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ABSTRACT

This module for a 1-semester Total Quality Management (TQM) course for high school or community college students contains a brief overview of problem solving and offers a practical approach along with some of the tools that can be used. The following components are included: (1) narrative of the problem-solving process; (2) the problem-solving process, using the Shewhart Cycle, the Joiner model, and the Xerox model; (3) problem-solving tools, including tools for generating ideas and collecting information, tools for reaching consensus, tools for analyzing and displaying data, and tools for planning actions; and (4) a problem-solving example using an algebra class. Handouts and transparency masters are included. (KC)

TOTAL QUALITY MANAGEMENT (TQM):

TRAINING MODULE

ON

" PROBLEM SOLVING "

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June 1, 1993

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PROBLEM SOLVING

CONTENTS:

PROBLEM SOLVING

INTRODUCTION:

Problem solving is a very powerful tool when used properly. This module is designed to give a brief overview of problem solving and to offer a practical approach along with some of the tools that can be used.

Problem solving is very powerful when used in conjunction with the Total Quality Management concept of continuous improvement. This module on problem solving will provide a couple of different problem solving processes. The Xerox problem solving process will be used in depth as a useful tool for problem solving. Many of the Xerox recommended tools will also be used and explained in the section on problem solving tools.

A problem solving example will be given in order to help the reader become more familiar with the problem solving process and problem solving tools. One of the key benefits of using problem solving in the classroom is to get the students involved in problem solving. I have found this approach will not only come up with better solutions than might be reached by the teacher using problem solving alone, but it also provides a level of ownership to the students. This empowerment of the students in solving some of their own problems has benefits, not only in educating the student in problem solving techniques, but also in having better solutions to problems. Hopefully, after reviewing this module and becoming familiar with the tools, teachers will find more chances to use problem solving in their daily activities.

PROBLEM SOLVING

NARRATIVE:

Problem solving is a very powerful tool, when used correctly. This module will give the student an opportunity to learn the Xerox model for problem solving, as well as many of the tools used for problem solving. It is not the intent of this module to make people experts in all aspects of problem solving, but rather to provide a very easy-to-use process and a set of tools that can be used in problem solving. The tools shown in this module are not all the possible tools that can be used but I have found them to be some of the more practical and easiest to learn tools. The example problem at the end of the module demonstrates many of the problem solving tools as part of the Xerox 6-step problem solving model.

Those people who are familiar with Total Quality Management, will recognize the "Shewhart" cycle which is sometimes known as the "Deming" cycle. This is known as the "Plan-Do-Study-Action" cycle. It has generally been used as a method of problem solving since the 1930's.

The seven-step, Joiner Associates, problem solving process is described on page 12. This process is shown here to demonstrate that there is more than one process for problem solving. All processes tend to have several things in common. They all:

- start with problem identification,
- require a level of analysis,
- require the generating of potential solutions,
- require the implementing of these solutions, and
- complete their cycle by evaluating the results.

The Xerox Problem Solving Model is summarized on page 14. Each of the six steps will be described briefly in the following paragraphs.

Several examples are provided which can be used to help focus the need for the different steps of problem solving. The six steps for problem solving are:

Step 1: Identifying and selecting. In order to identify a problem there are two approaches to be taken.

a. **The first approach is when there is actual data** to signify what the problem is. This data can be obtained through various tools that will be presented later. Certainly taking surveys, gathering the data or doing interviews would provide actual data.

b. **The second approach is when the cause of the problem or what the problem is isn't so clear.** Here the tools of brainstorming and brainwriting can be used. These will be described in the section called Problem Solving Tools. On pages 31 and 32, the various methods of brainstorming are presented. I have found brainstorming to be the most useful tool in identifying the problem when there is not enough data available. In order to select which problem to work on there are three methods presented. These are a) nominal group technique, b) weighted voting and c) paired comparisons. I have found the nominal group technique and weighted voting tend to be the easiest to use. These are described on pages 47 through 53 in the problem solving tools.

Step 2: Analysis. Once the problem has been identified and the particular problem selected to work on, analysis is the next step. In many cases, the actual problem selection may take several steps. The reason for this is that, the original problem may have sub-problems, somewhat like an outline, and it is important to get to the specific problem you want to address. This may be a sub-problem or even a sub-sub-problem of the original problem. This all must be done in the original problem selection stage. In many cases it will not be possible to determine the actual problem until a level of analysis has been done. Several tools will be used to show how to analyze problems.

Problems tend to fall into two categories; when data is available and when data is not available. When data is available, the tools: check sheet, pareto charts, histograms and pie charts can be used to analyze problems. When there is no data available, the cause and effect diagram, sometimes known as the "fishbone" diagram, can be used. All of these tools are described on pages 55 through 61.

Step 3: Generate Potential Solutions. The tools for generating solutions can also be used in generating the list of problems. Again, I have found that brainstorming is the easiest to use of these tools. It might be appropriate at this time to mention that there is a method which is a combination of brainstorming and brainwriting. This method allows each person in the group, while attempting to come up with potential solutions, to list two or three solutions on small cards. The cards can then be gathered together and taped to the wall in order to come up with a list of solutions. Again, this uses a combination of brainstorming (which means everyone coming up with ideas) and brainwriting (which means everyone writing ideas down). Used appropriately, this is a very good tool.

Step 4: Selecting and Planning a Solution. Once potential solutions have been listed, it is appropriate to select the solution you want to employ. In order to select a solution,the same tools that were used in selecting a problem can be used. These tools are; nominal group technique, weighted voting and paired comparison. Again, I have found that the weighted voting and the nominal group technique are the best

tools. In order to plan a solution, I have found the Gantt chart to be the most useful tool. The Gantt chart uses a combination of a flowchart which actually means determining which items need to be done, putting them in a logical time sequence and, what I call, drawing a time line for each event. This is a very powerful tool in, not only understanding what needs to be done, but also being able to present ideas to others.

Step 5: Implementing the Solution. Once a solution has been identified and a plan put in place, it is important to implement the solution. A way of measuring implementation is to have status reviews of the plan. This is a instance where the use of the Gantt chart can be very helpful. It is also important, when implementing a solution, to have a contingency plan. If, during the implementation phase, problems are encountered, or if it is clear the solution will not be effective, it is important to have, what are sometimes called, "backup" plans which allow you to go to another solution or perhaps modify the solution you are implementing.

Step 6: Evaluate. The final step in problem solving is evaluating the solution. It is important that once a solution has been implemented, and has been in place long enough to evaluate, that an evaluation occurs. Sometimes the solution may have caused more problems than the actual problem. It is important to do follow-up surveys or gather data, similar to the way it was gathered in the original problem statement. The effective solution is one that has resolved a major part, or at least a part, of the original problem. It is at this point that problem solving can easily be turned into a process for continuous improvement. If the problem wasn't completely solved with the first solution, you can go back through the cycle again and do additional problem solving or identify additional solutions. This becomes more of a continuous improvement process rather than a problem solving process.

The section on problem solving tools is broken into four categories. The first category is: tools for generating ideas and collecting information. These tools are brainstorming, brainwriting, the use of checksheets, interviewing and surveying. The second section of problem solving tools are: tools for reaching consensus. These tools are: the nominal group technique, weighted voting and paired comparisons. These tools that help reach consensus provide some very interesting results. Usually each person who is a part of a process to come up with ideas has a chance to not only come up with an idea, but also to explain why they selected that particular idea. Through the use of any of these three tools, the person's idea gets a fair assessment along with other people's ideas. I have found, through the use of these tools, that people tend to accept the final solution, or the final problem, that is reached through consensus without getting their feelings hurt. The typical comment(s) that I hear are, "Well, maybe my idea wasn't selected, but the process was fair." Very seldom are there hard feelings as a result of this process. I, therefore, strongly recommend the use of this consensus process. It must be remembered that this consensus process is not a compromise process. It is a process where the best selection is determined from a larger group based on the information available to the group making the selection at that time.

The third section of problem solving tools are those used for analyzing and displaying data. Again, for situations where there is data to be analyzed, the use of pareto charts, histograms and pie charts are useful tools. Where there is no data, the cause and effect analysis is the most effective approach. The fourth, and final, section of problem solving tools is: tools for planning actions. The flowcharts and Gantt charts are the most effective tools used for planning actions.

The problem solving example is one where an Algebra II class is having trouble mastering their competencies to the same level as other Algebra II classes. The teacher uses the Xerox method to solve the problem. It is key to note that the teacher involves the students in this process. Following the example, one gets a chance to see the six steps being followed, as well as, several of the tools used. Brainstorming is used to generate a list of problems and the weighted voting tool is used to help select the problem to address. In analyzing the problem, since there was no data, the students used the cause and effect analysis. Then they took all the ideas they generated using the cause and effect analysis, and used the nominal group technique to decide which of those problems to work on. Here is an example where there are two levels of problem solving. The first level of the problem being the homework assignment not completed and the second level being that there is too much homework given. Once again brainstorming is used to generate potential solutions and the paired comparison is used to select a solution.

It should be is noted that all tools for consensus building, be it weighted voting, nominal group technique or paired comparison, are demonstrated in this example. Once the solution has been determined, the Gantt chart is used to plan their implementation. This example should give a very practical approach to problem solving.

THE PROBLEM SOLVING PROCESS

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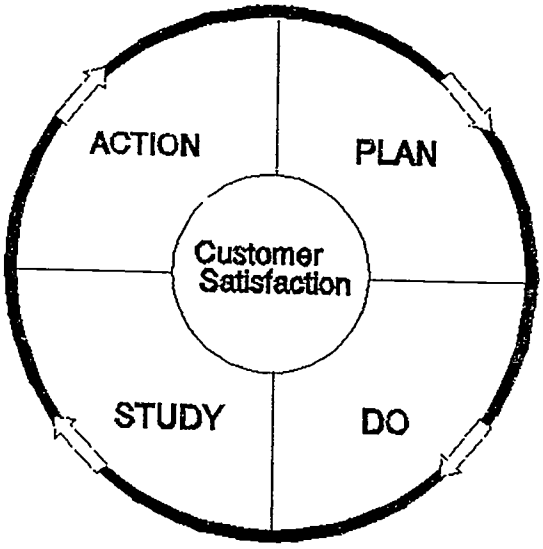
PROBLEM SOLVING

The Shewhart Cycle



- Sometimes Called the Deming Cycle
- May Be Called PDCA Cycle for:
  - Plan
  - Do
  - Check
  - Act
- Generally Used in Quality Since the 1930's

SEVEN STEP METHOD

FOR PROBLEM SOLVING

STEP 1: DEFINE THE PROJECT

STEP 2: STUDY THE CURRENT SITUATION

STEP 3: ANALYZE THE POTENTIAL CAUSES

STEP 4: IMPLEMENT A SOLUTION

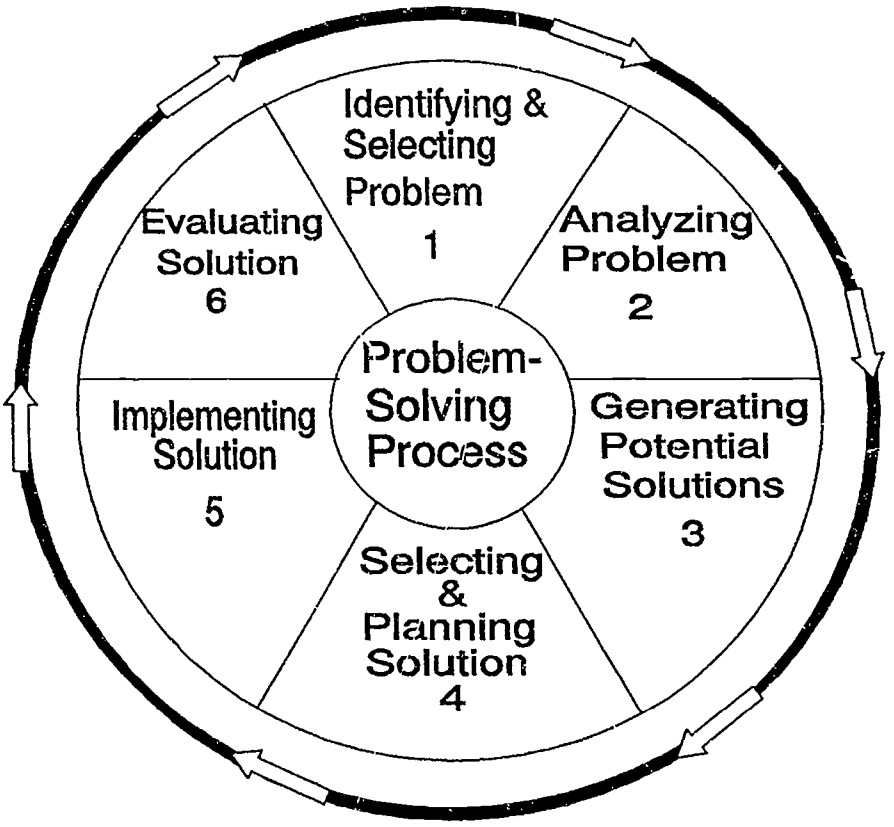
STEP 5: CHECK THE RESULTS

STEP 6: STANDARDIZE THE IMPROVEMENT

STEP 7: ESTABLISH FUTURE PLANS

--- Developed by Joiner Associates, Inc., article in **Quality Progress,** October 1991, titled "Accelerating Change," by Marie Gaudard, Roland Coates and Liz Freeman

PROBLEM-SOLVING PROCESS



PROBLEM SOLVING PROCESS

STEP 1: IDENTIFYING AND SELECTING PROBLEM

STEP 2: ANALYZING PROBLEM

STEP 3: GENERATING POTENTIAL SOLUTIONS

STEP 4: SELECTING AND PLANNING SOLUTION

STEP 5: IMPLEMENTING SOLUTION

STEP 6: EVALUATING SOLUTION

" A PROBLEM WELL STATED IS A PROBLEM HALF SOLVED. "

-- Charles F. Kettering

" IT ISN'T THAT THEY CAN'T SEE THE SOLUTION. IT IS THAT THEY CAN'T SEE THE PROBLEM. "

-- G.K. Chesterton

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PROBLEM SOLVING PROCESS

STEP 1: IDENTIFYING AND SELECTING PROBLEM

QUESTION TO BE ANSWERED:

- WHAT DO WE WANT TO CHANGE?

DESIRED OUTCOME:

- A CLEAR PROBLEM STATEMENT THAT IS AGREED UPON.

POTENTIAL TOOLS:

FOR PROBLEM IDENTIFICATION:
- BRAINSTORMING
- BRAINWRITING
- INTERVIEWING
- SURVEYING

FOR PROBLEM SELECTION:
- NOMINAL GROUP TECHNIQUE
- WEIGHTED VOTING
- PAIRED COMPARISON

" TO SOLVE A PROBLEM IT IS NECESSARY TO THINK. IT IS NECESSARY TO THINK EVEN TO DECIDE WHAT FACTS TO COLLECT. "

-- Robert Maynard Hutchins

" OPINION HAS CAUSED MORE TROUBLE ON THIS LITTLE PLANET THAN PLAGUES OR EARTHQUAKES. "

-- Voltaire

" ONE ACCURATE MEASUREMENT IS WORTH A THOUSAND EXPERT OPINIONS. "

-- Utvich

PROBLEM SOLVING PROCESS

STEP 2: ANALYZING PROBLEM

QUESTION TO BE ANSWERED:

- WHAT IS PREVENTING US FROM REACHING THE "DESIRED STATE"?

DESIRED OUTCOME:

- THE KEY CAUSES IDENTIFIED, VERIFIED AND RANKED.

POTENTIAL TOOLS:

- CHECKSHEET
- CAUSE-AND-EFFECT DIAGRAM
- PARETO CHARTS AND ANALYSIS
- HISTOGRAM
- PIE CHART

" THE BEST WAY TO HAVE A GOOD IDEA IS TO HAVE LOTS OF IDEAS. "

-- Linus Pauling

" IMAGINATION IS MORE IMPORTANT THAN KNOWLEDGE. "

-- Albert Einstein

PROBLEM SOLVING PROCESS

STEP 3: GENERATING POTENTIAL SOLUTIONS

QUESTION TO BE ANSWERED:

- HOW COULD WE MAKE THE CHANGE?

DESIRED OUTCOME:

- A LIST OF POTENTIAL SOLUTIONS

POTENTIAL TOOLS:

- BRAINSTORMING
- BRAINWRITING
- INTERVIEWING
- SURVEYING

" TAKE CARE OF THE MEANS, AND

THE END WILL TAKE CARE OF ITSELF. "

--- Gandhi

PROBLEM SOLVING PROCESS

STEP 4: SELECTING AND PLANNING SOLUTION

QUESTION TO BE ANSWERED:

- WHAT'S THE BEST WAY TO DO IT?

DESIRED OUTCOME:

- A PLAN FOR MAKING AND MONITORING THE CHANGE
- MEASUREMENT CRITERIA TO EVALUATE SOLUTION EFFECTIVENESS

POTENTIAL TOOLS:

FOR SELECTING A SOLUTION:
- WEIGHTED VOTING
- NOMINAL GROUP TECHNIQUE
- PAIRED COMPARISONS

FOR PLANNING TO IMPLEMENT SOLUTION:
- GANTT CHART
- FLOW CHART

" NOTHING COMES FROM DOING NOTHING. "

--- Shakespeare

PROBLEM SOLVING PROCESS

STEP 5: IMPLEMENTING SOLUTION

QUESTION TO BE ANSWERED:

- ARE WE FOLLOWING THE PLAN?

DESIRED OUTCOME:

- THE AGREED UPON SOLUTION IS IN PLACE

POTENTIAL TOOLS:

- STATUS REVIEWS OF IMPLEMENTATION PLAN
- MONITOR KEY PROGRESS CHECKPOINTS
- CONTINGENCY PLANS AS REQUIRED

" THOSE WHO CAN NOT LEARN FROM THE PAST ARE DOOMED TO REPEAT IT. "

-- George Santayana

" THE CHIEF CAUSE OF PROBLEMS IS SOLUTIONS. "

-- Eric Sevareid

PROBLEM SOLVING PROCESS

STEP 6: EVALUATING SOLUTION

QUESTION TO BE ANSWERED:

- HOW WELL DID IT WORK?

DESIRED OUTCOME:

- VERIFICATION THAT THE PROBLEM IS SOLVED <u>OR:</u>
- AGREEMENT TO ADDRESS CONTINUING PROBLEMS

POTENTIAL TOOLS:

- STATUS REVIEWS OF EFFECTIVENESS OF SOLUTION
- FOLLOW-UP SURVEYS
- FOLLOW-UP INTERVIEWS
- DATA COLLECTION ON ORIGINAL PROBLEM
- CHECK FOR NEW PROBLEMS CREATED BY SOLUTION

PROBLEM SOLVING TOOLS

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PROBLEM SOLVING TOOLS

TOOLS FOR GENERATING IDEAS:
- BRAINSTORMING
- BRAINWRITING

TOOLS FOR COLLECTING INFORMATION:
- CHECKSHEETS
- INTERVIEWING
- SURVEYING

TOOLS FOR REACHING CONSENSUS:
- NOMINAL GROUP TECHNIQUE
- WEIGHTED VOTING
- PAIRED COMPARISONS

TOOLS FOR ANALYZING DATA:
- CAUSE-AND-EFFECT ANALYSIS
- PARETO ANALYSIS

TOOLS FOR DISPLAYING DATA:
- PARETO CHARTS
- HISTOGRAMS
- PIE CHARTS

TOOLS FOR PLANNING ACTIONS:
- FLOW CHARTS
- GANTT CHARTS

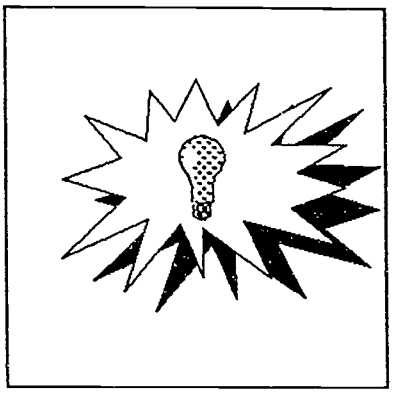
TOOLS FOR GENERATING IDEAS AND COLLECTING INFORMATION

Most steps in the Problem Solving Process require that the group members expand--to get ideas on which problems to work on, to get the information needed to isolate problem causes, and to come up with ideas on how to address the causes and solve the problems.

The tools and techniques presented in this section are designed to help groups generate ideas and collect information in effective, systematic ways.

BRAINSTORMING

What Brainstorming Is



Brainstorming is an idea-generating technique pioneered by Alex Osborn, an advertising executive. A group of people throw out their ideas as they think of them, so that each has the opportunity to build on the ideas of others.

The discipline of brainstorming is maintained by four basic rules. However, the informality of the process generates an atmosphere of freedom. These rules are:

- No Evaluation
- Encourage Wild Ideas
- Hitchhike--Build on the Ideas of Others
- Strive for Quantity

What Brainstorming Looks Like

The next page shows the list of problems brainstormed by Bubba's Team, a group of inspectors, material handlers, and assemblers in IPD's 820 production area.

How to Brainstorm

The group leader presents the problem for which ideas are sought. The wording should encourage specific, tangible ideas, not abstract ideas or opinions. The leader makes sure that the members understand the problem, the objective of the brainstorming session, and the process to be followed.

There are three methods of brainstorming. The most familiar is free wheeling, where

- Group members call out their ideas spontaneously.
- The scribe records the ideas as they are suggested.

CX:BRAINSTM

In round-robin brainstorming,

- The leader or scribe asks each member, in turn, for an idea.
- Members may pass on any round.
- The session continues until all members have passed during the round.
- Ideas are recorded as in free wheeling.

The slip method differs markedly from the other two approaches.

- The leader asks members to write down their ideas on small slips of paper or index cards.
- The ideas are then collected and organized.

Each approach has its advantages and disadvantages. These are summarized in the chart on the next page.

Regardless of the approach used, the output of the brainstorming session must be reviewed and evaluated. For ways of reducing the list and evaluating the items, look in the section entitled "Tools for Reaching Consensus."

PERCEIVED PROBLEMS

1. Lack of work available.
2. Inadequate work tables.
3. Material flow on 8-inch line.
4. Bad lighting.
5. Lack of incoming quality control.
6. Process out of date.
7. Lack of safety precautions.
8. Lack of crossover at 8-inch line.
9. Station 45 processor line layout.
10. Defect rate 8-inch line.

BALANCE SHEET ON BRAINSTORMING APPROACHES

	+	-
Free Wheeling		
	very spontaneous	strong individuals may dominate the session
	tends to be creative	confusion sets in: ideas may be lost when too many talk at once.
	easy to build on other's ideas	
ROUND ROBIN		
	difficult for one individual to dominate	difficult to wait one's turn
	discussion tends to be more focused	some loss of energy
	everyone is encouraged to take part	reluctance to pass
		not as easy to build on other's ideas
SLIP METHOD		
	anonymity allows sensitive topics to surface	not possible to build on ideas of others
	can be used with very large groups	some ideas may not be legible, understandable
	not necessary to speak out	slow
		difficult to clarify ideas

CX:BRAINSTM

When to Use Brainstorming

- In step 1, to produce a list of general problem areas.
- In step 2, to identify potential causes to be investigated.
- In step 3, to generate as many potential solutions as possible.

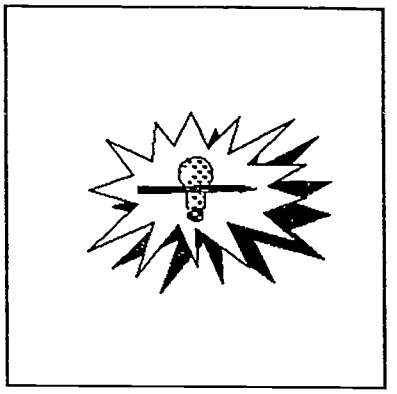
How to Improve the Group's Use of Brainstorming

Osborn recommended several "idea-spurring" questions to help group members build on each others' proposals. These questions (as printed in Karl Albrecht's Brain Power, pp. 225-26) include:

1. Put to other uses? New ways to use as is? Other uses if modified?
2. Adapt? What else is like this? What other ideas does this suggest?
3. Modify? Change meaning, color, motion, sound, odor, taste, form, shape? Other changes?
4. Magnify? What to add? Greater frequency? Stronger? Larger? Plus ingredient? Multiply?
5. Minify? What to subtract? Eliminate? Smaller? Lighter? Slower? Split up? Less frequent?
6. Substitute? Who else instead? What else instead? Other place? Other time?
7. Rearrange? Other layout? Other sequence? Change pace?
8. Reverse? Opposites? Turn it backward? Turn it upside down? Turn it inside out?
9. Combine? How about a blend, an assortment? Combine purposes? Combine ideas?

BRAINWRITING

What Brainwriting Is



Brainwriting is an idea-generating technique that combines features of the various approaches to brainstorming. As in the slip method, participants record their own ideas. Like freewheeling and round-robin, brainwriting provides participants the opportunity to build on others' ideas.

Compared to brainstorming, brainwriting tends to result in somewhat fewer, but more fully developed, ideas.

How to Use Brainwriting

In the most common approach to brainwriting, participants sit around a table and each writes his or her ideas on a sheet of paper. Members then place the papers in the center of the table to exchange their own with someone else's. Examining the others' ideas, participants try to build on them or come up with entirely new approaches. After an agreed-upon time period the papers are collected. Ideas can be clarified and evaluated at that time or later.

As a variation, some groups use large index cards, writing a single idea on each. Cards are then passed to the person on the right, to stimulate modifications or new ideas.

An alternate approach, sometimes referred to as the "gallery method," involves posting several flipchart sheets (at least two per participant) around the room. As above, each member writes his or her ideas on the sheets for 20 to 30 minutes. Participants then walk around the room for 10 to 15 minutes, reading the ideas recorded by others. For the final 20 minutes or so, members return to their sheets to continue writing, stimulated by and building on others' ideas.

CX:BRAINWRI

When to Use Brainwriting

Like brainstorming, brainwriting is a powerful tool for the expansion phases of the problem-solving process. There are several situations, however, where brainwriting may offer clear advantages over brainstorming:

- **When it's important to get more carefully thought-out ideas.** The very act of writing down one's ideas encourages people to think them through, to express them more clearly and completely.

- **If previous brainstorming sessions have been monopolized by one or two dominant members.** Brainwriting provides everyone equal time to think and write, and it virtually eliminates pressure toward g.oup conformity.

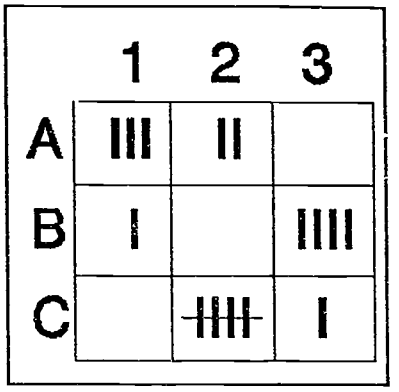
- **If the group tends to "socialize" too much.** Brainwriting provides a very strong task orientation that some groups may need to keep them focused.

- **If there is strong conflict within the group, or if the topic is highly controversial.** Although conflict can be beneficial to a group, it must be carefully managed by the leader or facilitator. Brainwriting can be successful in tense, highly charged situations where brainstorming pay not be manageable.

CX:BRAINWRI

CHECKSHEETS

What Checksheets Are



Data must be collected carefully and accurately. Using checksheets makes it easy to compile, and then to analyze, data. Checksheets are used to determine how often an event occurs over a designated period of time. Information is usually collected for events as they happen; less frequently, checksheets are used for recording events that have already occurred.

Although the purpose of a check sheet is to track--not analyze--data, checksheets often help to indicate what the problem is.

Many kinds of data can be tracked using checksheets:

- Number of times something happens.
- Length of time it takes to get something done.
- Cost of a certain operation over a period of time.
- Frequency of occurrence--by branch, team, machine, etc.
- Impact of an action over a period of time.

What Checksheets Look Like

The facing page shows a checksheet prepared by the Subsolvers, a problem-solving team in Components Manufacturing Operations in Webster. Team members used this checksheet to track miswires and electrical failures of the 845 interface and module assemblies, from January 1 to October 31, 1983.

CHECKSHEET FOR MISWIRES AND ELECTRICAL FAILURES

Defect	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Tot
Defective wiring in line filter	/	/	//	/	//// //	//	/		//// //	//// //// //// / //// /	38
Miswired at line filter			//		/	//	////				9
Miswired at circuit breaker	/	/	///		//// /		/		////	//// //// //	25
Conven-ience outlet miswired			//		////	///	///		/	//// ////	21
Damaged wires			/								1
Ground wire not connected					//						2
Miswire at GFI		//							/	///	6
Total	**2**	**4**	**10**	**1**	**18**	**7**	**9**	**0**	**12**	**39**	**102**

How to Use Checksheets

There are two questions that must be answered to set up a checksheet.

- What do you want to know?
- What is the most reliable way to collect the data?

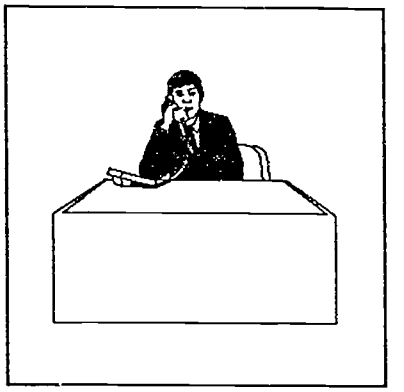
Information on checksheets is usually collected in categories: by branches, by product code, by date, by shift.

In constructing checksheets try to form categories that will be easy for the person recording the data to use. The data recorder should not have to make difficult judgments about when and where to "check" a box on the form.

When to Use Checksheets

- In step 2, to collect the information needed to analyze the identified problem.
- In step 5, to collect information needed to evaluate the solution.

INTERVIEWING



What Interviewing Is

Interviewing is a structured technique for collecting information from individuals or groups. If you have access to the people who have the information you need, interviewing--either in person or on the telephone--can be a very efficient means of data collection.

What an Interview Protocol Looks Like

The list of questions to be asked in an interview is referred to as an interview protocol, or interview schedule. On the next page is the interview protocol used by the family group responsible for developing training for first-line managers. Several members interviewed senior Xerox managers to collect information about the topics and skills to be included in the training.

How to Interview

Tackle this just as a reporter would:

- Before the interview, develop a list of questions.
- Be sure to include follow-up questions to get at the information you really need.
- When you conduct the interview, write down the responses.
- Verify your understanding of the interviewee's responses.

If you are collecting sensitive information, you may want to ensure the confidentiality of the respondents. In that case, do not use respondents' names, identifiable quotes, or other information.

When to Use Interviewing

- In step 2, to collect information to help analyze the problems.
- In step 3, to involve those outside the group in generating potential solutions.
- In step 4, to get information from people outside the group on how to implement the proposed solution.
- In step 6, to collect information to help evaluate the effectiveness of the implemented solution.

How to Improve the Group's Use of Interviewing

Although the primary interactive skill used in interviewing is seeking information, don't overlook the importance of testing understanding to ensure that you have clearly understood what the respondent is saying.

SENIOR MANAGEMENT INTERVIEW PROTOCOL

1. Have you had the opportunity to work with any managers that you would consider excellent managers?

   If yes, what skills did you observe them using that distinguished them from other managers?

   If no, what skills would you expect excellent managers to use that would distinguish them from other managers?

2. How do you think managers learn these skills?

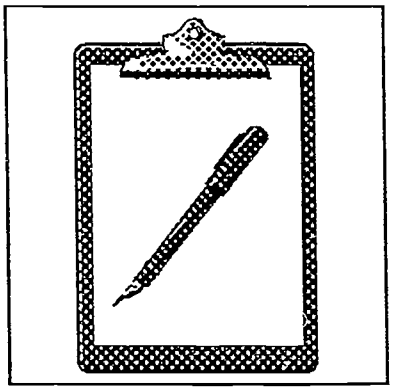
3. What do you think is the most difficult problem that managers have to handle? Do you think most managers have the skills to handle that kind of problem?

4 What skills do you think managers can best learn in training programs?

5. What informational topics do you think should be taught in management training courses?

6. What do you think is the biggest challenge that Xerox managers will have to face in the next 5 years?

SURVEYING



What Surveying Is

Surveying is interviewing on paper. Instead of responding to an interviewer, people answer items on a questionnaire. The major advantage is that you can get a great deal of information from a lot of people very economically. The disadvantage is that people may interpret the questions somewhat differently than intended; their answers may be ambiguous as well, and there is no opportunity to test understanding.

What Surveys Look Like

On the facing page is a copy of the questionnaire used by the Charioteers, a problem-solving team of Monroe county secretaries. The purpose of the survey was to test reactions to a proposed Combined Petty Cash/Local Travel form.

How to Survey

- Identify the information you need.
- Decide who has this information in its most reliable form.
- Plan how you will use the information when you have it in hand.
- Develop a series of questions that will enable respondents to provide the information accurately and unambiguously.
- Keep the questionnaire short, simple, and clear.
- Try out the questions with several people to uncover any unclear questions.

Questions can be "closed," with a limited number of responses from which to choose:

How long have you worked in your present job?

_____less than 1 yr. _____1 - 3 yrs. _____ more than 3 yrs.

Or they can be "open":
How do you use the information contained in the monthly progress report?

COMBINED PETTY CASH/LOCAL TRAVEL QUESTIONNAIRE

Please take a minute to answer the following questions and leave on the table in the back of the room upon your departure. If there is an area of concern that has not been covered, please let us know. This new form is available from Forms Administration and required usage will be on May 1st. Thanks for your time and valued input.

1. Do you like the concept of combining Petty Cash and Local Travel on one form? YES___NO___

2. Do you feel you would have occasion to use both sections of the combined for one transaction? YES___NO___

3. Do you like the uniform heading and signature area? YES___NO___

4. Do you like the uniform size of this combined form? YES___NO___

5. Do you feel there is an advantage with this uniform size combination for filing purposes and time saver in not having to make a copy? YES___NO___

6. Do you like the idea of a total mileage concept vs. listing separate trips for Local Travel? YES___NO___

7. How much time do you feel this new form will save you on a monthly basis? _____

CX:SURVEYIN

COMMENTS:

_____

_____

_____

_____

We would very much like to initiate a Secretarial Quality Circle at Xerox Square. If you are interested in becoming a member of a Team, please complete this section and someone will contact you in the near future.

NAME:_____

LOCATION:_____ EXTENSION:_____

THE CHARIOTEERS
4/24/84

Tools for Reaching Consensus

Although consensus is commonly used to mean complete or unanimous agreement, its precise meaning is general agreement. Consensus is reached, therefore, when all members of a group are willing to accept a decision. Even though a decision may not necessarily be an individual's first choice, he or she considers it a workable approach and in the best interest of the group.

In the words of William G. Ouchi, author of Theory Z, consensus has been reached when all members of a group can agree on a single solution or decision and each can say:

- I believe that you understand my point of view.
- I believe that I understand your point of view.
- Whether or not I prefer this decision, I will support it because it was reached openly and fairly.

To determine if all group members have reached the mutual acceptance of a decision, the leader or facilitator (or any team member) should ask:

- Does everyone accept this decision?
  A "yes" answer means that decision has been made.
- Is there any opposition to this decision?
  If no one speaks, the answer may be that everyone agrees with the decision; the questioner should also be alert for non-verbal signs which could indicate opposition.
- Can everyone live with the decision?
  A "yes" ensures that no one has a conflict with the decision.

Consensus plays an important role in group problem solving. Almost every step requires that the group converge: on a single problem statement, on the key problem causes, on the optimum solution. Even moving from one step to the next requires consensus that the work is complete, that it's time to proceed.

Tools and techniques to help group members work toward consensus are explained on the following pages. The tools are not intended to make the decision for the group, but more to "take the temperature," to find out who stands where, and how far the group is from consensus. The objective is to bring viewpoints, especially conflicting ones, to the surface so that they can be discussed openly.

Consensus is more about listening than about talking. The tools will help identify group members with differing viewpoints--those to whom others should listen, in order to understand why they are not in agreement. Consensus cannot be reached without understanding and exploring the divergent opinions of all group members.

NOMINAL GROUP TECHNIQUE

One of the most practical tools to use when reaching consensus is the nominal group technique. This technique allows a group of people to come up with a consensus of which problem to work on or which solution to implement. The three steps for this technique are:

Step 1: Have all potential problems or solutions listed.

Step 2: Have each person vote on a sub-set of these problems/solutions.

Step 3: Reduce the number of items being voted on.

There are many approaches to the nominal group technique. The approach that will be described here is very practical and easy to use. It may best be shown by the use of an example.

The example on the following page illustrates a group of teachers deciding what they want to eat for lunch. There is nothing magic about the number of items that are listed or the number of particular items a group of people can vote on. A good rule of thumb is "the larger the list of items, the more votes a person gets" (i.e., the more items a person can vote on). In this particular example, it took three rounds to narrow it down to a choice of one. It is important to remember, in the use of the nominal group technique, to use several different cycles in order to reduce the list. It is critical not to reduce the list from a large number to one with a single vote. This would only be appropriate if one particular item received an overwhelming majority of the votes, which is usually not the case when people vote on more than one item. So, it is very useful to go through two to three, perhaps more, cycles to reduce the list down to one. It is important that everyone feels the item they listed has a fair chance of winning.

NOMINAL GROUP TECHNIQUE

EXAMPLE

"WHAT'S FOR LUNCH"

A group of 15 teachers are deciding what they want for lunch during their "in service" training day. They have decided that they all want to eat together.

Step 1: **List all potential solutions/problems.**

In this case, the teachers used brainstorming to come up with seven ideas. They are listed below:

1. Chinese food
2. Mexican fool
3. Pizza
4. Hamburgers
5. Soup/salad
6. Steaks
7. Barbecue

Step 2: **Each person gets to vote on more than one selection.**

In this case, it was decided that each teacher could vote on three different choices. The results of that vote are shown below:

1.	Chinese food	12
2.	Mexican fool	8
3.	Pizza	2
4.	Hamburgers	4
5.	Soup/salad	10
6.	Steaks	4
7.	Barbecue	3

C:NOMGRPT.EX

Step 3: **The list is reduced and another vote is taken.**

In this example, the top three items were put on a list for a second vote. This time each teacher could select only one item. The results are shown below:

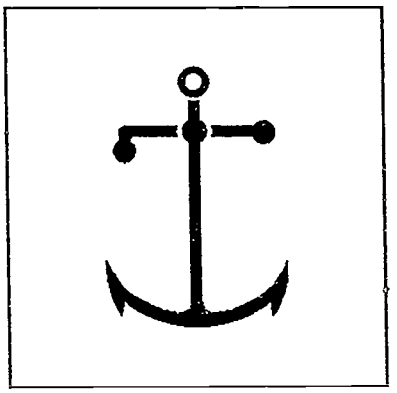
1.	Chinese food	13
2.	Mexican food	7
3.	Soup/salad	10

Since no item received a majority of the votes, it was decided to reduce the list to the top two and vote again. The results of that vote are as follows:

1.	Chinese food	16
2.	Soup/salad	14

The final result was that the teachers would eat Chinese food for lunch.

WEIGHTED VOTING



What Weighted Voting Is

Weighted voting is a way to quantify the positions and preferences of group members. It differs from criteria rating forms in two ways. First, no decision factors or criteria are used. Second, individual members' votes are recorded; there is no discussion or effort to reach agreement on a single number.

What Weighted Voting Looks Like

Here's an example of weighted voting used by a family trying to reach consensus on where to go on vacation next year. Each member had six votes to distribute among four options.

	A	B	C	D
Dad	1	2	2	1
Mom	1	0	1	4
Lauren	3	1	1	1
Matthew	4	1	1	0
Michael	1	1	1	3

A: DISNEYWORLD

B: CAMPING

C: BEACH

D: GRANDPARENTS

How to Use Weighted Voting

Set up a grid--members by options, as shown below--on flip chart. Give each member a number of votes to distribute in accordance with their preferences. As a rule of thumb, the number of votes should be about 1 1/2 times the number of options. Members then decide how to distribute their votes among the options, to indicate their relative preferences.

CX:WEIGHT

	A	B	C	D	E
JIM					
LINDA					
MARILYN					
BILL					

- Encourage people to spread their votes to represent their relative feelings about the options, rather than lump all their votes on a single favorite.

- Have members decide how they will distribute their votes (preferably jotted down on paper) before any votes are recorded on the chart.

- Ask members to show their votes for each option all at once by raising the number of fingers that represents their vote.

- Ask for and record votes by option, not by person. That is, call for the votes for the first option, the second, and so on. Record all votes so that the group can see where the agreements and disagreements lie.

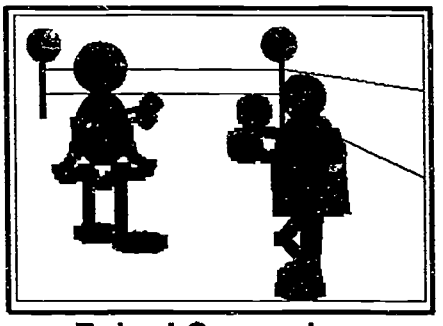
Weighted voting does not make decisions. It merely gives the group information about where individual members stand, and how strongly. This information makes it easier to surface opposing viewpoints. Consensus cannot be reached without dealing with those viewpoints.

When to Use Weighted Voting

Weighted voting is most useful for "taking the temperature" of the group as it is working toward consensus. The approach can be used to identify the group's positions and priorities when fewer than eight or ten options are under consideration. It is most often used in steps 1 and 4.

CX:WEIGHT

Paired Comparisons



Paired Comparisons

What Paired Comparisons Are

Like weighted voting, using paired comparisons will help a group to quantify the preferences of its members. Each option (e.g., a potential solution) goes head-to-head against every other option. In each "face off," members vote for the option they prefer. Votes are recorded and totaled when all possible comparisons have been made.

What Paired Comparisons Look Like

The weighted voting example showed how a family used that technique to work toward consensus on where to go on next year's vacation. The chart below shows the family's use of paired comparisons to help make the same decision.

Options ▽	A vs B	A vs C	A vs D	B vs C	B vs D	C vs D	Totals
A	4	4	3				11
B	1			1	2		4
C		1		4		1	6
D			2		3	4	9

A: Disneyworld B: Camping C: Beach D: Grandparents

How to Use Paired Comparisons

Set up a grid such as the one shown in the example. The number of possible comparisons depends on the number of options. The table below shows the number of comparisons for a given number of options.

Number of options	Number of comparisons
2	1
3	3
4	6
5	10
6	15
7	21
8	28

- In each comparison, each member has one and only one vote. He or she must decide which of the two alternatives is better. (The total number of votes cast in any comparison must equal the number in the group.)

- Everyone must cast a vote in each comparison, even if neither choice is very appealing.

The power of paired comparisons comes from the choices it forces group members to make. Even when two alternatives seem equal, members must choose one or the other. Having to make difficult choices often leads people to see advantages (or disadvantages) they may not have noticed before.

The highest total on the paired comparisons chart does not automatically become the group's decision. In working toward consensus, the group can focus discussion on the two or three highest-scoring options.

When to Use Paired Comparisons

Because the number of comparisons increases rapidly as options increase, it's best to use paired comparisons when the group is evaluating six or fewer options. Like weighted voting, the approach is most often used in steps 1 and 4.

Tools for Analyzing and Displaying Data

All of the tools presented in this section are graphical. As you use them, keep in mind these principles of graphical excellence, from Edward R. Tufte's The Visual Display of Quantitative Information (p. 51):

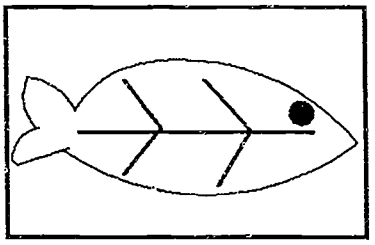
- Graphical excellence is the well-designed presentation of interesting data--a matter of **substance**, of **statistics**, and of **design**.

- Graphical excellence consists of complex ideas communicated with clarity, precision, and efficiency.

- Graphical excellence is that which gives to the viewer the greatest number of ideas in the shortest time with the least ink in the smallest space.

- And graphical excellence requires telling the truth about the data.

CAUSE-AND-EFFECT ANALYSIS



What Cause-and-Effect Analysis Is

Like Pareto analysis, this analysis is usually shown diagrammatically. Cause-and-effect diagrams are also known as fishbone (because of their shape) or Ishikawa diagrams (after their inventor, Dr. Kaoru Ishikawa, the Japanese quality control statistician).

Cause-and-effect analysis is a systematic way of looking at effects and the causes that create or contribute to those effects. The effects can either be problems--the "as is" statement of the situation you want to correct; or they can be desired states--what you want to exist when problems have been solved.

What Cause-and-Effect Analysis Looks Like

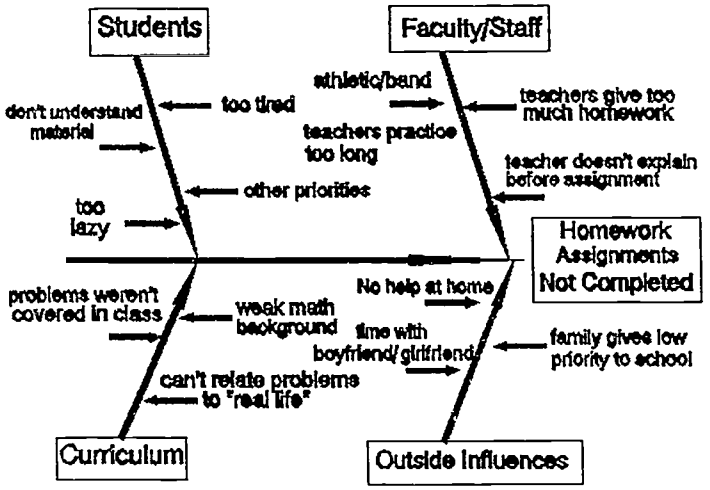
The cause-and-effect analysis shown on the next page is based on an example developed by a subgroup in training to demonstrate the use of this tool. The as-is problem statement, "Lamp doesn't turn on," appears at the head. The bones represent the major causes that could explain why the lamp doesn't light.

How to Use Cause-and-Effect Analysis

- Decide on the effect to be analyzed, and write it on the right end of a board or large sheet of paper--the fish's head.
- Draw a horizontal line from the head across the paper, with several "major bones" drawn on a slant.
- Write the main factors which contribute to the effect at the ends of the major bones.
  - -- For technical problems, the factors Man, Machine, Materials, Method, and Environment are frequently used.
  - -- For sales problems, the factors People, Product, Price, and Promotion may be useful.

- On each of the major bones, write the specific factors that the group considers to be causes. The group may use brainstorming or other data collection methods to identify these.

- Identify the most significant factor (or combination of factors): collect additional data to verify causal relationship to effect.



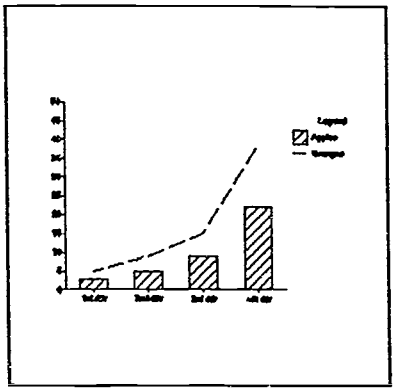
When to Use Cause-and-Effect Analysis

- In Step 2, to identify and verify the factors which are casing the problem.

- In step 4, to identify what factors must be present in order to implement the recommended solution successfully.

PARETO ANALYSIS

What Pareto Analysis Is



Pareto analysis is a technique that separates the "vital few" from the "trivial many." Named for Vilfredo Pareto, a 19th century economist who did work with income and other unequal distributions, a Pareto analysis is designed to point out inequalities.

The familiar 80-20 rule ("Eighty percent of our business comes from twenty percent of our customers") is an example of Pareto analysis.

The basic concept behind a Pareto analysis involves the ranking of data, and the analysis is usually presented in a Pareto diagram. Like a histogram (or bar graph), a Pareto analysis shows a distribution. The bars, however, are arranged in descending order.

A Pareto analysis (or diagram) is used to draw attention to problems (or causes) in a systematic way. It shows which are the greatest problems, thereby enabling a group to set priorities.

Pareto diagrams may be used with or without a cumulative line. When cumulative liens are used, they represent the percentage sum of the vertical bars, as if they were stacked on each other going from left to right.

What a Pareto Diagram Looks Like

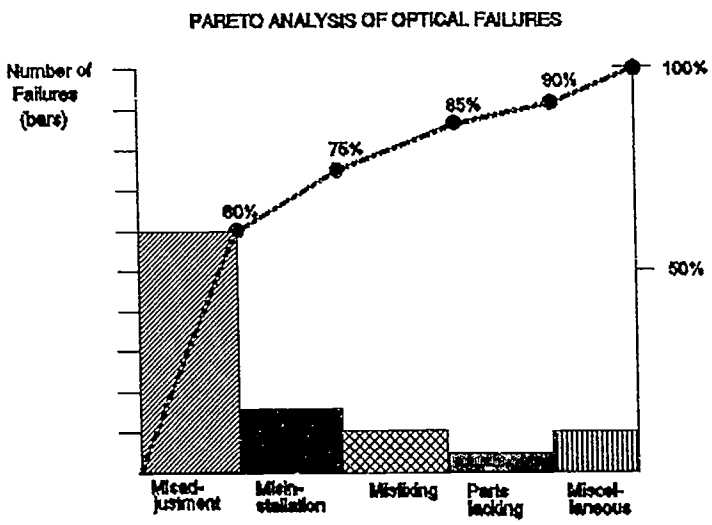
The opposite page shows a Pareto analysis prepared by Target Part I, a Fuji Xerox problem-solving team. Group members assemble optical systems at the Ebina plant.

Notes: Because of the sensitivity of this data, numbers have been deleted from the vertical (frequency) scales. Also, the last bar ("Miscellaneous") is larger than the previous category because it is the total of several small categories.

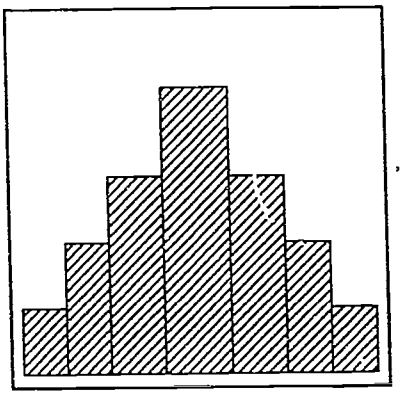
How to Make a Pareto Diagram

- Use a checksheet to collect the required data.
- Arrange the data in order from largest category to smallest.

- Calculate the total.
- Compute the percent of the total that each category represents.
- Compute the cumulative percent. (See example below.)
- Draw horizontal and vertical axes on graph paper.
- Scale the vertical axis for frequency (0 to total calculated above).
- Working from left to right, construct a bar for each category, with height indicating the frequency. Start with the largest category and add them in descending order.
- Draw a vertical scale on the right of the graph, and add percent scale (0% to 100%).
- Plot the cumulative percent line as shown below.



HISTOGRAMS



What a Histogram Is

A histogram, a specialized type of bar chart, shows the distribution of some characteristic. Because of its immediate visual impact, a histogram is more effective for displaying data than a checksheet or frequency table.

What a Histogram Looks Like

The opposite page shows a frequency table and histogram for the distribution of the weights of 120 students. This example is from Elementary Statistics (3rd Edition), by Paul G. Hoel.

How to Construct a Histogram

- If the data is not already arranged by frequency, make a checksheet.
- Draw vertical and horizontal axes on graph paper. Mark data values along horizontal axis, from the smallest to the largest; label the axis to indicate what is being displayed, and the unit of measurement (e.g., pounds).
- Label the vertical axis "Frequency," and mark values.
- Using the information in the frequency distribution table, construct vertical bars for each of the values, with height corresponding to frequency.

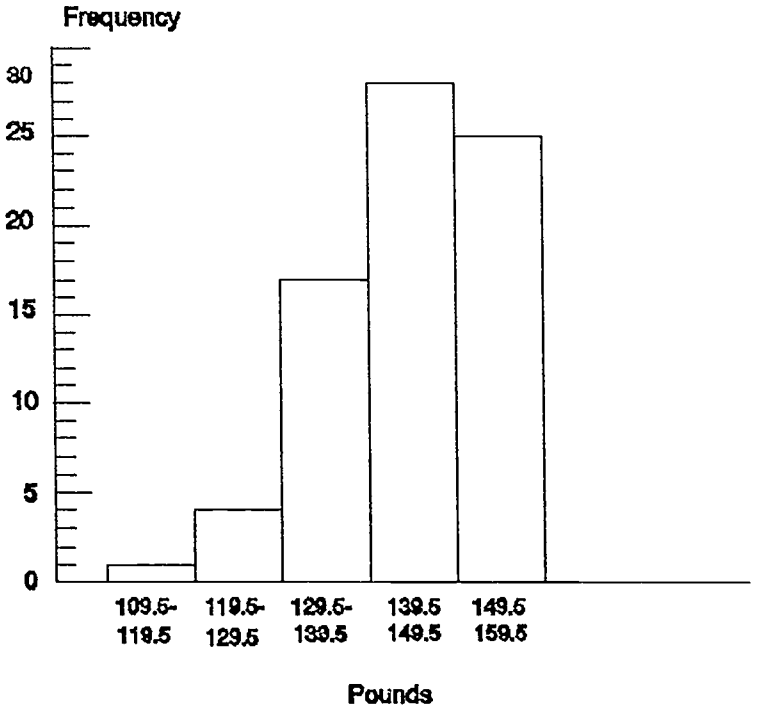
When to Use Histograms

- In step 2, to display data collected to analyze problem.
- In step 6, display data collected to evaluate effectiveness of implemented solution.

DISTRIBUTION OF THE WEIGHTS OF 120 STUDENTS

Class Boundaries (Pounds)	Frequencies
109.5-119.5	1
119.5-129.5	4
129.5-139.5	17
139.5-149.5	28
149.5-159.5	25
TOTAL	75

(Weight measured to the nearest pound)



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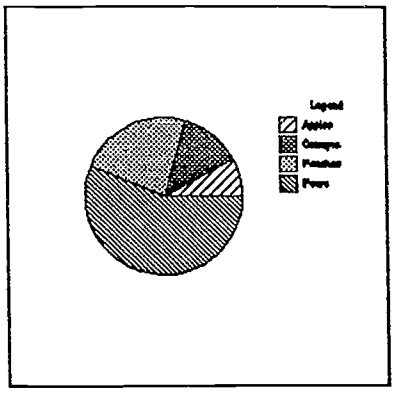
PIE CHARTS

What Pie Charts Are



Pie Charts are used to show the relationship of each part to the whole--how each part contributes to the total product or process.

What a Pie Chart Looks Like

The opposite page shows a pie chart prepared by the Charioteers, a problem-solving team of secretaries based in Monroe County. This chart indicates the type of forms processed by Forms Administration in 1982.

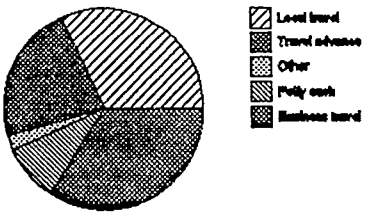
How to Make a Pie Chart

The 360 degrees of the circle, or pie, represent the total or 100%. The pie is divided into "slices" proportionate to each component's percentage of the whole:

- For each "slice" of the pie, calculate the size of the angle by multiplying the percent by 360 (e.g., 20% x 360° = 72°).
- Using a protractor, mark off the angle at the center of the pie.

Many software packages (e.g., data base, spreadsheet) have graphics options that will produce pie charts.

FORMS PROCESSED IN 1982



When to Use Pie Charts

Pie charts are useful when it's important to show the relationship of various parts to each other, and to the whole. They are easily interpreted and can present data effectively and efficiently.

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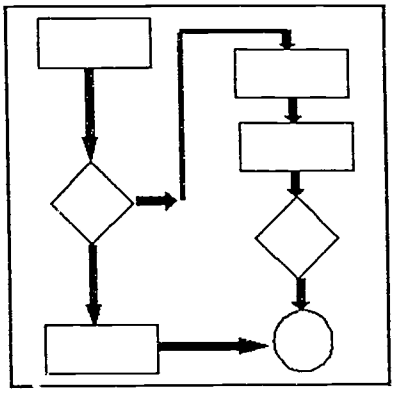
Tools for Planning Actions

Implementation is as critical as careful analysis of the problem and appropriate selection of the solution. The tools in this section will help you to:

- Specify and clarify the tasks that must be done.
- Sequence those tasks--decide on the order in which they should be done.
- Assess the requirements for each task--Who is needed to do what? How long will it take?
- Establish a schedule, with completion dates for each task or activity.
- Make sure everyone knows who is responsible for each task.
- Specify the results you expect.
- Specify how the results will be monitored and measured.

FLOWCHARTS

What Flowcharts Are



Flowcharts show the inputs, activities, decision points, and outputs for a given process. Programmers and analysts make extensive use of flowcharts to document the logic of computer programs. There are many variations that have been adapted for specific purposes (e.g., to show flow of paperwork through an administrative system; to show movement of materials and inventory through a manufacturing system).

What a Flowchart Looks Like

The next page presents a flowchart of an approach used by many groups to work through step 1 of the Problem-Solving Process. For more information on this system, refer to the section on step 1.

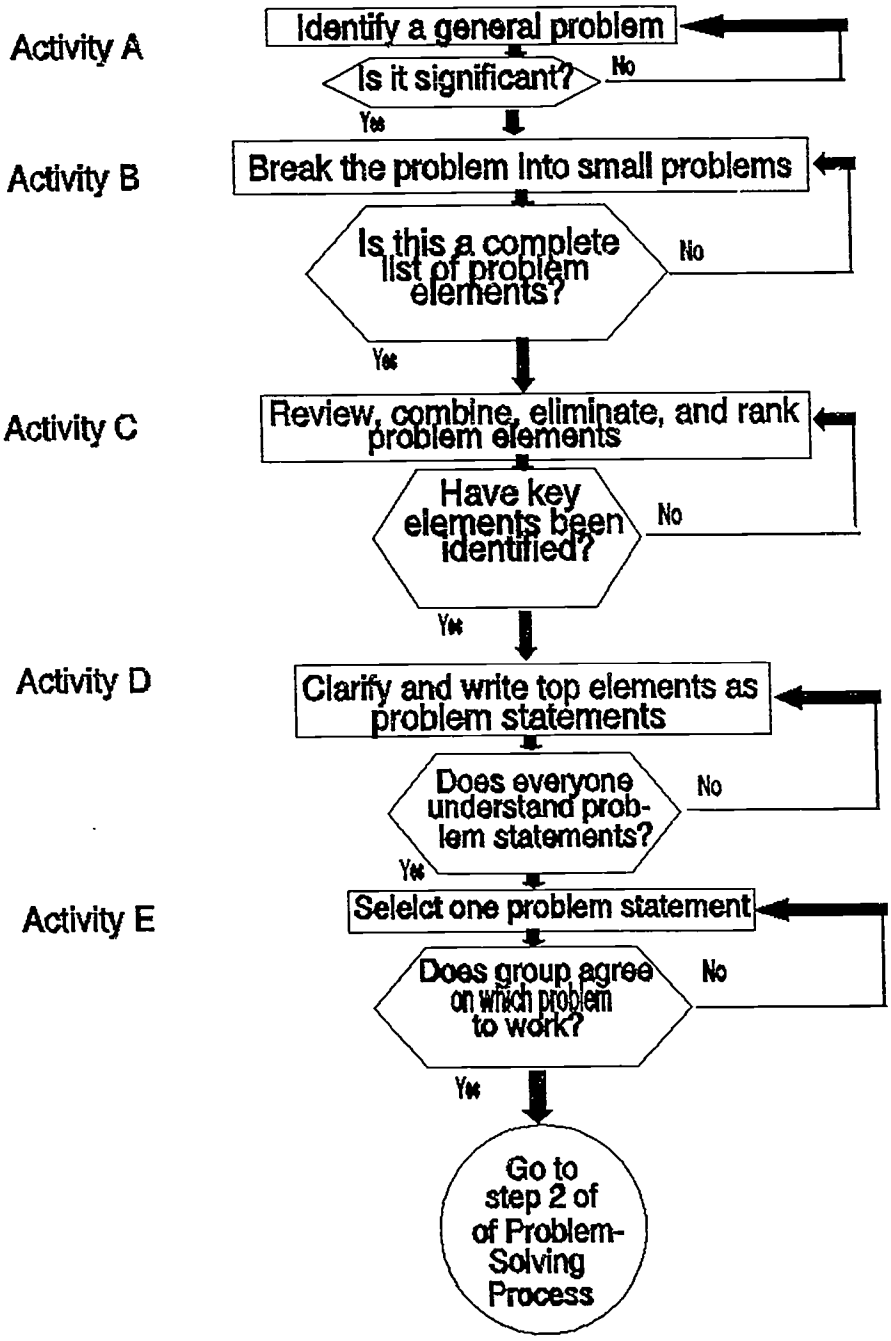
How to Construct a Flowchart

Flowcharts use standard symbols connected by arrows to show how the system or work process operates. To construct a flowchart, identify the major activities to be completed and decisions to be made as the recommended solution is implemented. Then check the logic of the plan by following all possible routes through the chart to ensure that you have planned for contingencies.

When to Use Flowcharts

Flowcharts are particularly useful for documenting the contingencies--and contingency plans--that may arise during the course of implementing the recommended solution.

STEP 1 FLOWCHART



– Based on "Problem-Solving Process User's Manual", copyright Xerox Corporation

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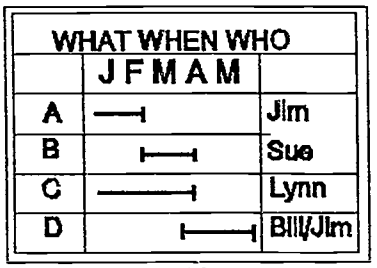
GANTT CHARTS



Gantt Chart

What Gantt Charts Are

A Gantt chart is a diagram that documents the schedule, events, activities, and responsibilities necessary to complete a project or implement a group's proposed solution.

What a Gantt Chart Looks Like

The form on the next page is an example of a Gantt chart. Although there are many variations, all Gantt charts document **what** is to be accomplished, by **whom**, and **when**. This chart also allows a group to document the assumptions underlying their implementation plan. For example, if the plan is based on installation of equipment by May 15, that assumption can be noted. The group can then develop contingency plans in case that deadline slips.

How to Use a Gantt Chart

- Break the implementation plan into achievable steps.
- Assign responsibility for each step to a group member.
- Decide how long each task will take, and set a realistic completion date.
- Document the assumptions on which the plan is based, and the contingency plans to implement if those assumptions are not valid.

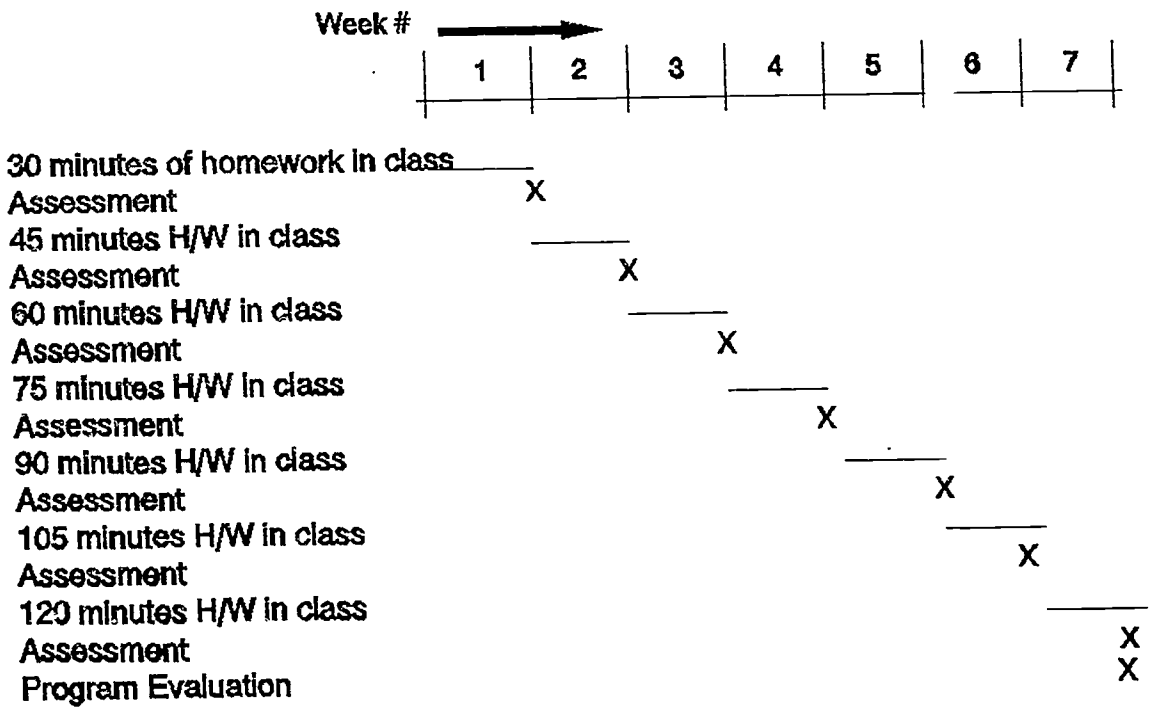
C:\GANTTCHA

Assumptions	Week Ending									

SCHEDULE

Task	Assigned To	Week Ending									

SAMPLE GANTT CHART



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PROBLEM SOLVING EXAMPLE

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PROBLEM SOLVING

"Example"

Background:

An algebra II class was having trouble mastering their competencies to the same level as the teacher's other three algebra II classes. This class consisted of twenty students, most of whom were sophomores. During December, the teacher decided to include the students in a problem solving exercise to identify the problem and implement a solution.

The teacher had been trained in the "Xerox" method of problem solving and decided to use it to facilitate the exercise with the class.

STEP 1: Identifying and Selecting the Problem

The class used the brainstorming technique to identify the problems for the lower level of mastery in their class. They identified the following potential problems:

1. The tests are too hard.
2. The students don't understand the material.
3. The students don't have a good background in math.
4. The teacher doesn't explain the material.
5. The students don't complete a large percentage of their homework assignments.
6. The measurements used to establish mastery "aren't fair".

It was decided that the "weighted voting technique" would be used to determine which problem to work on first. Each student had the opportunity to select three problems from the list and gave a "3" to the problem they felt was the most important, a "2" for the second most important and a "1" for the least important. The results of the scoring are listed below:

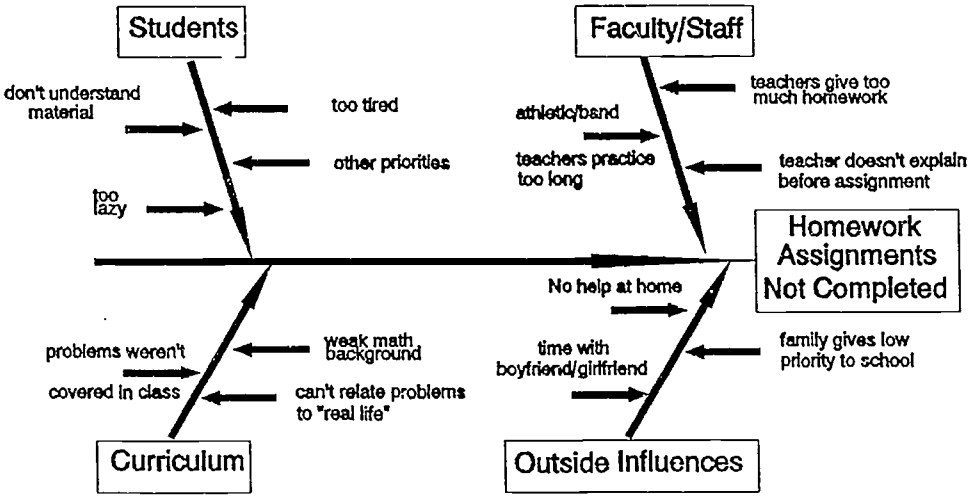
Student

Problem #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	3		2			1	1	1		2			3			1		3		1
2		2		3				3		3	1		2		2		1		2	3
3		3			2		3		1		2		1	3		2		1		
4		1	1	2		2		2	3			1		2			3			2
5	1		3	1	3		2		2		3	2		1	3		2	2	3	
6	2				1	3				1		3			1	3			1	

Since the class ranked Problem #5, 'students don't complete a large percentage of their homework assignments', the highest with 28 points, they agreed that they should try to solve that problem first.

STEP 2: Analyzing the Problem

The class decided to use the cause-and-effect or "fishbone" diagram to identify potential causes for the problem. They decided not to use the checksheet, histogram or pie charts because they didn't have any data. The following diagram is a result of their analysis:



After the causes were identified, the students used a modified "nominal group technique" to rank them. Each student selected three causes that they thought were most important. Each cause got a value of "1". These results were compiled on the following checklist: (only the top five causes are listed).

1.	Other teachers give too much homework	17
2.	Athletic/Band teachers practice too long	14
3.	No help at home	11
4.	Teacher doesn't explain before assignment	8
5.	Other priorities	7

STEP 3: Generating Potential Solutions

After looking at the list of possible causes, the class decided to use brainstorming to come up with a list of potential solutions for the top cause. The list they generated is shown below:

A. Teachers could coordinate their homework assignments.
B. Other teachers don't give homework on Thursday night, so that could be the night for algebra homework.
C. Do not give homework in algebra.
D. Give some time in class to work on homework.
E. Reduce the amount of homework in algebra.

STEP 4: Selecting and Planning a Solution

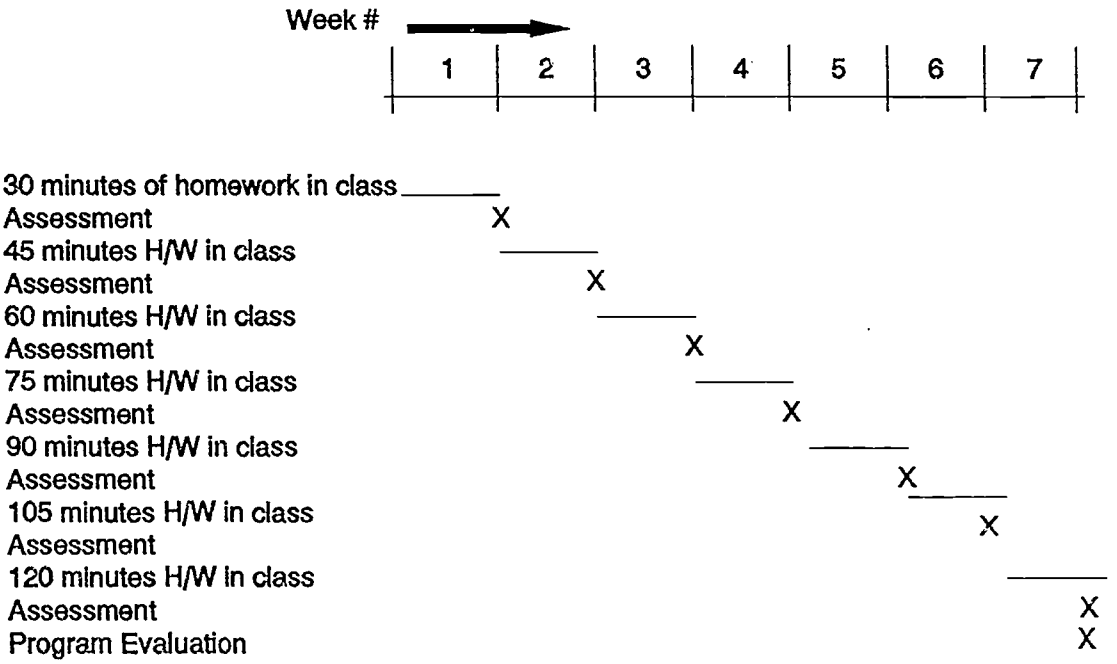
The students decided to use the "paired comparison" approach to selecting a solution. The matrix they developed is shown below:

--	A	B	C	D	E
A	--	A	C	D	E
B	A	--	C	D	E
C	C	C	--	D	E
D	D	D	D	--	D
E	E	E	E	D	--

The paired comparison showed that "D" was the preferred solution with a count of "8" times in the matrix, with "E" being second with "6".

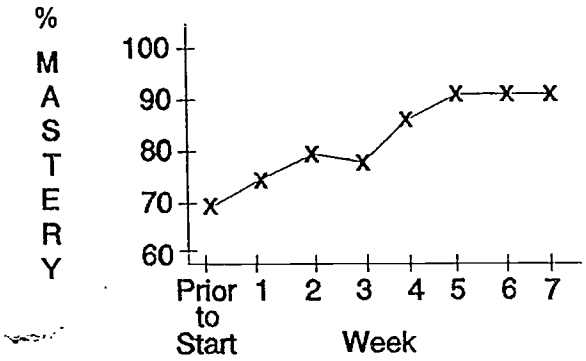
The class (teacher and students) decided to implement a plan for making more time available in class to work on homework. They decided that they would start with thirty minutes a week in class time devoted to homework and increase the time by fifteen minutes each week until two hours a week were dedicated to homework.

They decided that an assessment performed each Friday would be the measure of the success of their solution. They then developed a GANTT Chart to show their implementation plan.



STEP 5: Implementing the Solution

The class started implementing the plan that had been developed. They plotted their progress on the weekly assessments. They agreed that if their assessments dropped for two consecutive weeks, they would review their plan and implement another solution. The graph below shows their weekly assessments. (They had been having an average of 70% of the students mastering the subject at the start of this plan.)



STEP 6: Evaluating the Solution

After the class had completed the seventh week, they evaluated their results. They determined that their understanding of the subject had improved. They liked being able to ask the teacher questions about homework as they worked on it. They analyzed the assessment data and found that there was no improvement in mastery after spending 90 minutes a week on homework in class.

The class decided to only spend 90 minutes a week on homework in class and use the other thirty minutes during the next two weeks to go through the problem solving process again to find other ways to improve the class' mastery.

They plan to go back to Step 1 and start over again. They were going to address the second rated problem: "the students don't understand the material," but they decided that this problem may no longer be the most important.

PROBLEM SOLVING PROCESSES

Bibliography

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Goal/QPC. The Memory Jogger. Massachusetts: 1985, 1988.

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