that the cause of the problem has been eliminated permanently!

Some Tools: Flowchart, Control Chart, Trend Chart, 4W & 1H Matrix, &Graphs

INSTRUCTIONS

A. Describe the task necessary to standardize the solution.

- ☞ Use the 4W & 1HC matrix to develop a matrix as in step 4. (Teams also should consider adding a "check" column as a reference point to think about how the solution will be checked.) You should include a description of how the QIT will know the standard is being followed.

What *(will be done)*	Where *(will it be done)*	When *(will it be done)*	Who *(will do it)*	HOW *(will it be done)*	CHECK *(that it is done)*

figure 27

B. Document the process change.

- ☞ Use the existing documentation system if possible.
- ☞ Provide the organization with clear instructions that last over time.

  Answer why the new standard is necessary. It increases the likelihood that the standards will be observed.

Process Change Notice

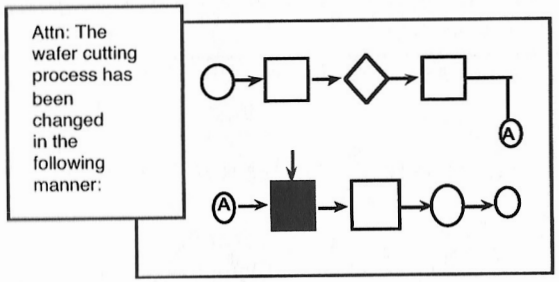


figure 28

C. Ensure that your process change has provision for updating and revising the process.

Other changes may be necessary in the future. Does a method exist for these changes to occur? Standardization is not a one-shot deal. Revise the standard as necessary.

D. Make changes to the existing flowchart to communicate the new standard.

This is a good graphical/visual method of communicating changes.

E. Continue to monitor the results over time.

- ☞ Use a **graph**. A graphical format simplifies the communication.
- ☞ Confirm that the results do not deteriorate over time.

☞ Identify how and by whom the status of the new standard will be monitored.

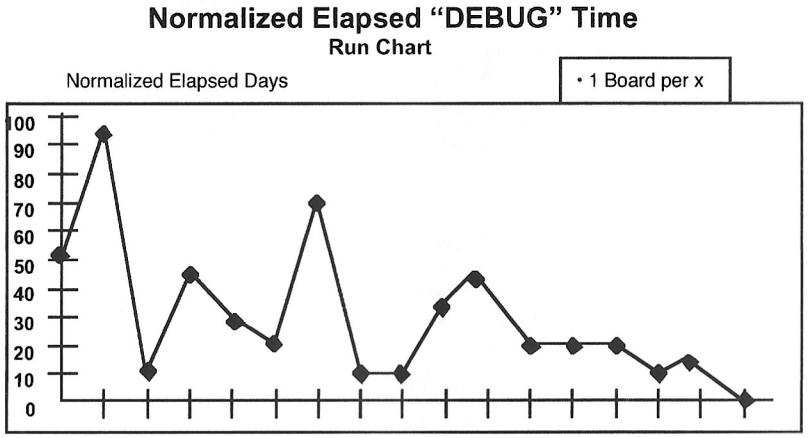


figure 29

F. Train, inform, and/or involve affected individuals.

☞ Ensure that all affected individuals know about the change and their role in it.

Some individuals will need only to be informed. Others may need a detailed explanation, or formal training.

☞ Put in place appropriate metrics to keep the focus on the intent of the new standard as the quality improvement team fades away.

G. Ensure that you communicate with other parts of the organization who could benefit from your experience.

Chances are that other parts of the organization within the company are wrestling with the same or similar problem. You could save them a great deal of work.

H. Summarize (list) the changes that have been made.

☞ Make it clear to the QIT and others what was actually done.

This list is a good communication vehicle for others to see the QIT's progress.

I. Complete step 6 of the QI Story and review with your sponsor.

☞ Remember to update your milestone chart.

STEP 7. REFLECTION

The purpose of Reflection is to review the problem-solving process and to identify the next problem.

Some Tools: 4W & 1H Matrix, Brainstorming, LP Method, Pareto Diagram, and Theme Selection Matrix

INSTRUCTIONS

A. Summarize the team's achievements.

- ☞ Confirmation of results occurred in step 5, but this is an opportunity to step back and look at the big picture.

B. Summarize the lessons learned related to the 7-Steps. The focus here should be on the process.

- ☞ Use the 4W & 1H matrix to describe the practices that worked well and how you plan to standardize these practices (figure 30).
- ☞ Use the 4W & 1H matrix to describe the practices that did not work well and how you plan to correct them or avoid them next time.
- ☞ Reflect back on the effectiveness of using the 7-Steps problem solving methodology.

  What would you like to share with other QITs so that they could learn how to accelerate their progress and avoid mistakes?

4W & 1H MATRIX

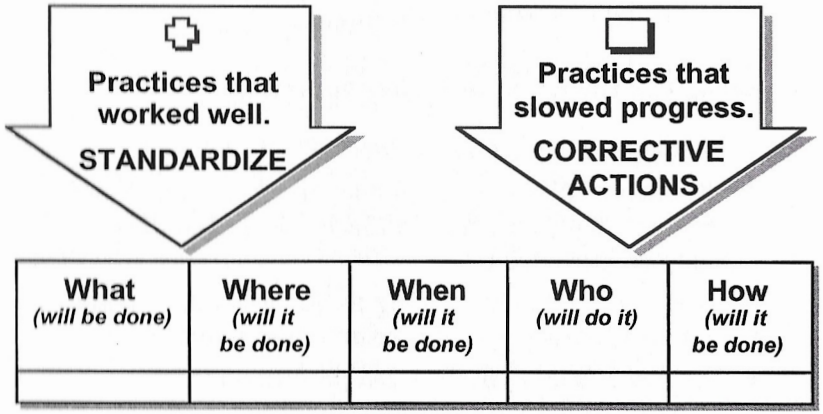


figure 30

C. Compare the milestone chart "plan" and "actual."

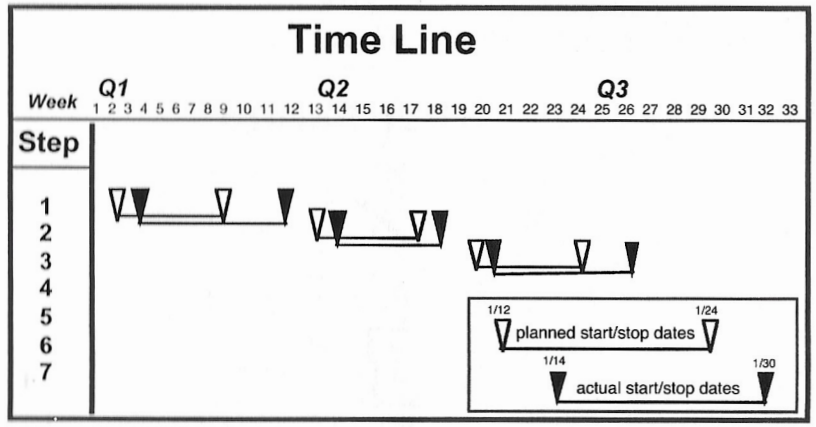


figure 31

☞ Identify what went wrong and why.

Reflection is especially important if deadlines slipped or the targets were missed.

D. Recognize the team and other contributors.

☞ Recognize the team's efforts.

☞ Recognize those not on the team but making contributions (e.g., they assisted in the Ishikawa diagram, data collection, etc.).

You can do this by placing these individuals' names on the QI Story as "significant contributors."

☞ Evaluate team dynamics and performance.

E. Recommend a weakness for the next PDCA cycle.

The QIT is now in an excellent position to recommend, based on facts learned, the next problem area needing attention. This will help reinforce the continuous improvement mindset.

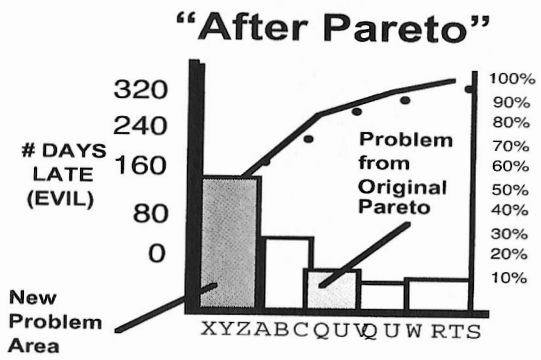


figure 32

F. Complete the QI Story and review with your sponsor.

☞ The QI Story should follow the 7-Steps sequence as a *presentation format.*

This practice should be followed even if the team went through iteration loops.

☞ Document the team's work in 3–4 pages so that others can benefit from the work done by your team, see examples of 7-Steps work, and see the data.

☞ Put detailed data in an appendix for those who might need it in the future.

☞ Present the report — it should be 15–20 minutes. The written documentation can also be used in training.

G. Communicate the report.

☞ Determine who else needs to know, and disseminate your experience.

This will help others learn. Others will be motivated by seeing your success. Communicating the report is also an excellent method of recognition for the team.

IV. TELLING THE QI STORY

Every time the 7-Step Problem Solving Method is employed, the process and the results are documented as a Quality Improvement (QI) Story by the team. This story is then presented to management. Telling the QI Story spreads the improvements throughout the organization and informs management of what exactly has been done. It is also a way of acknowledging the team's efforts and accomplishments. The QI Story also organizes the work that has been done so the sponsor can easily diagnosis the team's problem-solving skill and the team can ensure the most important problems were solved and the solutions were effective.

The QI Story is an *efficient* format for presenting process improvement studies to management. It is *not* the same thing as the 7-Steps. Remember, the 7-Steps refer to a methodology for actually solving problems. The sequence of problem solving may in fact contain iterating steps (e.g., revising the theme based on data collection or choosing alternative solutions based on the evaluation of results). The QI Story is the *sequential* format in which the team presents its findings to management. It is not necessary to waste management's time explaining previous themes, sidetracks and trials and errors (although these are important lessons for future problem solving). QI Stories are simply a standard presentation format of the 7-Steps.

One can think about the QI Story as the creation of a common language. Management is fluent in this language. When teams use the same 7-Steps or the same format for a Pareto, management immediately grasps the meaning. If a different format or sequence is presented, management must stop and translate what they see or hear into their language. Time is wasted trying to understand each word or piece of data. The focus on the improvement story gets lost.

Explicit guidelines on how to present a QI Story, as well as an example of one that a member company of the Center for Quality of Management has made available, can be found in appendix B. For guidelines on diagnosing the QI Story see the Center's manual *Diagnosing Teamwork Through the QI Story*.

Appendix A: Glossary

Checksheet

Technique to transform raw data into categories. Results are recorded for each category (e.g., number of errors by type, time, place, symptom) through routine checking of the situation.

Control chart

A statistical device used to study and control repetitive processes by plotting deviations from a mean or control value.

Fishbone (aka cause-and-effect diagram or Ishikawa diagram)

Diagram used to organize the *causes* or factors that produce a quality *effect* (e.g., defects). Information is generated during a brainstorming session by asking "why" 5 times. The information is arranged into main branches and many smaller branch details. The name "fishbone" comes from the shape of the diagram, which looks like a skeleton of a fish.

Graph

A pictorial means of displaying trends or condensing data. Examples include line, bar and pie charts.

Histogram

A graphical picture of a frequency table. The X-axis is intervals of a measure (e.g., temperature ranges) and the Y-axis is the frequency. Histograms are used to exhibit measures of central tendencies and dispersion within a process.

Language Processing Method (LP)

A structured method for dealing with facts that are nonquantifiable. This tool helps to gather large amounts of "language" data (ideas, issues) and organizes them into groupings that help to focus on the most important problems. It is largely a creative rather than a logical process.

Appendix A: Glossary (cont.)

Pareto chart

A diagram showing the cumulative frequency of defects. Helps to focus on the vital few problems. Generally, 20% of the causes account for 80% of the defects.

Scatter diagram

A tool for studying the correlation between two variables. Each point on the graph represents a pair of values.

The 7 Management & Planning Tools
(Source: A New American TQM)

Affinity diagram

A basic version of LP that structures detailed data into more general conclusions. Used for providing initial structure in problem exploration. Often structures answers to "what?" questions, e.g., "what is going on in a complex situation?"

Relations diagram

A network of cause-and-effect relations. Often used to trace through answers to "why?" questions, e.g., "why is 'what's happening' happening?" A relations diagram is used when the situation is too complex for use of an Ishikawa diagram.

Matrix diagram

For relating multiple alternatives to multiple consequences of each. Often used to answer "which?" questions, e.g., "which things do we have to do to satisfy the customer's requirements?"

Tree diagram

A tool often used to relate means to ends, which in turn are means to more general ends. Often used to structure answers to "how?" questions, e.g., "how do we do the things that we have chosen to do?"

PDPC diagram (process decision program chart)

A diagram of the flow of alternative possibilities and countermeasures for each. Often used to design responses to possible setbacks—answers to "what if?" questions.

Arrow diagram

A simplified PERT chart, used for scheduling events and identifying bottlenecks ("critical paths"). Answers "when?" questions, e.g., "when do we have to do the things we have chosen to do?"

Matrix data analysis

Mathematical analysis of numerical data arranged as matrices, e.g., "where in the data do we find various patterns?" There are many methods, often called multivariate analysis, including cluster, multiple regressions, and principle component analysis.

Presenting the QI Story

Step 1. Theme Selection
- √ State theme (explain why it is so important).
- √ Show data, e.g., Paretos.
- √ Assume audience is a customer not familiar with your business and does not understand the problem. Draw flowcharts, define terms, show pictures, etc.

Step 2. Data Collection and Analysis
- √ Explain how data was collected, # of data points, stratification, etc.
- √ Show Paretos.

Step 3. Causal Analysis
- √ Show Ishikawa diagram(s).
- √ Highlight the root causes.
- √ Explain how team verified that root causes were real.

Step 4. Solution Planning and Implementation
- √ Show matrix that demonstrates how solution addresses root cause.

Step 5. Evaluation of Effects
- √ Show benefit of solution by comparing before and after Paretos.

Step 6. Standardization
- √ Show 4W & 1H.
- √ If appropriate, show control charts to demonstrate the holding of the gains.

Step 7. Reflection
- √ Discuss what team learned about the process.
- √ Identify next problem.

I will now explain our theme. ADS is the largest division at Analog Devices Incorporated, and is located at Wilmington, MA. As shown in the figure, ADS ships packaged integrated circuits to a plant in the Philippines, known as ADPI, for a welding process that seals the package. The package is then tested for something called "hermeticity," which I will explain in the next slide, and is then shipped back to ADS, which performs an electrical test of the part, and then stamps the ADI logo on the part ("Brand"). After that, a final test at OQC is performed. We measure failures at this point in terms of PPM or the number of parts defective per million parts that pass through this point.

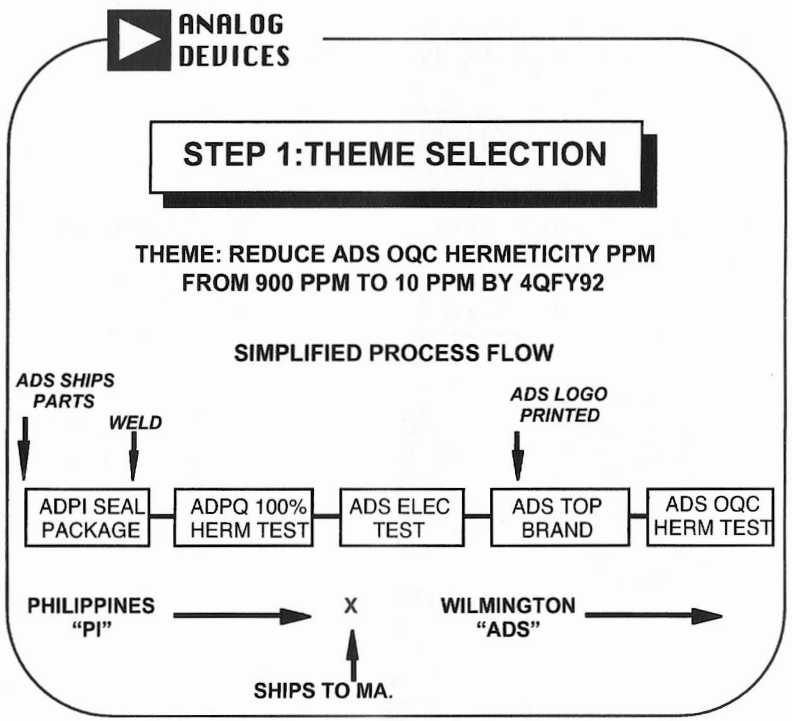


figure 35

I will now present hermeticity to complete my explanation of the theme. This figure shows the cross section of a package part. The body of the package is called a "header"; the chip is shown in the header, connected to two metal wires or leads that protrude through the header. The top piece is a metal can; in the sealing process, the metal can is welded onto the header, sealing in the chip. Hermeticity measures the goodness of this seal, that is, whether or not the seal leaks.

Now, I hope you understand our theme. The defect we are reducing is the hermeticity loss in PPMs of our packaged ICs as measured at the OQC point shown on our first figure.

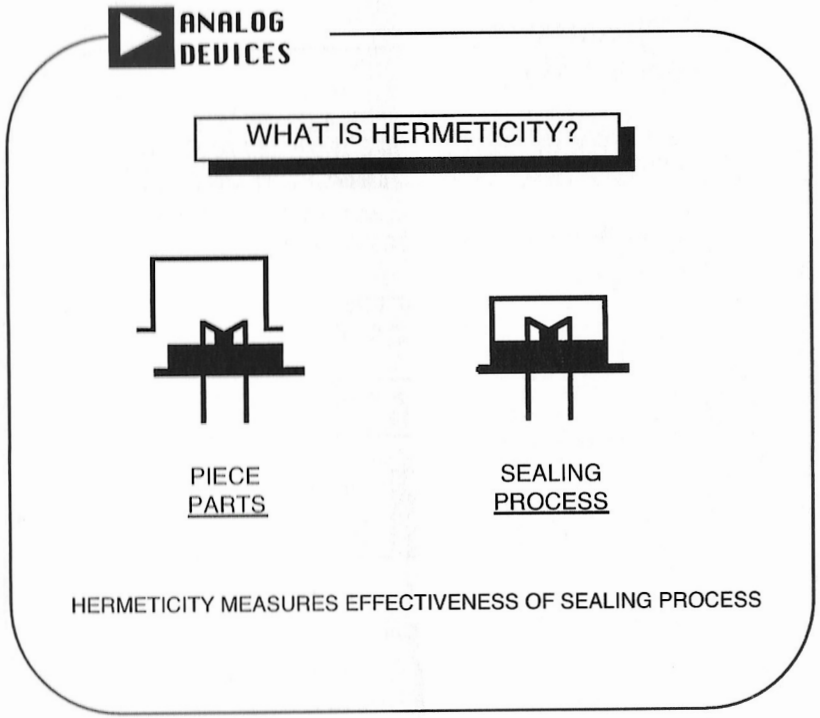


figure 36

Theme selection is incomplete without a demonstration of the importance of the problem. This figure shows that there are many types of yield loss associated with the packaging process; however, hermeticity loss was the highest cause of loss, and so we worked on this problem first.

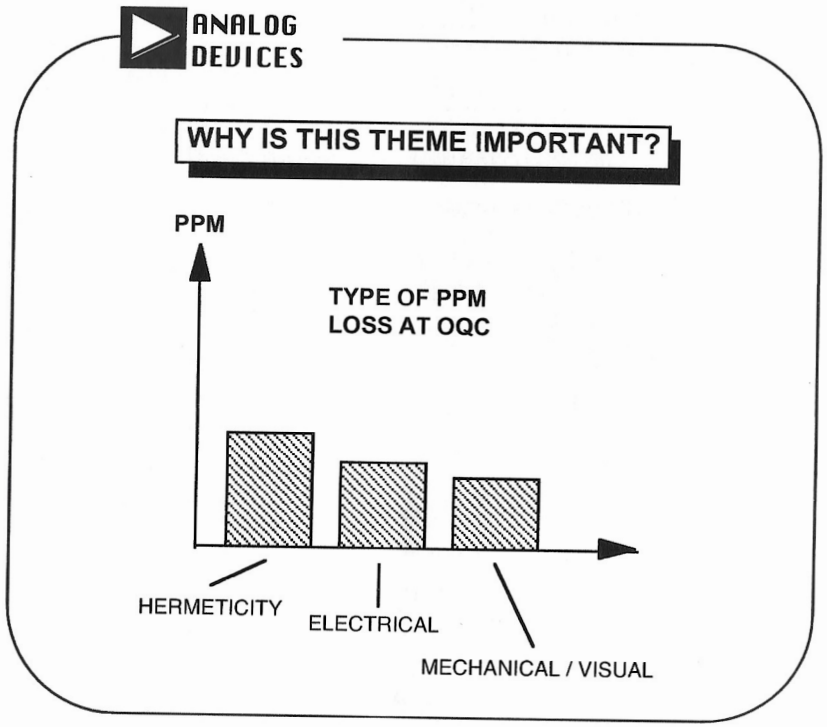


figure 37

Step 2. Data Collection and Analysis

Our initial data collection occurred at the OQC point indicated in the figure. We collected this data from September through November of 1988, and used about 3,000 data points. The data was taken from an existing database at first — an OQC database had been maintained in that part of ADS.

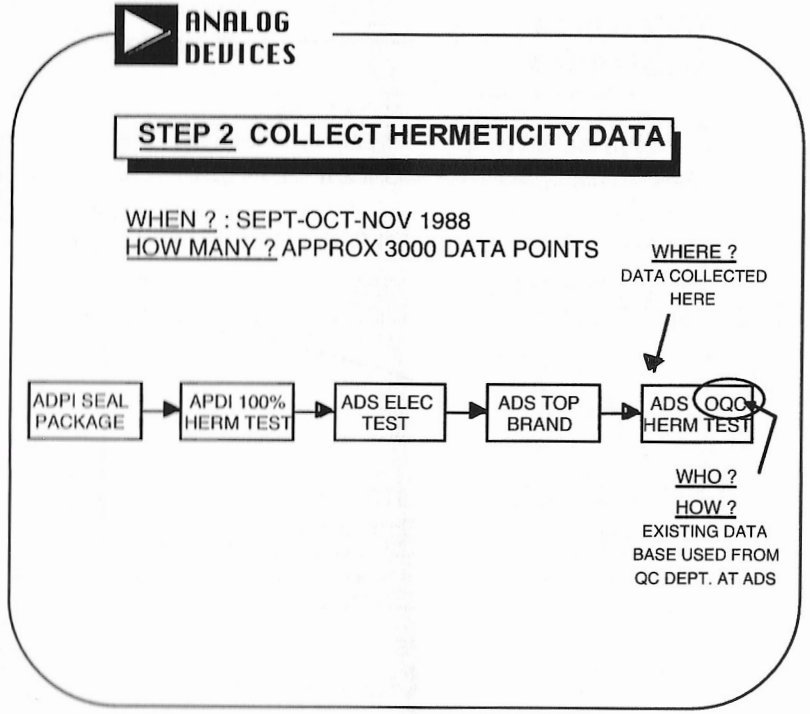


figure 38

This shows our initial Pareto of causes of hermeticity loss from our data collection. As you can see, the type of package we call "Small Header" was the leading cause of loss, so we concluded that we should focus on "Small Header." We were not satisfied with our database, so we decided to take data of our own.

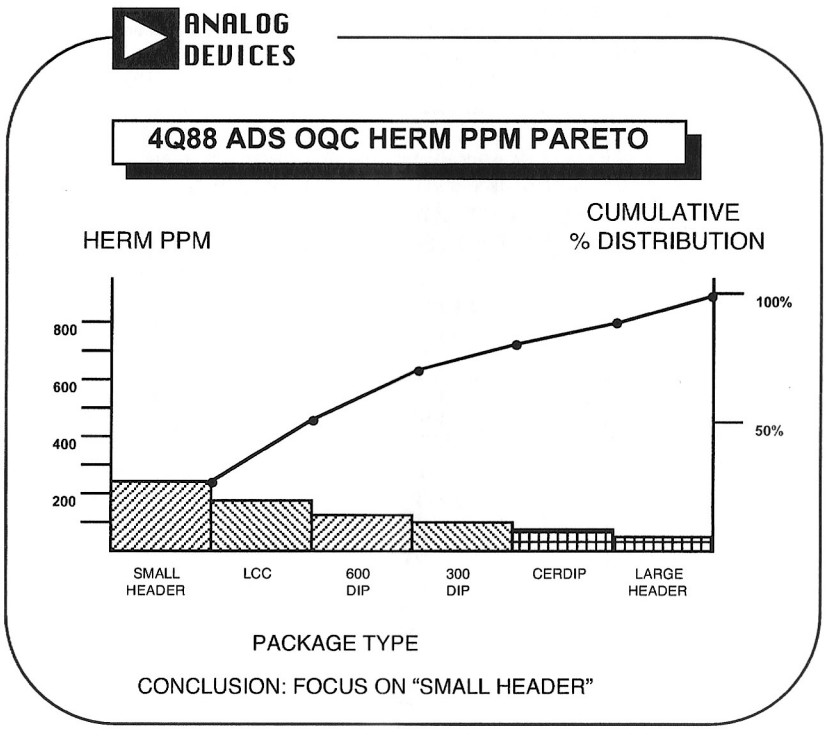


figure 39

The top figure shows the flow of processes I have already shown you. We were already receiving data at the OQC point at the right; at the same time, our ADPI facility had collected data at the 100% hermeticity test point indicated. Thus, we decided to focus in on the ADS Electrical Test point for more data, especially since this is where manual handling of the parts occurred and we theorized this might give us an interesting "cut" at the data. We installed test points before and after manual load as indicated in the figure.

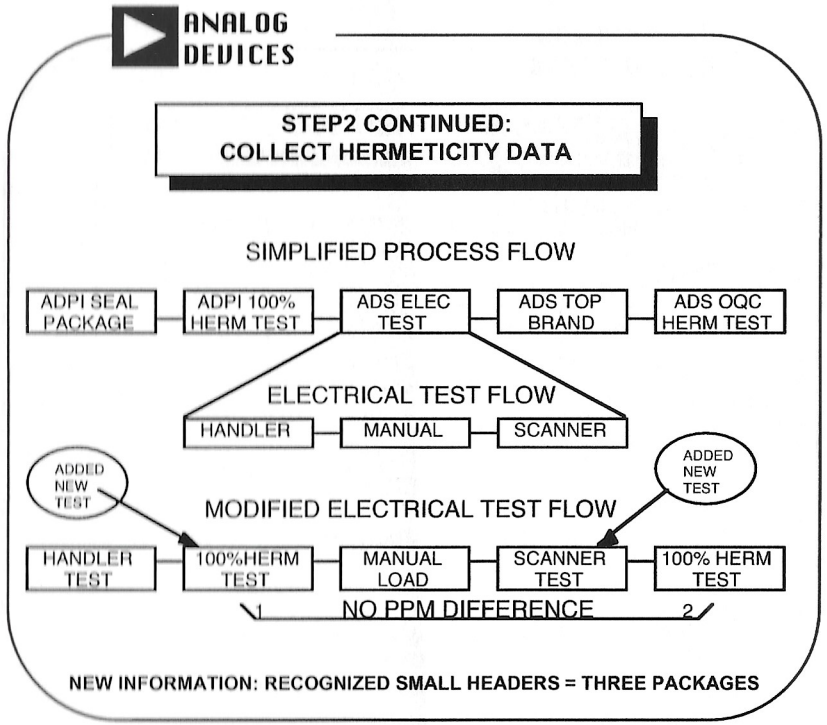


figure 40

We found that the PPM defective rate did not increase at any point through this process. Thus, this was not the cause of the hermeticity loss. We began to defocus on the process as the cause, and looked more carefully at the materials themselves. At this point, we realized that what we had been calling "Small Header" actually consisted of three package types that, aside from having a different number of leads, were very similar in construction.

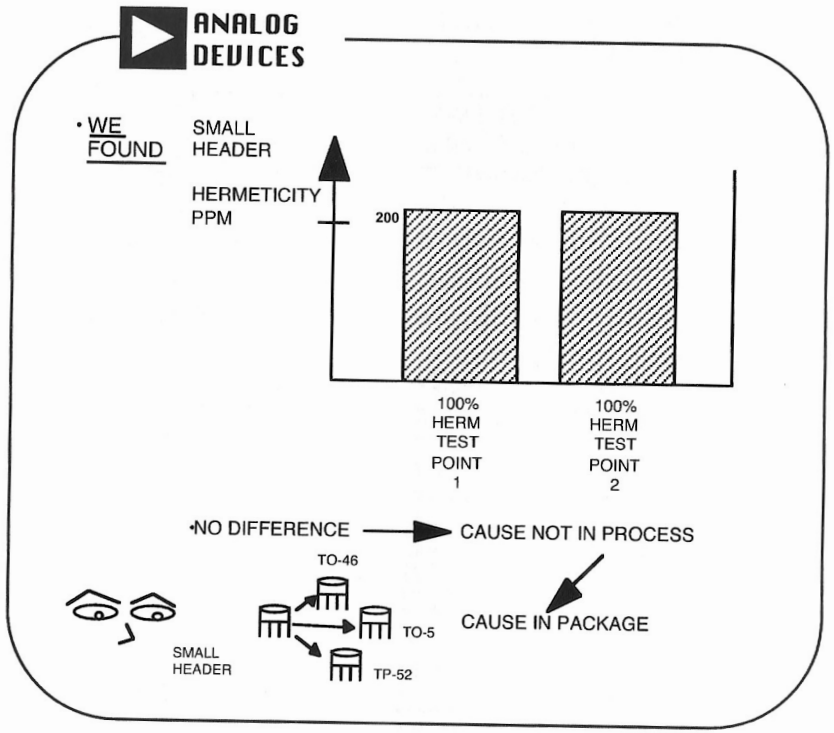


figure 41

We then replotted our original Pareto, this time separating out the three small header types, called TO-46, TO-5, and TO-52. As can be seen in the Pareto, TO-46 was a much larger source of defects than the other two types. Note that LCC type is now the leading cause; however, there was an independent engineering effort to fix this problem, so we continued to focus on TO-46. Our conclusion was that we would begin step 3 to determine the root cause of why TO-46 was a larger cause of defects than TO-5 and TO-52.

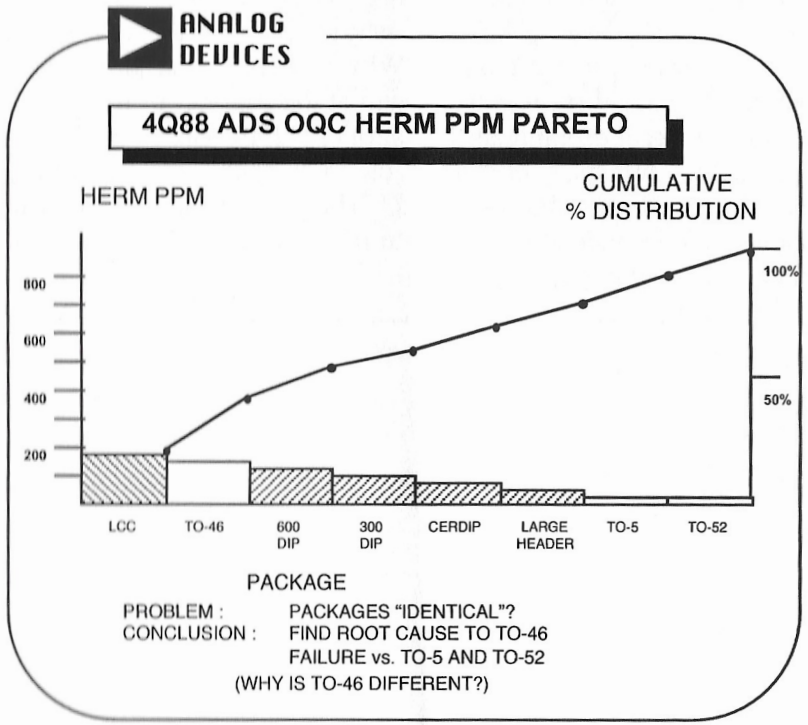


figure 42

Step 3. Causal Analysis

This shows our Ishikawa diagram; the effect that we explored was, "Why does the TO-46 package have the highest hermeticity loss?" We tried to keep in mind the other package types and the question "...as compared to TO-5 and TO-52?" as well. The "answer" on the first level of the diagram was grouped into causes due to Materials, Equipment, and Process. As you can see from the diagram, we tried to ask "why" at least five times. For example, please follow along in the Materials section; when we asked, "Why does TO-46 have higher defects?" (1st why), we answered, "Because the TO-46 materials were defective." "Why were the materials defective?" (2nd why), "Because the base leaks." "Why does the base leak?" (3rd why), "Because there is a leak path somewhere in the base." "Why is there a leak path?" (4th why), "Because there was a problem at the supplier of the parts." "Why is there a problem at the supplier?" (5th why). We in fact agreed that this path contained the root cause, after carefully examining all the other branches. Thus, the conclusion was to choose this branch and investigate the piece parts from the supplier's viewpoint.

APPENDIX B: QI STORY GUIDELINES AND SAMPLE STORY (CONT.)

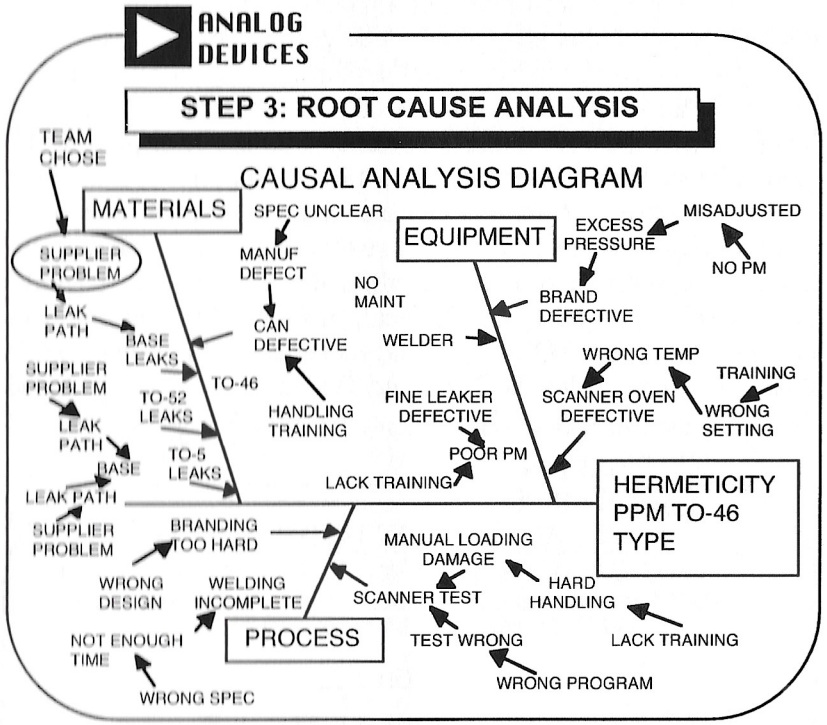


figure 43

The figure demonstrates our analysis of this root cause. The circled area contains all possible leak paths with the base: leaks from can to base, and leaks from lead through the base. We tested the weld that we performed on the can-to-base seal, and found no leaks. Thus, the only other possibility was the leak path at the lead. The seal here is an oxide grown by the supplier to seal in the lead to the base. At this point, we asked the supplier to join the team to help solve the problem, since this step occurred at the supplier. The supplier found that while the three header package types were supposed to be identical, in fact a different engineer had worked on the TO-46 type and had specified a thinner oxide than was specified for the TO-5 and TO-52. Thus, we concluded the root cause was that this oxide on the TO-46 was too thin.

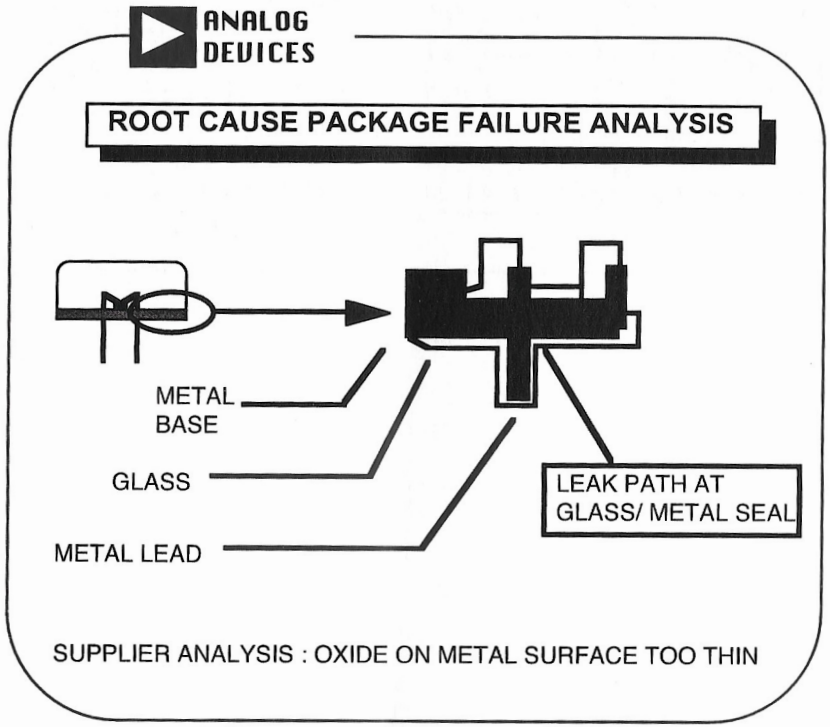


figure 44

Step 4. Solution Planning and Implementation

Step 4 is Solution Planning and Implementation. Our solution was to have the supplier grow a thicker oxide on 10,000 test parts. We assembled these parts to test for leaks. We show here a summary of our plan: what was to be done, by whom, and by when.

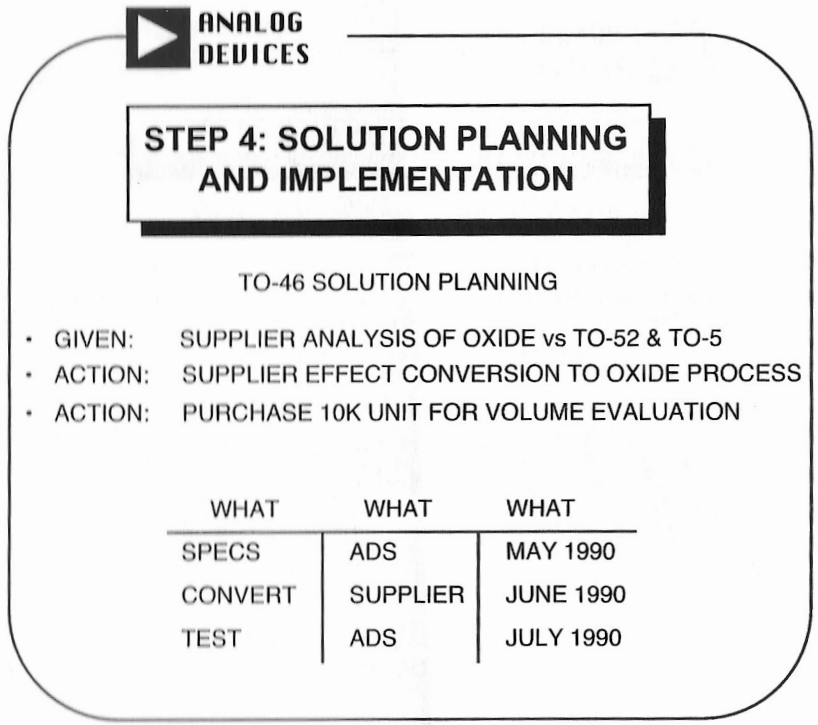


figure 45

Step 7. Reflection

Step 7 is reflection on the process and planning future work. Upon reflection, we concluded that our original data collection and analysis had been weak; if we had broken down the Small Header parts into the three types, we would have focused immediately on the TO-46 part and saved much time. In terms of future work, we plan to attack the next- largest bar on our original Pareto. First, though, we checked to see if this was still an important problem to solve.

ANALOG DEVICES

STEP 7: REFLECT ON THE PROCESS & PLAN FUTURE WORK

HERMEDICS PROBLEM SOLVING LEARNED

- DID RIGHT: CONSTRUCTED DETAILED PARETO
  " " ISHIKAWA
  TOOK OUR OWN DATA
- DID WRONG: PARETO NOT DETAILED ENOUGH
  USED EXISTING DATABASE
  DID NOT FOCUS ON 3" SMALL HEADER TYPES

→ WASTED VALUABLE TIME & RESOURCES
TOOK TOO LONG (11 MOS.)

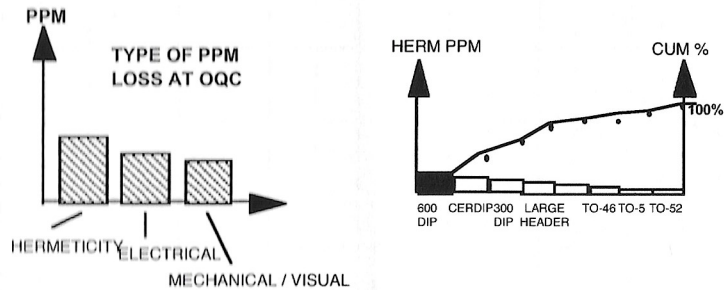
→ CONCLUSION:
- REDUCE & REDUCE DATA TO FIND REAL ISSUES

figure 48

As this slide shows, hermeticity loss is still an important defect to fix. Thus, we chose to continue working on this, and are collecting data to replot our Pareto to choose a new theme. We would appreciate your feedback on our efforts at this point so that we may improve how we solve problems, and we thank you very much for your attention.

ANALOG DEVICES

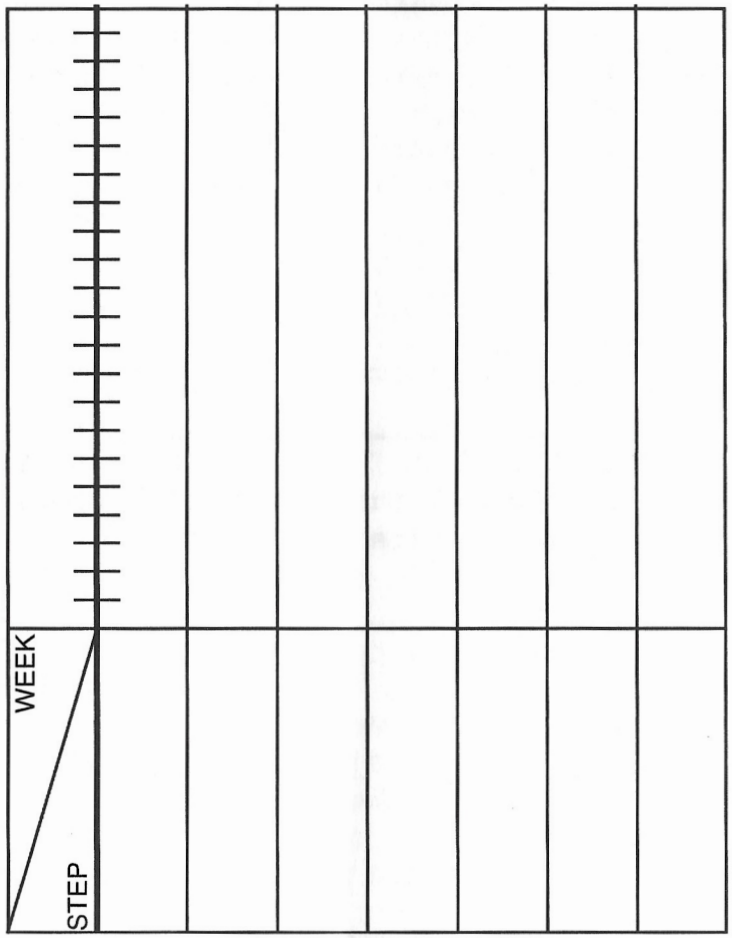
STEP 7: CONTINUED PLAN FUTURE WORK



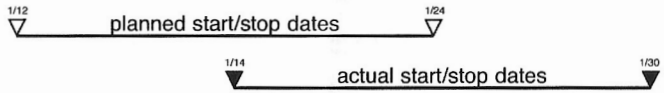
CONCLUSION:
- WORK ON 600 DIP PACKAGE
- TAKE NEW "CUT" AT DATA DUE TO FLAT PARETO

figure 49

MILESTONE CHART



Instructions: Record planned start/stop dates for each step. At conclusion of each step, record actual start/stop dates. Use symbols below:



SOLUTION SELECTION MATRIX

PRIMARY ROOT CAUSE: _____

_____

_____

ALTERNATIVE SOLUTIONS	SELECTION CRITERIA: FEASIBILITY	EFFECTIVENESS			TOTAL SCORE
1.					
2.					
3.					
.....					
n^{th}					

SCORING VALUES: ⊙ = HIGH ○ = MEDIUM △ = LOW

POSSIBLE SCORING SCALES	3 OR 5	2 OR 3	1

Appendix D: The 4 M Checklist

A. HuMan (Operator)

1. Does he/she follow standards?
2. Is his/her work efficiency acceptable?
3. Is he/she problem-conscious?
4. Is he/she responsible? (Is he/she accountable?)
5. Is he/she qualified?
6. Is he/she experienced?
7. Is he/she assigned to the right job?
8. Is he/she willing to improve?
9. Does he/she maintain good human relations?
10. Is he/she healthy?

B. Machine (Facilities)

1. Does it meet production requirement?
2. Does it meet process capabilities?
3. Is the oiling (greasing) adequate?
4. Is the inspection adequate?
5. Is operation stopped often because of mechanical trouble?
6. Does it meet precision requirements?
7. Does it make any unusual noises?
8. Is the layout adequate?
9. Are there enough machines/facilities?
10. Is everything in good working order?

C. Material

1. Are there any mistakes in volume?
2. Are there any mistakes in grade?
3. Are there any mistakes in the brand name?

Appendix D: The 4 M Checklist (cont.)

4. Are there impurities mixed in?
5. Is the inventory level adequate?
6. Is there any waste in material?
7. Is the handling adequate?
8. Is the work-in-process abandoned?
9. Is the layout adequate?
10. Is the quality standard adequate?

D. Operation Method

1. Are the standards adequate?
2. Is the work standard upgraded?
3. Is it a safe method?
4. Is it a method that ensures a good product?
5. Is it an efficient method?
6. Is the sequence of work adequate?
7. Is the setup adequate?
8. Are the temperature and humidity adequate?
9. Are the lighting and ventilation adequate?
10. Is there adequate contact with the previous and next processes?

Endnotes

[1]Hayakawa, S. I., and Alan R. Hayakawa, *Language in Thought and Action*, fifth ed. (New York: Harcourt Brace Jovanovich, 1990).

[2]Center for Quality of Management, *Managing Teams* (Cambridge, MA: CQM, 1991).

Bibliography

CQM® Quality Improvement Tool Kit

Center for Quality of Management, *Concept Engineering*™ (Cambridge, MA: Center for Quality of Management, 1992).

_____, *Diagnosing Teamwork Through the QI Story* (Cambridge, MA: Center for Quality of Management, 1991).

_____, *Managing Teams* (Cambridge, MA: Center for Quality of Management, 1992).

_____, *Method for Priority Marking*™ (Cambridge, MA: Center for Quality of Management, 1991).

_____, *Language Processing*™ *Method* (*LP*) (Cambridge, MA: Center for Quality of Management, 1991).

_____, *Tree Diagrams* (Cambridge, MA:Center for Quality of Management, 1990).

Foreword

Smith, Preston G., and Donald G. Reinersten, *Developing Products in Half the Time* (New York: Van Nostrand Reinhold, 1991).

7-Step Method

Imai, Masaaki, Kaizen: *The Key to Japan's Competitive Success* (New York: Random House, 1986).

JUSE, *How to Operate QC Circle Activities* (Tokyo: JUSE, 1985).

Shiba, Shoji, et al., *A New American TQM* (Portland, OR: Productivity Press, 1993).

QC Tools

Asaka, Tetsuichi, & Kazuo Ozeki (eds.), *Handbook of Quality Tools: The Japanese Approach* (Portland, OR: Productivity Press, 1990).

Ishikawa, Kaoru, *A Complete Guide to Total Quality Control* (White Plains, NY: Kraus International Publications, 1987).

Kume, Hitoshi, *Statistical Methods for Quality Improvement* (Tokyo: ATOS, 1985).

Teams

Center for Quality of Management, *Managing Teams: Guidelines and Principles* (Cambridge, MA: Center for Quality of Management, 1992).

Compilation done by Divisional TQM Managers. *QIT Resource Book.*

Ishikawa, Kaoru, *Guide to Quality Control.*

JUSE, *How to Operate QC Circle Activities* (Tokyo: JUSE, 1985).

Kume, Hitoshi, Statistical Methods for Quality Improvement (Tokyo: ATOS, 1985).

Scholtes, Peter R., *The Team Handbook: How to Use Teams to Improve Quality* (Madison, Wisconsin: Joiner, 1990).

Shiba, Shoji, et al., *A New American TQM* (Portland, OR: Productivity Press, 1993).