

# **Fundamentals of Total Quality Leadership**

## **Module 5: Basic Process Improvement Tools**

# Instructor Information

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### Lesson Outline (continued)

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## **Instructor Information (continued)**

### **Lesson Objectives**

By the end of this module the student will be able to:

EO 5-1 Explain the purpose and uses of process improvement tools.

EO 5-2 Construct and apply Flowcharting, Brainstorming, Affinity Diagrams, Cause and Effect Diagrams, Nominal Group Technique (NGT), Multivoting, Check Sheets, Pareto Charts, and Run Charts.

EO 5-3 Describe Histograms and Control Charts.

EO 5-4 Describe the importance of a Data Collection Plan.

EO 5-5 Complete an exercise using the basic process improvement tools.

### **Length of Instruction**

This lesson takes approximately 7 hours

### **Methods of Instruction**

Lecture, exercises, and discussion

### **Media Required**

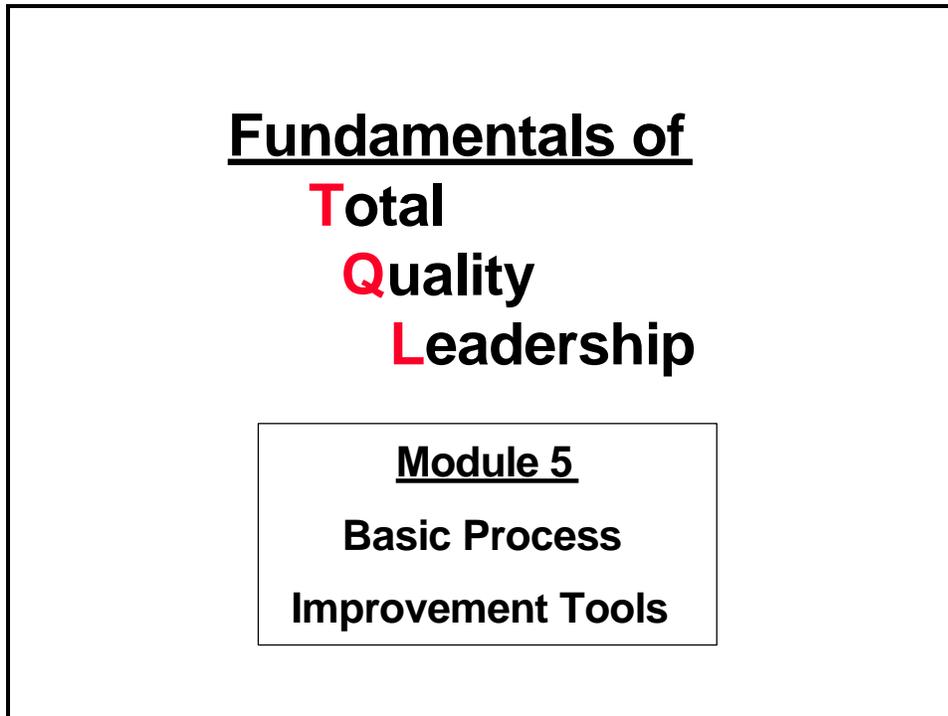
Overhead projector, screen, chartpack, and felt-tip pens

### **Videotapes**

None

### **Additional Reading**

None



## **Fundamentals of Total Quality Leadership (FTQL)**

### **Module 5 - Basic Process Improvement Tools**

This module introduces a variety of graphic and group process tools that have a wide application of uses. We will be looking at some of the “basic” tools used by individuals and teams to help improve and standardize organizational processes.

## Learning Objectives

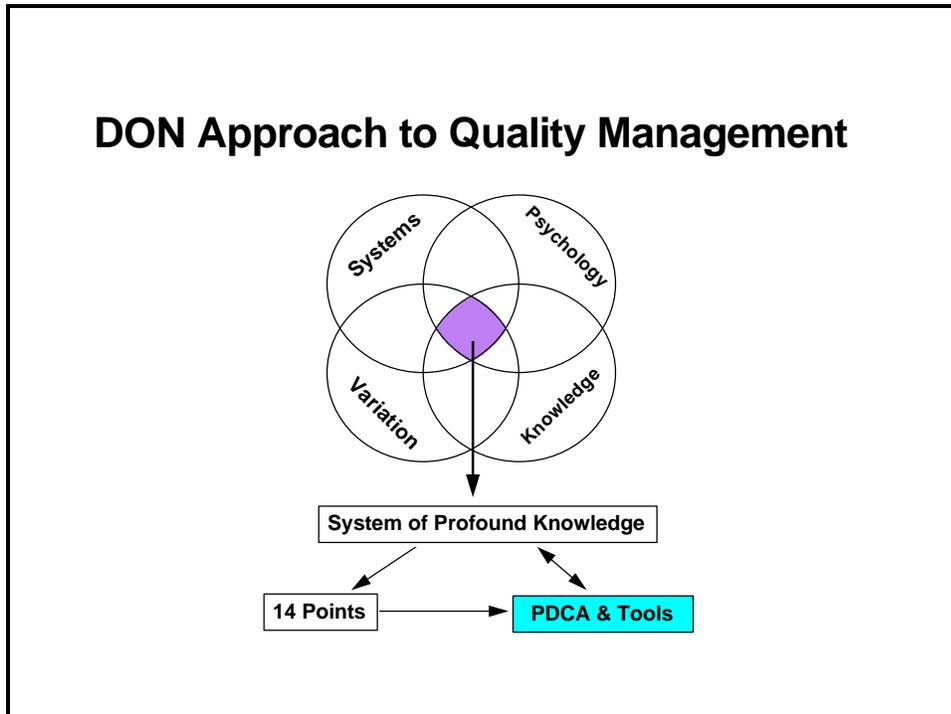
**By the end of this module the student will be able to:**

- ◆ Explain the purpose and uses of basic process improvement tools
- ◆ Construct and apply Flowcharting, Brainstorming, Affinity Diagrams, Cause and Effect Diagrams, Nominal Group Technique (NGT), Multivoting, Check Sheets, Pareto Charts, and Run Charts
- ◆ Describe Histograms and Control Charts
- ◆ Describe the importance of a Data Collection Plan
- ◆ Complete an exercise using the basic process improvement tools

## Learning Objectives

*By the end of this module the student will be able to:*

- ◆ Explain the purpose and uses of basic process improvement tools
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- ◆ Describe Histograms and Control Charts
- ◆ Describe the importance of a Data Collection Plan
- ◆ Complete an exercise using the basic process improvement tools



**DON Approach to Quality Management**

We saw in Module 3-4 (Knowledge), that the **Plan-Do-Check-Act (PDCA)** cycle is a scientific method for gaining knowledge based on data. The two-way arrow between the System of Profound Knowledge and PDCA and Tools represents the growth of knowledge obtained from using the PDCA cycle. **Tools** are contained in the box with PDCA because tools can be used and applied throughout the PDCA cycle.

## **Basic Tools for Process Improvement**

- |                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>◆ <b>Flowcharting</b></li> <li>◆ <b>Brainstorming</b></li> <li>◆ <b>Affinity Diagram</b></li> <li>◆ <b>Cause and Effect Diagram</b></li> <li>◆ <b>Nominal Group Technique (NGT)</b></li> <li>◆ <b>Multivoting</b></li> </ul> | <ul style="list-style-type: none"> <li>◆ <b>Check Sheet</b></li> <li>◆ <b>Pareto Chart</b></li> <li>◆ <b>Histogram</b></li> <li>◆ <b>Run Chart</b></li> <li>◆ <b>Control Chart</b></li> <li>◆ <b>Data Collection Plan</b></li> </ul> |
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### **Basic Tools for Process Improvement**

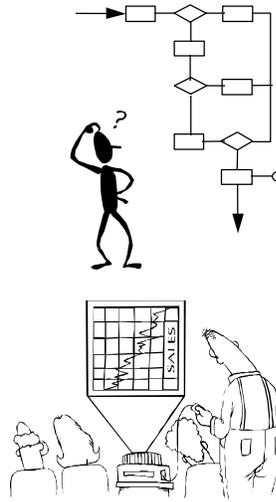
- |                                      |                             |
|--------------------------------------|-----------------------------|
| <b>Flowcharting</b>                  | <b>Check Sheet</b>          |
| <b>Brainstorming</b>                 | <b>Pareto Chart</b>         |
| <b>Affinity Diagram</b>              | <b>Histogram</b>            |
| <b>Cause and Effect Diagram</b>      | <b>Run Chart</b>            |
| <b>Nominal Group Technique (NGT)</b> | <b>Control Chart</b>        |
| <b>Multivoting</b>                   | <b>Data Collection Plan</b> |

We will explore some basic tools selected from among the many that have an application in process improvement. These tools have a wide range of use, not only with total quality but many other applications as well, both organizational and personal. These tools are used for language and numerical data.

While these tools fill a “basic” toolbox, there are others such as the “seven management and planning tools” that can provide advanced application in quality improvement. These additional tools are covered in follow-on courses such as Methods for Managing Quality (MMQ) and Systems Approach to Process Improvement (SAPI).

## Purpose of Tools

- ◆ Describe and improve processes
- ◆ Evaluate process or output variation
- ◆ Assist with decision-making
- ◆ Analyze data in a variety of ways
- ◆ Display information



### Purpose of Tools

#### ◆ Describe and improve processes

Tools can be used to describe steps and activities in a process or system and how they interact. They can help identify areas for improvement.

#### ◆ Evaluate process or output variation

Process variation can be measured and evaluated. This provides valuable information in improving processes to meet customer specifications and expectations.

#### ◆ Assist with decision-making

Tools can be used to assist with the decision-making process. It is important not to let the tool make the decision for you or a team.

#### ◆ Analyze data in a variety of ways

Often looking at process data from different vantage points can be extremely helpful in pinpointing improvement opportunities.

#### ◆ Display information

You've heard the saying "a picture is worth a thousand words". This is true when displaying data. Numerical data on a sheet of paper can often tell you very little. Displaying those same numbers in a Pareto chart, histogram, or run chart can be very revealing.

## Flowchart

A diagram that uses graphic symbols to depict the nature and flow of the steps in a process

### Benefits of Using Flowcharts

- ◆ Promotes understanding of a process
- ◆ Identifies problem areas and opportunities for process improvement
- ◆ Provides a way of training employees
- ◆ Depicts customer-supplier relationships

## Flowchart

A flowchart is a diagram that uses graphic symbols to depict the nature and flow of the steps in a process

### ◆ Promotes understanding of a process

People may have different ideas about how a process works. A flowchart can help you gain agreement about the sequence of steps. Flowcharts promote understanding in a way that written procedures cannot. One good flowchart can replace many pages of words.

### ◆ Identifies problem areas and opportunities for process improvement

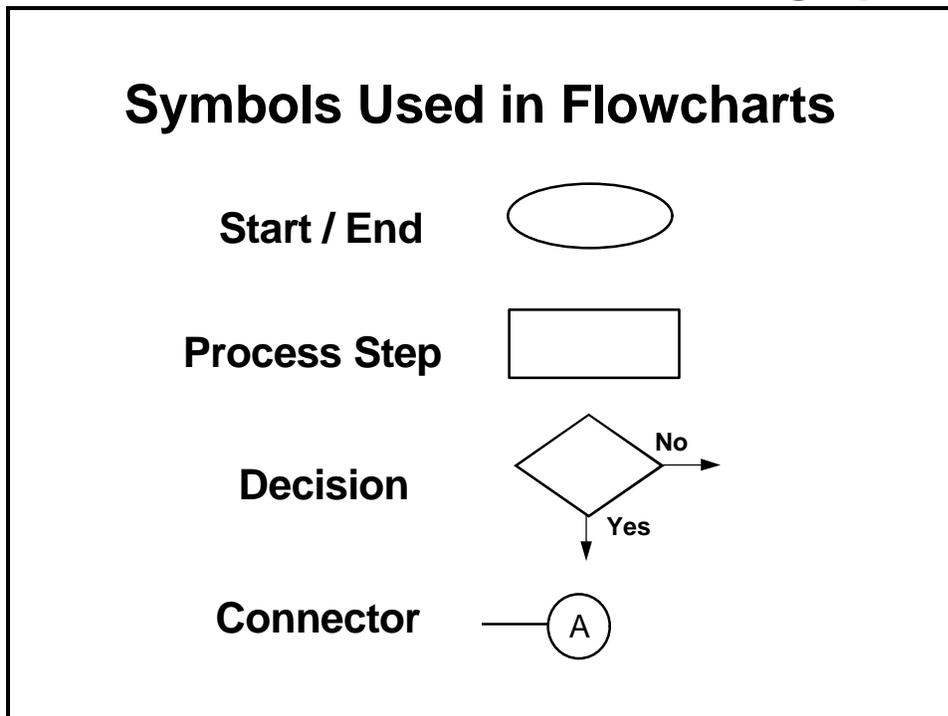
Once you analyze process steps and flowchart them, problem areas become more visible. Flowcharts tend to highlight decision points, redundant steps, and rework loops. Flowcharting makes it easy to spot opportunities for simplifying and refining a process.

◆ **Provides a tool for training employees**

Because of the way flowcharts visually lay out the sequence of process steps, they can be very helpful in training employees to perform the process according to standardized procedures.

◆ **Depicts customer-supplier relationships**

Flowcharts help the process workers understand who their customers are. As we learned earlier in this course, it is important to recognize that most people are both customers and suppliers to someone else in the process. Flowcharts can make these relationships clearer.

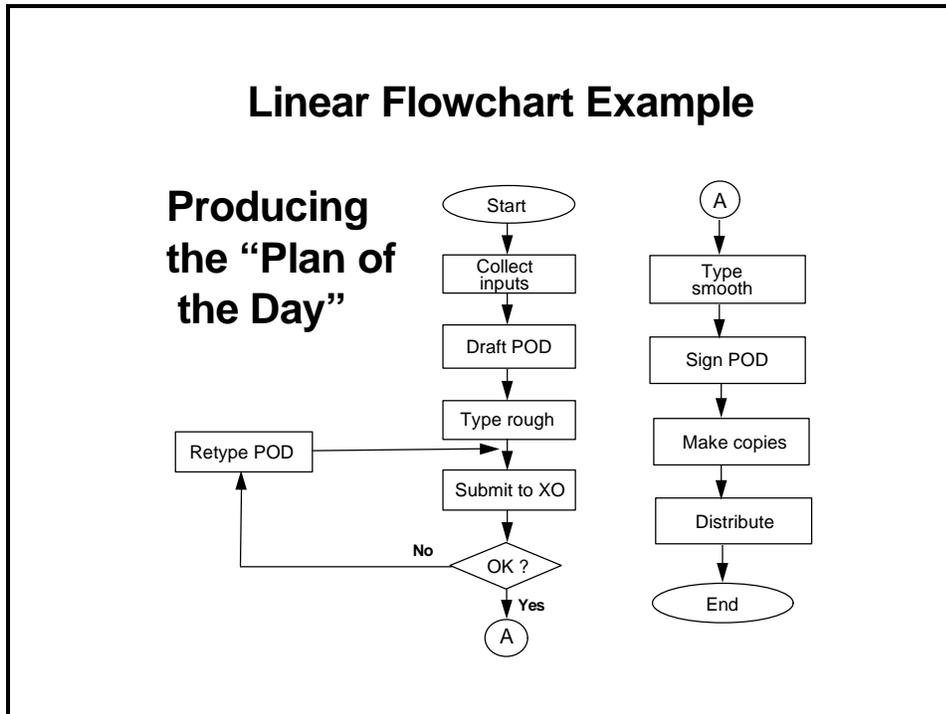


### Symbols Used in Flowcharts

The **symbols** that are commonly used in flowcharts have **standard meanings** and are **connected by arrows indicating the flow** from one step to another:

- ◆ **Start / End** - Ovals indicate both the starting point and the ending point of the process steps.
- ◆ **Process Step** - A box represents an individual step or activity in the process.
- ◆ **Decision** - A diamond shows a decision point, such as *yes/no* or *go/no-go*. Each path emerging from the diamond must be labeled with one of the possible answers.
- ◆ **Connector** - A circle indicates that a particular step is connected to another page or part of the flowchart. A letter placed in the circle clarifies the continuation.

There are many other symbols that can be used -- some with specialized applications. The symbols shown here are the most commonly used and widely recognized.

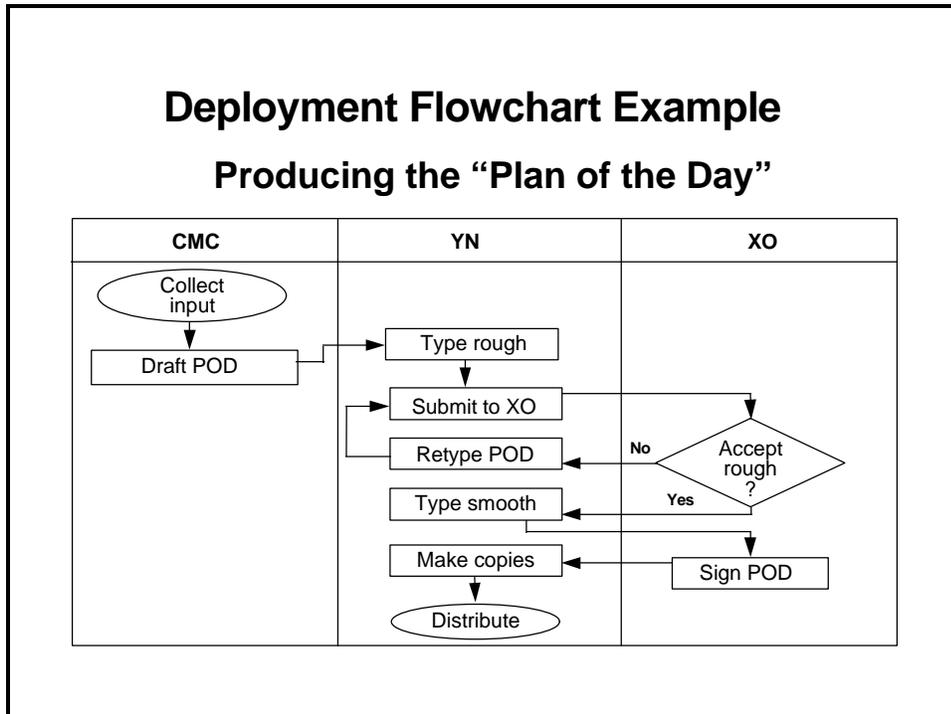


### Types of Flowcharts - Linear

There are many different **types** of flowcharts -- **Linear, Deployment, Opportunity, Workflow, and Top-Down** among them. You will learn Linear and Deployment flowcharting. The level of detail can be depicted as macro, mini, or micro for each of these types.

This viewgraph and the next show how one process, Producing the Plan of the Day (POD), can be depicted using Linear and Deployment flowcharts.

- ◆ **Linear Flowchart** . A linear flowchart is a diagram that displays the sequence of work steps in a process. This tool can help identify rework and redundant or unnecessary steps within a process.

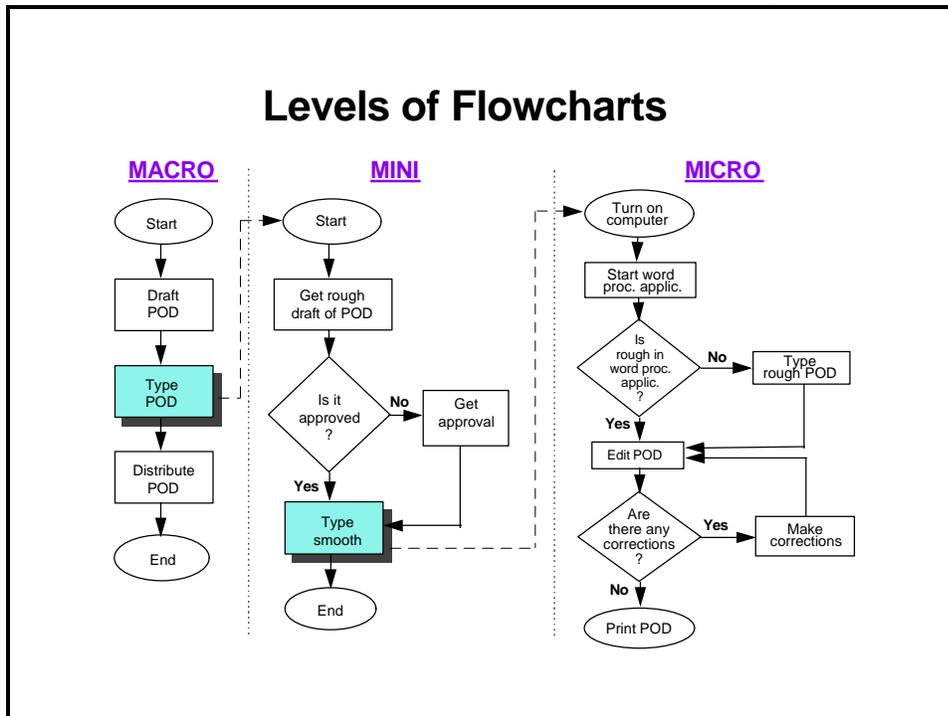


### Types of Flowcharts - Deployment

- ◆ **Deployment Flowchart.** A deployment flowchart shows the process flow and identifies the people or groups involved at each step. Horizontal lines define customer-supplier relationships.

This type of chart shows where the people or groups fit into the process sequence, and how they relate to one another throughout the process.

Now let's look at some levels of flowcharts.



## Levels of Flowcharts

When you are developing a flowchart, consider how it will be used and the amount and kind of information needed by the people who will use it. This will help you determine the level of detail to include. This viewgraph compares the levels described below using the process for producing the Plan of the Day (POD).

### Macro level

Top leaders may not need the amount of detail required by the workers in a process. A "big picture," or *macro-level* view of the process may be enough for their purposes. Think of it as a view of the ground from an airplane flying at 50,000 feet.

### Mini level

The term "mini" is used for a flowchart with a more detailed view than the macro flowchart. Typically, it focuses on only a part or step of the macro-level flowchart. Using the airplane analogy, you see the level of detail as if looking at the ground from 25,000 feet.

## Micro level

People trying to improve the way a job is done need detailed process steps. The *micro-level*, or ground-level, view provides a very detailed picture of a specific portion of the process. It is commonly used to chart how a particular task is performed.

The label used to identify the level of detail in a flowchart is not important. “Macro”, “Mini”, and “Micro” are not standard terminology. We have used them here only as an example of different levels. What matters is that the people constructing a flowchart understand how the information is going to be used and the people interpreting the chart understand the level of detail it presents.

## Guidelines for Flowcharting

- ◆ Assemble the right people
- ◆ Start with the big picture
- ◆ Observe the current process
- ◆ Decide on “as-is”, “regulation”, or “ideal” flowchart
- ◆ Define the level of detail

### Guidelines for Flowcharting

#### ◆ Assemble the right people

It is important to have those who know the process develop the flowchart -- those operators, technicians, or office workers who are actually involved in the process.

#### ◆ Start with the big picture

It is best to draw a **macro-level** flowchart first. After you've depicted this big picture of the process, you can develop other diagrams with increased levels of detail.

#### ◆ Observe the current process

A good way to start flowcharting a process is to walk through the current process, observing it in actual operation.

### ◆ Decide on “as-is”, “regulation” or “ideal” flowchart

At the beginning of your process improvement efforts, an **as-is** flowchart helps your team and others involved in the process to understand how it currently works. The team may find it helpful to compare an **as-is** flowchart with a **regulation** flowchart -- the way it is supposed to work. Later, the team will develop a flowchart of the modified process -- again, to record how it actually functions. At some point, your team may want to create an **ideal** flowchart to show how you would ultimately like the process to be performed.

It is vital that you start by **depicting the process the way it really works, not the way you think it should work.** You need to chart the process **as-is**. Later you can chart it as it is supposed to work (by regulation), or as you would like it to work (your ideal picture of the process).

### ◆ Define the level of detail

Define the level of detail required. If you started with a macro-level flowchart you may require developing one at the micro-level.

## Constructing a Flowchart

- ◆ Define the process to be flowcharted
- ◆ Record the steps, activities, and decisions
- ◆ Arrange the sequence of steps
- ◆ Draw the flowchart using symbology
- ◆ Validate the finished flowchart

### Constructing a Flowcharting

The following are the steps for developing a flowchart.

#### ◆ Define the process to be flowcharted

Establish process boundaries -- the starting and ending points for your flowchart. Identify the major activities or sub-processes that are included in the process. For example, process boundaries for a repair shop overhauling a pump might be when the pump enters the shop and when it passes final testing. The boundaries determine the number of activities to be studied and the number of people involved in the process, functionally and cross-functionally.

Determine what is **not included** in the scope of the process to remove any doubt or confusion about the boundaries. This may also help establish the scope of related processes.

#### ◆ Record the steps, activities, and decisions

If your team is not sure about a step, mark it to be investigated later. Record the steps as they actually occur in the process while you observe it. Write the steps on index cards or post-it™ notes. You can use a different color to represent each individual or group involved if that will help you to understand and depict the flow more accurately.

### ◆ **Arrange the sequence of steps**

Now arrange the cards or post-it™ notes exactly as you observed the steps. Using cards lets you rearrange the steps without erasing and redrawing and prevents ideas from being discarded simply because it's too much work to redraw the diagram. Sometimes it's easier to start with the last step and work back to the first step.

### ◆ **Draw the flowchart using symbology**

Depict the process exactly as you observed, recorded, and arranged the sequence of steps. Assign flowchart symbols such as boxes, diamonds, and triangles. Draw the arrows indicating flow and decision points.

### ◆ **Validate the finished flowchart**

Discuss with workers, customers, and suppliers. Trace or follow through several times from beginning to end to ensure you have it right.

At first, many teams struggle with flowcharting. Team members may be unsure about process boundaries or disagree on the level of detail needed. The first drawings can become a tangled mess of lines as steps are added, moved, and reconnected. This is normal and can be expected. But once you get it smooth, the process of doing the flowchart and seeing the results, validates the effort that goes into constructing a flowchart.

## Constructing a Deployment Flowchart

- ◆ List major steps of the process vertically on the left
- ◆ List the responsible process workers across the top
- ◆ Place each step in the appropriate column
- ◆ Connect the steps

### Constructing a Deployment Flowchart

To develop a deployment flowchart, follow the basic steps for constructing a linear flowchart, but modify the steps as follows:

- ◆ List the major steps of the process vertically on the left side of a sheet of paper.
- ◆ List the responsible process workers across the top , each in a separate column.
- ◆ Place each step in the appropriate column under the responsible process worker's name.
- ◆ Connect the steps in the order in which they relate to each other.

**NOTE:** Every horizontal line in a deployment flowchart identifies a customer-supplier relationship.

## Interpreting a Flowchart

### Step 1 - Examine each process step

*Bottlenecks? Poorly defined steps?  
Ineffective sequence? Delays? Weak links?*

### Step 2 - Examine each decision symbol

*Can this step be eliminated?*

### Step 3 - Examine each rework loop

*Can it be shortened or eliminated?*

### Step 4 - Examine each activity symbol

*Does the step add value for the end-user?*

## Interpreting a Flowchart

### Step 1 - Examine each process step

Look for the following conditions that indicate a need to improve the process. Remember that you are examining the process, not just a picture of the process as represented by the flowchart. You may need to watch the process or collect additional data to complete one or more of these steps.

◆ *Bottlenecks.* Points in the process where it slows down may be caused by redundant or unnecessary steps, rework, lack of capacity, or other factors.

◆ *Poorly defined steps.* Steps which are not well-defined may be interpreted and performed in a different way by each person involved, leading to process variation.

◆ *Ineffective sequence.* Many times the order in which steps are performed causes delays or rework.

◆ *Delays.* Waiting (for signature, inspection, completion, etc.) Lengthens cycle time.

◆ *Weak links.* Steps where problems occur because of inadequate training of process workers, equipment that needs to be repaired or replaced, or insufficient technical documentation.

## **Step 2 - Examine each decision symbol**

You may want to collect data on how often there is a "yes" or "no" answer at a decision point. If the decision is always the same you may be able to remove this decision point. Decision points represent inspections. The question to ask is, "Does this inspection add value?"

## **Step 3 - Examine each rework loop**

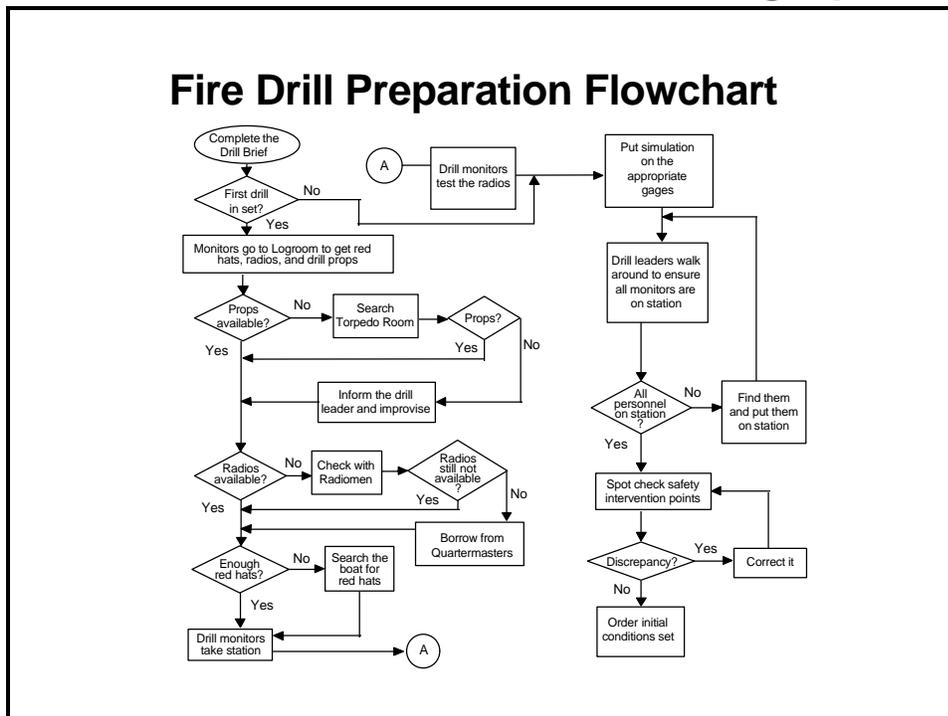
Processes with numerous checks generate rework and waste. Examine the activities preceding the rework loop and identify those that need to be improved. Look for ways to shorten or eliminate the loop.

## **Step 4 - Examine each activity symbol**

Does the step add value for the end-user? Consider removing a step if possible.

**There are a number of things that can go wrong when you create your flowchart that may interfere with interpretation and full understanding of the process.**

- Those developing the flowchart may have drawn it to represent the process as they envision it, not as it is.
- People may be reluctant to depict the obviously illogical parts of the process for fear they will be called upon to explain why they allowed it to be that way.
- Rework loops are either not seen or not documented because people assume rework is small and inevitable.
- People drawing the flowchart truly do not know how the process works.



### Fire Drill Preparation Flowchart

**Instructor Direction:** Give the team members a few minutes to study this viewgraph, then guide them through an interpretation of this flowchart based on the following questions. It is understood many might not have process knowledge, but this represents an example for interpretation purposes.

- ◆ Is the process flow depicted so you can follow it?
- ◆ What level of flowchart is this?
- ◆ What type of flowchart is this?
- ◆ Are the symbols properly used?
- ◆ What bottlenecks or weak links, or poorly defined steps are shown?
  - *In the Fire Drill Preparation example, the "Monitors go to Logroom to get red hats. . ." step indicates a potential bottleneck.*
  - *"Inform the drill leader and improvise" is one of the weak links.*

- ◆ What poorly defined steps are shown?
  - *"Improvise" is a poorly defined step in the weak link cited above.*
  
- ◆ Can you identify places where it would be useful to take data?
  
- ◆ Are there any rework loops that could be shortened or eliminated?

## Flowchart Exercise

***Construct a mini-level  
flowchart of “cutting  
the grass”***

### Flowchart Exercise

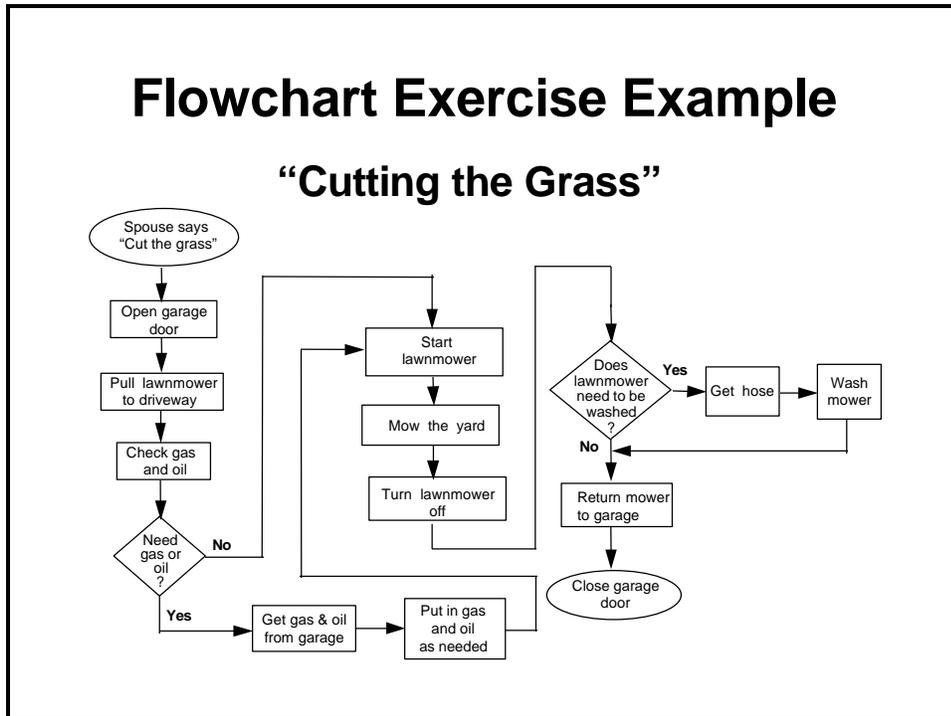
The following exercise will enable you to practice what you’ve learned by flowcharting a familiar process.

 **Exercise: Construct a mini-level flowchart of “cutting the grass”**

Remind the students to follow the guidelines and steps of constructing a flowchart. Have the teams use post-its™ to develop the flowchart. **Ensure you have enough supplies on hand.** Have one person serve as team leader and brief out upon completion of the exercise. **Rotate team leaders for each exercise.** Assist the teams in determining the following as required.

- Starting and ending points of the process
- Sequence of the steps written on the post-its™
- Decision points
- Appropriate symbols and connectors to use

**Time: 30 minutes**



### Flowchart Exercise Example

This is an example of a possible flowchart for “cutting the grass.”

## Brainstorming

An idea-generating technique used by teams to generate many ideas in a short period of time

### Benefits of Brainstorming

- ◆ Rapidly produces a large number of ideas
- ◆ Encourages creativity and innovation
- ◆ Encourages involvement by all members
- ◆ Fosters a sense of ownership
- ◆ Provides input to other tools

## Brainstorming

Brainstorming is used by teams to obtain the ideas of each individual and to facilitate the synergistic effect of group idea-generation. A key ingredient is to provide an environment *free of criticism* for creative and unrestricted exploration of options or solutions.

## Benefits of Brainstorming

Brainstorming helps a team break free of old ideas. This free-wheeling technique for generating ideas may produce some that seem half-baked, but it can lead to new and original solutions to problems. Some of the specific benefits of brainstorming are:

### ◆ Rapidly produces a large number of ideas

By encouraging people to offer whatever ideas come to mind, brainstorming helps groups develop many ideas quickly.

### ◆ Encourages creativity and innovation

Brainstorming expands your thinking to include all aspects of a problem or a solution. You can identify a wide range of options.

◆ **Encourages involvement by all members**

It provides a nonjudgmental environment that encourages *everyone* to offer ideas. All ideas are recorded, even if they seem silly or far out.

◆ **Fosters a sense of ownership**

Having all members actively participate in the brainstorming process fosters a sense of ownership in the topic discussed and in the resulting activities. When the people on a team contribute personally to the direction of a decision, they are more likely to support it.

◆ **Provides input to other tools**

You may want to “affinitize” or group the brainstormed ideas. And, if appropriate, you can work with the team to reduce the number of ideas by Nominal Group Technique (NGT) or Multivoting.

## Guidelines for Brainstorming

- ◆ **Set the format**  
(structured/unstructured)
- ◆ **Display ideas exactly as presented**
- ◆ **No discussion of input**
- ◆ **Build on others' ideas**
- ◆ **Maintain a brisk pace**
- ◆ **Active participation by everyone**

### Guidelines for Brainstorming

For all participants to enjoy a creative and productive brainstorming experience, the facilitator needs to make sure participants understand the ground rules for the session.

#### ◆ **Set the Format**

- **Structured:** The facilitator establishes a rotation that enables each person in the group to contribute an idea in turn. Any individual who is not ready with an idea when his or her turn comes can pass until the next round, when he or she may offer an idea or pass again.
- **Unstructured:** Team members call out ideas as they come to mind. This method calls for close monitoring by the facilitator to enforce the ground rules and ensure that no one's ideas are censored.

#### ◆ **Display ideas exactly as presented**

Write down ideas on a chartpack where everyone can see them. Try to capture the exact words from the person. Assign a recorder (or the facilitator can do this.)

◆ **No discussion during idea generation**

Criticisms, compliments, or other comments -- during the brainstorming. This is hard to do!

◆ **Build on others' ideas**

Others' ideas will often trigger additional thoughts that might not have surfaced without the brainstorming technique. Some people call this spin-off effect "piggybacking."

◆ **Maintain a brisk pace**

Brainstorming should be a rapid, energetic generation of ideas, keep the pace moving so individuals aren't tempted to "self-censor."

◆ **Active participation by everyone**

All team members are able to express their ideas, even if ideas may seem silly or far-out.

## Steps for Brainstorming

- ◆ **Generate the ideas**
  - Clearly state the topic
  - Review the guidelines
  - Collect everyone's ideas
  - Record and display ideas
- ◆ **Clarify, combine, cancel**
  - Clarify the meaning of each item
  - Combine like items
  - Cancel the obvious far out items

### Steps for Brainstorming

The recommended sequence of steps for conducting brainstorming are provided below:

- ◆ **Generate the ideas**
  - **Clearly state the topic** to be brainstormed -- often in the form of a question. Write it down and post it where everyone can refer to it. Ensure that everyone understands it.
  - **Review the guidelines** for brainstorming. Describe how this session will be conducted by going over the points below.
  - **Collect everyone's ideas.** After allowing a few minutes for the participants to think about the question, ask them to give their ideas. Establish either a *structured* or *unstructured* format for calling out ideas. Sometimes it is helpful to start with a structured format then open it up to an unstructured format. This helps keeping everyone involved.

- **Record and display ideas** on a chartpack as they are called out, or collect ideas written by team members on post-its™. Display the ideas where everyone can see them. Having the words visible to everyone at the same time helps stimulate creative thinking by other team members.

When recording ideas, ensure that they are written down exactly as spoken by the team member. Don't interpret. Try to generate as long a list as possible. Keep brainstorming until all participants have passed or the group has clearly run out of ideas.

#### ◆ Clarify and combine

- **Clarify the meaning of each item** . Briefly review to ensure that all members have the same understanding of it. Pointing to each idea on the chartpack in turn, ask the participants whether they have any questions about its meaning. You may have to ask the contributor to explain the idea in a different way.
- **Combine like items** . If two or more ideas appear to mean the same thing, you should try to combine them or eliminate the duplicates. Before you can wrap the like ideas into a single item or eliminate any items on the list, all of those who contributed the similar ideas must agree that they mean the same thing. Otherwise, they remain as separate items.
- **Cancel the obvious far out items** . Once you begin to refine the list, you may also find that some ideas are so far out that they can be discarded. If you've had a really free-wheeling session, you'll even have some "joke" items that invoked humor, but aren't that viable. This is the time to get rid of them.

**Caution:** *Some teams will go beyond the intent of these steps and reduce their list to only a few items. Try to keep the combine and cancel steps to only the obvious few.*

Brainstorming is only the idea-generating phase of a task such as problem-solving. Later in this module we will introduce other tools you can use to reduce the list down to the most important items.

## Brainstorming Example

***What can be done to ensure the proper disposal of recyclable material on base?***

### Brainstorming Example

A team of recycling experts from throughout the base was assembled and they were asked to brainstorm the following question:

***What can be done to ensure proper disposal of recyclable material on the base?***

The team clarified the topic by defining the terms used in it:

***Proper disposal*** means that **all** recyclable material is placed in containers designated for that purpose and segregated so that different types of recyclable material aren't mixed; for instance, paper is not mixed with cans.

***Recyclable material*** is defined as white paper, aluminum cans, cardboard boxes, glass bottles, and plastic containers not contaminated by food.

***On the base*** is defined as inside the perimeter fence that surrounds the property of the base.

The following list is an example of the kind of large list of diversified solutions that might be brainstormed during a session such as the one in the example.

1. Use metal detectors on all trash leaving the command.
2. Pass monetary gains back to the individual.
3. Hold mandatory training for all hands.
4. Place more recycling bins throughout the command.
5. Station a watch next to the trash cans.
6. Have remote cameras monitoring the trash cans.
7. Throw an annual picnic using the money from recycling.
8. Have a contest between base commands.
9. Place recycling bins next to wastebaskets.
10. Remove wastebaskets from all office areas.
11. Inspect wastebaskets at the end of each day.
12. Make it an honor offense not to recycle.
13. Educate personnel on why we need to recycle.
14. Make recycling violators perform community service.
15. Post signs throughout the command encouraging recycling.
16. Use computers to make the command paper-less.
17. Have instant cash rewards for people who recycle.
18. Don't pick up trash if it has recyclable material inside.
19. Find a way to recycle yellow post-its™.
20. Put up signs at all soft drink machines.
21. Remove all soft drink machines.

# Brainstorming

## Exercise

### Brainstorm Exercise

A practical exercise will enable you to apply the skills you've just learned.

 **Exercise:** Depending on the class make-up you may choose a topic to brainstorm that is suitable for your audience. Ensure the topic chosen lends itself to generate a lot of input (ie 20-30 items). **This brainstormed list will be used as input for future exercises.**

Remind the teams to apply the guidelines and steps for brainstorming. Have each team leader brief out upon completion.

**Time: 20 minutes**

**Possible exercise topics :**

- What are the barriers to implementing TQL?
- What are the causes of computer down time?
- How can we improve the readiness of the command?
- What can be done about the state of readiness of the fire control systems?
- Why is our ship dragging anchor in heavy weather?
- What things do we need to consider in planning a perfect meeting?
- What can be done to improve the productivity of our meetings?
- How can information flow be improved within our organization?
- Why are the organization's vehicles getting poor gas mileage?
- How can we reduce the time it takes the pharmacy to fill a prescription?

Choose other topics or issues as appropriate.

## Affinity Diagram

A tool that organizes large amounts of language data (ideas, opinions, issues) into groupings based on their natural relationships

### Use the Affinity Process to:

- ◆ Sift through large volumes of data
- ◆ Encourage new patterns of thinking

### Affinity Diagram

An Affinity Diagram is a tool that gathers large amounts of language data (ideas, opinions, issues) and organizes them into **groupings based on their natural relationships**. The affinity process is often used to group ideas generated by brainstorming.

The affinity process is a good way to get people to work on a creative level to address difficult issues. It may be used in situations that are unknown or unexplored by a team, or in circumstances that seem confusing or disorganized, such as when people with diverse experiences form a new team, or when members have *incomplete* knowledge of the area of analysis.

### Use the Affinity Process to:

The affinity process is formalized in an affinity diagram and is useful when you want to:

- ◆ **Sift through large volumes of data**

For example, a process owner who is identifying customers and their needs might compile a large list of unsorted information. In such a case, creating an affinity diagram might be helpful for organizing the information into similar groups.

◆ **Encourage new patterns of thinking**

An affinity exercise is an excellent way to get a group of people to react on a "gut level" rather than mulling things over intellectually. Starting with a brainstormed list that is not arranged in pre-determined categories often allows them to look at data from new perspectives. They may see new approaches and possibilities based on natural affinities that were not obvious before.

## Guidelines for Creating an Affinity Diagram

- ◆ “Affinitize” silently
- ◆ Go for gut reactions
- ◆ Handle disagreements simply
- ◆ Generally not used for less than 15 items

### Guidelines for Creating an Affinity Diagram

“Affinitizing” is a process performed by a group or team. The idea is to meld the perspectives, opinions, and insights of a group of people who are knowledgeable about the issues. The process of developing an affinity diagram seems to work best when there are no more than five or six participants.

Before we go over the steps used to create an affinity diagram, you need to know some unique features of the affinity process that are important to its success:

#### ◆ “Affinitize” silently

The most effective way to work is to have everyone to take action to group the displayed ideas at will, **without talking**. This is a new experience for many people. It has two positive results: It encourages unconventional thinking (which is constructive), while it discourages semantic battles (which can be destructive). It also helps prevent one person from steering the affinity.

#### ◆ Go for gut reactions

Encourage team members not to agonize over sorting but to react quickly to what they see. Speed rather than deliberation is the order of the day, so keep the process moving.

◆ **Handle disagreements simply**

The process provides a simple way to handle disagreements over the placement of ideas. If a team member doesn't like where an idea is grouped, they move it. This creates an environment in which it is okay to disagree with people having a different viewpoint. If after several back and forth moves consensus cannot be reached, make a duplicate of the idea and place one copy in each group.

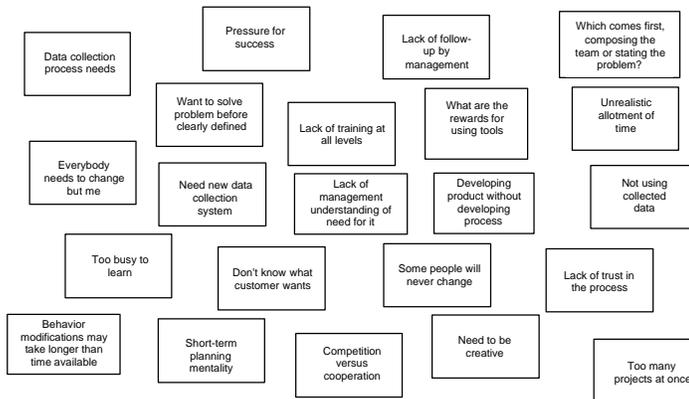
◆ **Generally not used for less than 15 items**

As a rule of thumb, if less than 15 items of information have been identified, you can skip the Affinity process. Instead, you can clarify and combine the ideas and then use one of the decision-making tools to identify the highest priority items.

Now let's walk through the step-by-step process of creating an affinity diagram.

## Step 1 - Display the Generated Ideas

### *Issues in Implementing Continuous Process Improvement*

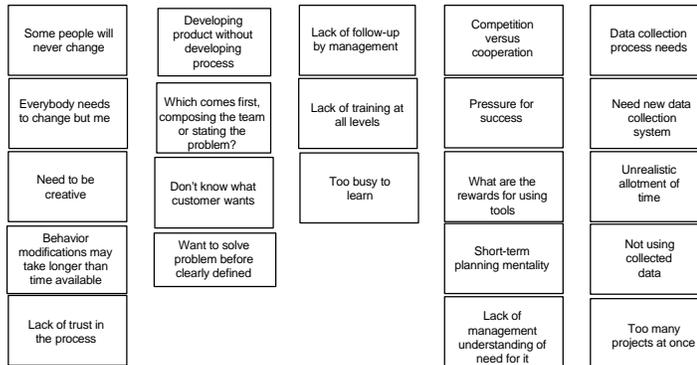


## Step 1 - Display the Generated Ideas

Brainstorming is typically used to generate a list of ideas, issues, or options. This large set of data then can be grouped using the affinity process. The rest of the steps in the affinity process will be easier if these ideas are written on post-its™. Post the ideas on a chartpack, a wall, or a table in a **random** manner. Make sure everyone understands them.

## Step 2 - Sort Ideas into Related Groups

### *Issues in Implementing Continuous Process Improvement*



## Step 2 - Sort Ideas into Related Groups

The team members physically sort the cards into groupings, **without talking**, using the following process:

- ◆ Start by looking for two ideas that seem related in some way. Place them together in a column off to one side.
- ◆ Look for ideas that are related to those you've already set aside and add them to that group.
- ◆ Look for other ideas that are related to each other and establish new groups.

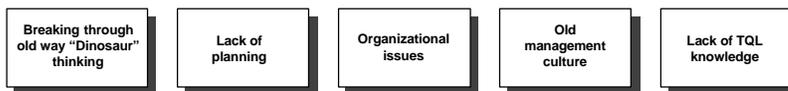
This process is repeated until the team has placed all of the ideas in groups.

**NOTE:** Ideally, all of the ideas can be sorted into related groups. If there are some "loners" that don't fit any of the groups, don't force them into groupings where they don't really belong. Let them stand alone under their own headers.

## Step 3 - Create Header Cards

*Issues in Implementing Continuous Process Improvement*

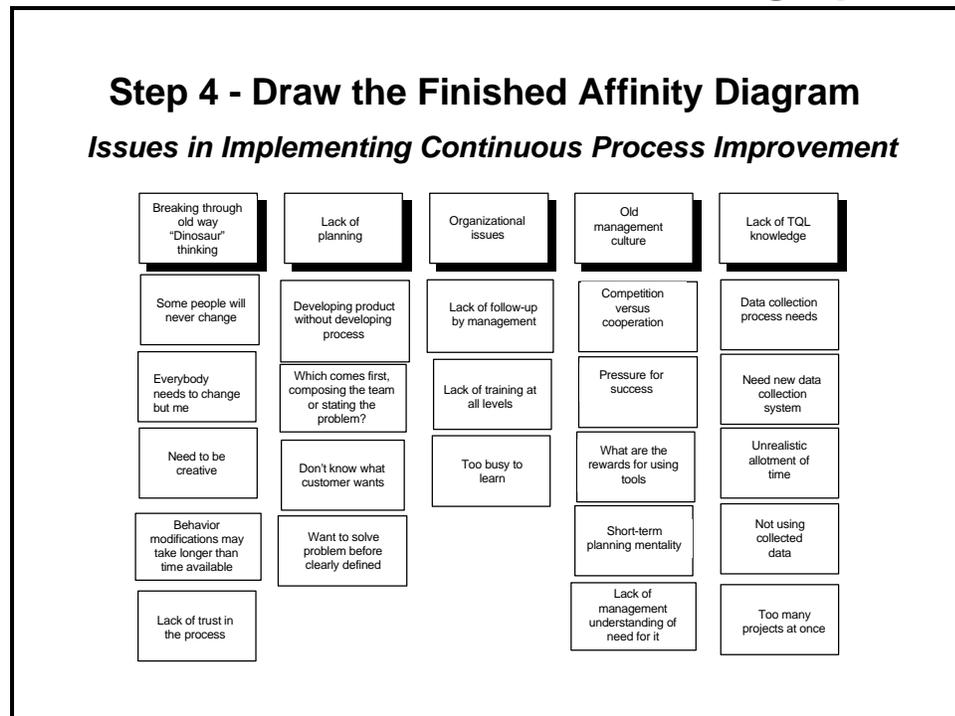
(Header Cards)



### Step 3 - Create Header Cards

When the movement of the cards has diminished or stopped, its time for the group to now discuss outloud for creating the header cards. A header is an idea that captures the **essential link among the ideas contained in a group of cards** . This idea is written on a single card or post-it™ and should consist of a phrase or sentence that clearly conveys the meaning, even to people who are not on the team. The team develops headers for the groups by:

- ◆ Finding already existing cards within the groups that will serve well as headers and placing them at the top of the group of related cards.
- ◆ Alternatively, discussing and agreeing on the wording of cards created specifically to be headers.
- ◆ Discovering a relationship among **two or more groups** and arranging them in columns under a **superheader** . The same rules apply for superheaders as for regular header cards.



**Step 4 - Draw the Finished Affinity Diagram**

- ◆ Write a problem statement at the top of the diagram.
- ◆ Place header and superheader cards above the groups of ideas.
- ◆ Review and clarify the ideas and groupings.
- ◆ Document the finished affinity diagram.

Some people like to draw boxes around the groupings to clearly define them.

# Affinity Exercise

*Use the list generated during  
the Brainstorming Exercise*

## Affinity Exercise

A practical exercise will enable you to apply the skills just described. This exercise is intended to be done by a team with everyone taking an active part. The important thing is that the finished diagram should be one that everyone on your team can live with and support.

 **Exercise:** Have the teams go through the steps of the affinity process to create a diagram using the list created from the Brainstorming exercise.

**Time: 20 minutes**

**Step 1- Display the generated ideas.** Copy each of the ideas displayed onto post-its™ or cards, one idea to a card. The facilitator can do this in advance, or the participants can do it at the beginning of the exercise. Place the post-its™ on a chartpack, easel, or wall, in a random manner.

**Step 2 - Sort the ideas into related groups** . Group the ideas by moving the cards independently. Participants should go with their gut reactions. If they disagree on the placement of a card, they are free to move it. The instructor should remind them that “affinitizing” is a quick process conducted in silence.

**Step 3 - Create header cards** . Make sure that each header placed at the top of a group captures the essential link among all of the ideas beneath it and consists of enough words to clearly convey the meaning.

**Step 4 - Draw the finished affinity diagram** . Make sure you write the problem statement on top of the diagram, place a header card above each group of ideas, allow the team to review and discuss points for clarification, and document the finished product.

#### **Other optional exercise topics :**

Try developing an affinity diagram for one or more of these topics:

- How can we improve the readiness of the command?
- What can be done about the state of readiness of the fire control systems?
- Why is our ship dragging anchor in heavy weather?
- What things do we need to consider in planning a perfect meeting?
- What can be done to ensure proper disposal of recyclable material?
- How can information flow be improved within our organization?
- Why are the organization's vehicles getting poor gas mileage?
- What can be done to ensure fast service at the pharmacy prescription counter?

## Cause and Effect Diagram

A graphic tool that helps identify, sort, and display possible causes of a problem or quality characteristic

### Benefits of Cause and Effect Diagrams

- ◆ Uses an orderly, easy-to-read format
- ◆ Increases knowledge of the process
- ◆ Indicates possible causes of variation
- ◆ Identifies areas for collecting data

### Cause and Effect Diagram

A cause and effect diagram is a tool that helps identify, sort, and display possible causes of a specific problem or quality characteristic. It graphically illustrates the relationship between a given outcome and all the factors that influence the outcome. This type of diagram is sometimes called an "Ishikawa Diagram" because it was invented by Kaoru Ishikawa, or a "Fishbone Diagram" because of the way it looks.

### Benefits of Cause and Effect Diagrams

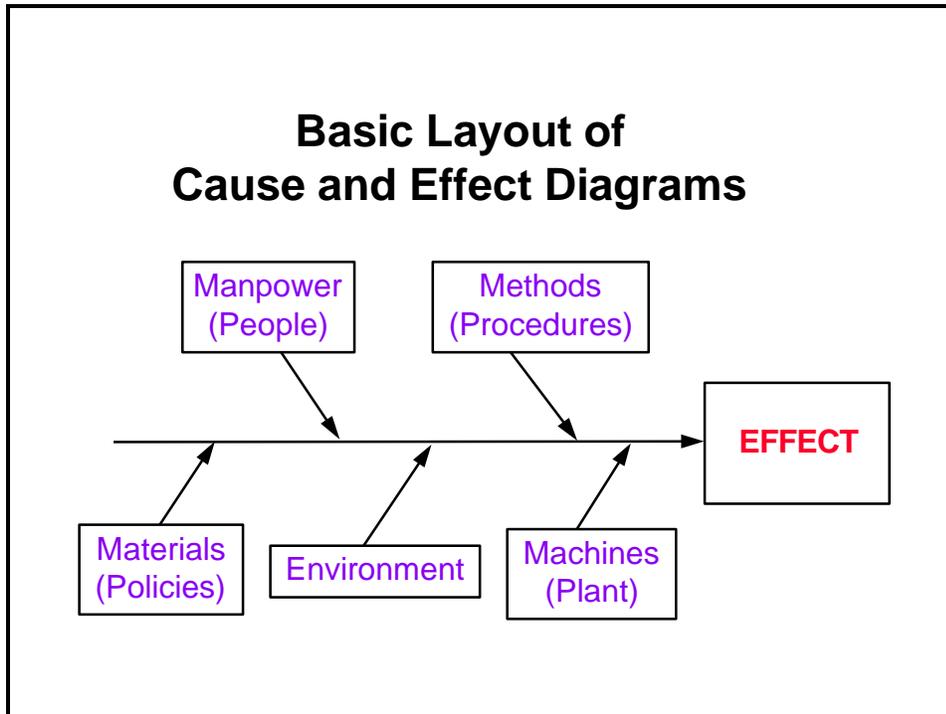
A cause and effect diagram is a tool that is useful for identifying and organizing the known or possible causes of quality, or the lack of it. The structure provided by the diagram helps team members think in a very systematic way. Benefits of constructing a cause and effect diagram:

- ◆ **Uses an orderly, easy-to-read format** to diagram cause and effect relationships. Branches and headers can be tailored for a specific use or application.
- ◆ **Increases knowledge of the process** by helping everyone to learn more about the factors at work and how they relate. Encourages group participation and utilizes group knowledge of the process.

- ◆ **Indicates possible causes of variation** in a process. Helps determine the *root causes* of a problem or quality characteristic using a structured approach.
- ◆ **Identifies areas for collecting data** for further study.

Constructing a cause and effect diagram can help your team when you need to:

- ◆ **Identify the possible root causes**, the basic reasons, for a specific effect, problem, or condition.
- ◆ **Sort out and relate some of the interactions** among the factors affecting a particular process or effect.
- ◆ **Analyze existing problems** so corrective action can be taken.



### Basic Layout of Cause and Effect Diagrams

When you develop a cause and effect diagram, you are constructing a structured, pictorial display of a list of causes organized to show their relationship to a specific effect. This shows the basic layout of a cause and effect diagram. Notice that the diagram has a *cause* side and an *effect* side. Here are some commonly used categories:

- 4Ms - methods, materials, machinery, and manpower -- most often used for “hands on” work
- 4Ps - policies, procedures, people, and plant -- most often used for administrative work
- Environment - a potentially significant fifth category

Lets look at the steps for constructing and analyzing a cause and effect diagram.

## Step 1 - Identify and define the effect

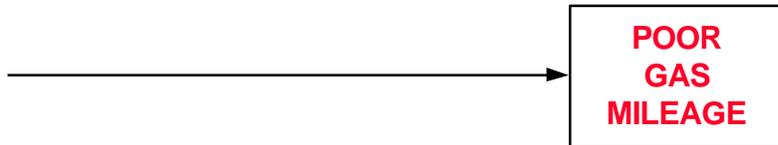
- ◆ **Decide on the effect to examine**
- ◆ **Develop clear definitions**
- ◆ **Phrase effect as**
  - positive (an objective) or
  - negative (a problem)

## Step 1 - Identify and define the effect

- ◆ Decide on the effect to be examined. Effects are stated as particular quality characteristics, problems resulting from the process, planning objectives, and the like.
- ◆ Develop clear definitions. Clearly state the effect and ensure that it is understood.
- ◆ Remember, an effect may be positive (an objective) or negative (a problem), depending upon the issue that's being discussed.
  - *Using a positive effect which focuses on a desired outcome tends to foster pride and ownership over productive areas. When possible, it is preferable to phrase the effect in positive terms.*
  - *Focusing on a negative effect can sidetrack the team into justifying why the problem occurred and placing blame. You should be cautious about the fallout that can result from focusing on a negative effect. Getting a team to concentrate on things that can go wrong may foster a more enthusiastic atmosphere and sometimes enhances group participation.*



## Step 2 - Fill in the effect box and draw the spine



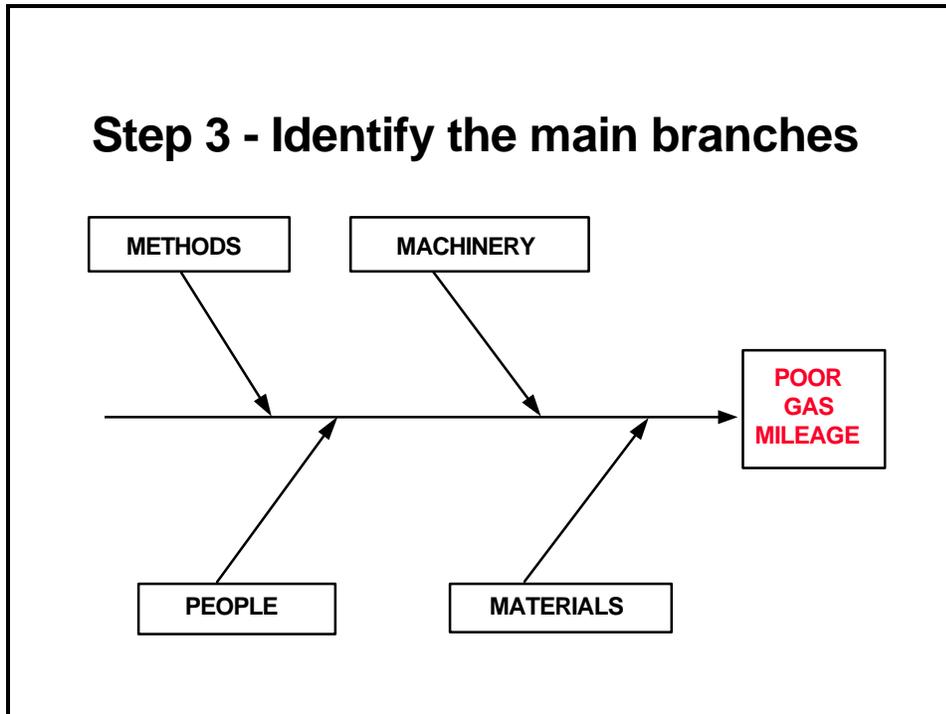
### Step 2 - Fill in the effect box and draw the spine

- ◆ Draw a horizontal arrow pointing to the right. This is the spine.
- ◆ To the right of the arrow, write a brief description of the effect or outcome which results from the process.

**EXAMPLE:** The effect is *Poor Gas Mileage*.

- ◆ Draw a box around the description of the effect.

 **Instructor Note:** The example on the next few pages has been broken down into its component parts and expanded to illustrate the construction steps. Using this example, we will identify the possible causes relating to a car's getting poor gas mileage.

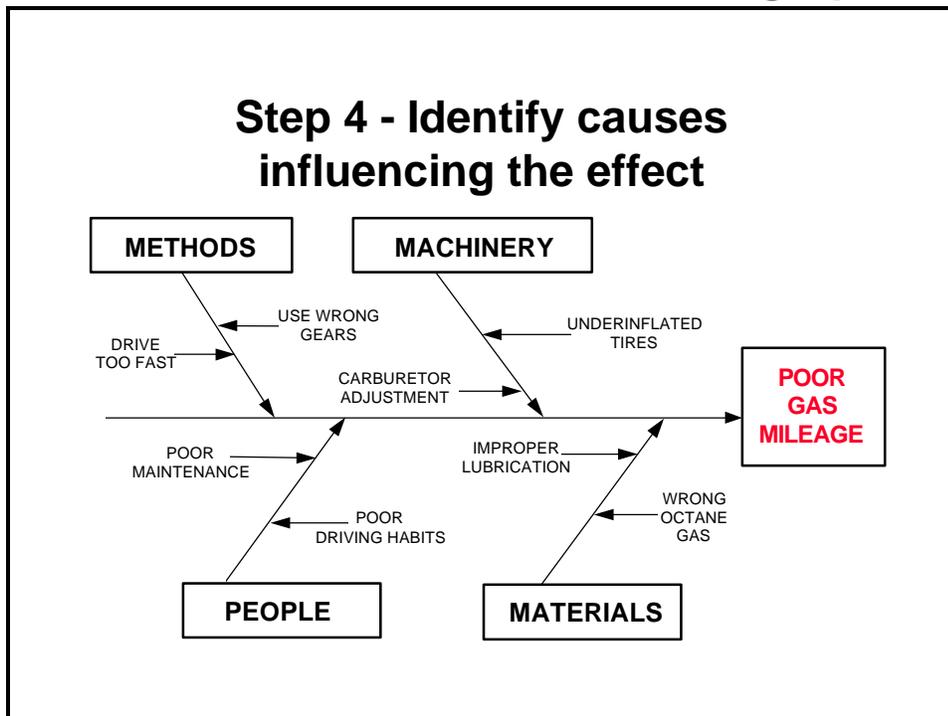


### Step 3 - Identify the main branches

These are the labels for the **major branches** of your diagram and become **categories** under which to list the many causes related to those categories.

- ◆ Establish the main causes, or categories, under which other possible causes will be listed. You should use category labels that make sense for the diagram you are creating.
- ◆ Write the main categories your team has selected to the left of the effect box, some above the spine and some below it.
- ◆ Draw a box around each category label and use a diagonal line to form a branch connecting the box to the spine.

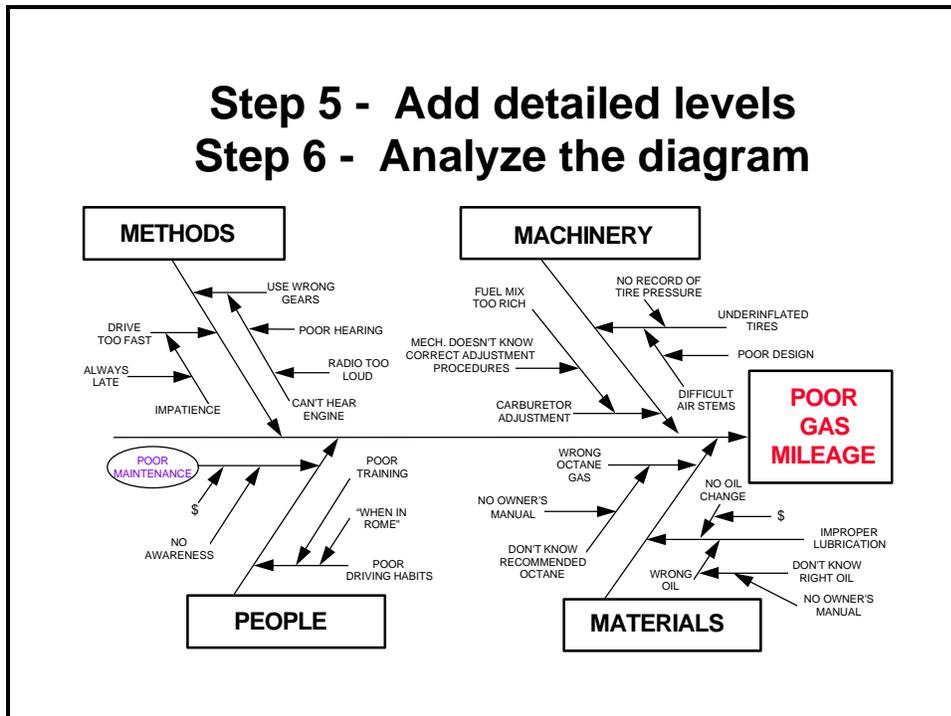
**EXAMPLE:** This viewgraph uses the 3Ms and P to start developing the diagram we began in Step 2.



**Step 4 - Identify causes influencing the effect**

- ◆ Identify as many potential causes or factors and attach them as subbranches of the major branches.
- ◆ Fill in detail for each cause. If a minor cause applies to more than one major cause, list it under both.

**EXAMPLE:** The potential causes for *Poor Gas Mileage* are listed under the appropriate categories in this viewgraph.



**Step 5 - Add detailed levels**

Identify increasingly more detailed levels of causes and continue organizing them under related causes or categories. You can do this by asking a **series of why questions**.

**EXAMPLE:** We'll use a series of *why* questions to fill in the detailed levels for one of the causes listed under each of the main categories.

**Under Methods:**

**Q:** Why was the driver USING THE WRONG GEAR?

**A:** The driver *couldn't hear the engine*.

**Q:** Why couldn't the driver *hear the engine*?

**A:** The **radio was too loud**, **Poor hearing**

**Under Machinery:**

**Q:** Why were the TIRES UNDER-INFLATED?

**A:** *No record of tire pressure, Difficult air stems*

**Q:** Why were the *air stems difficult*?

**A:** **Poor design**

## Under People:

**Q:** Why was MAINTENANCE POOR?

**A:** *Lack of money, No awareness*

## Under Materials:

**Q:** Why was WRONG OCTANE GAS used?

**A:** *Didn't know recommended octane*

**Q:** Why wasn't *recommended octane* known?

**A:** **No owner's manual**

This viewgraph shows how the diagram looks when all the contributing causes that were identified by the series of *why questions* have been filled in. As you can see, there may be many levels of causes contributing to the effect.

**NOTE:** You may need to break your diagram into smaller diagrams if one branch has too many subbranches. Any main *cause* (3Ms and P, 4Ps, or a category you have named) can be reworded into an *effect*.

## Step 6 - Analyze the diagram

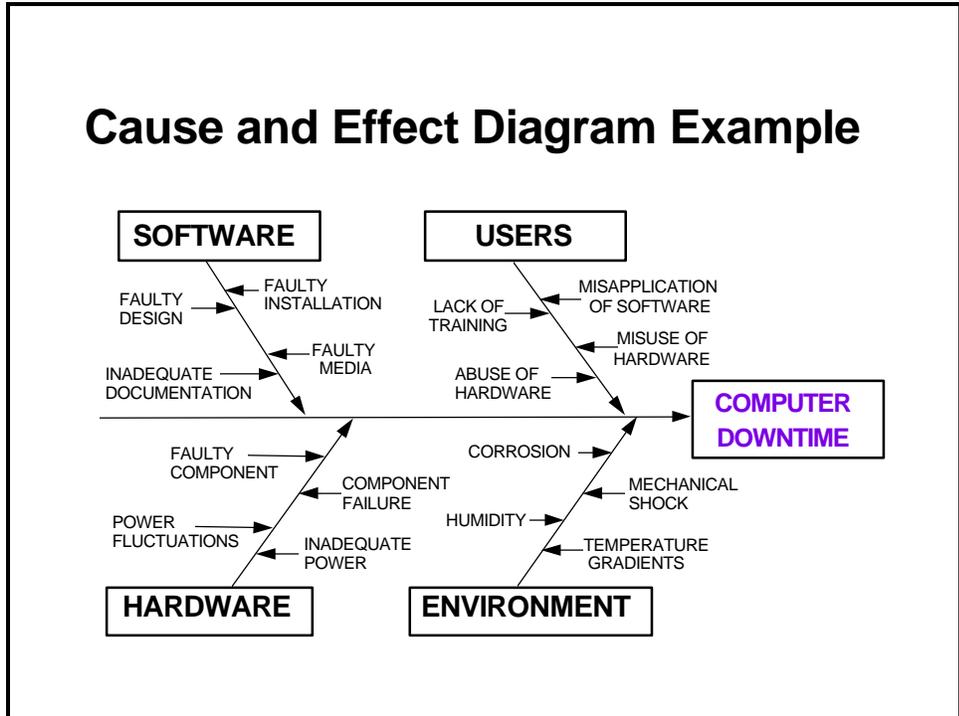
Analysis helps you identify causes that warrant further investigation. Since Cause and Effect diagrams identify only **possible causes**, you may want to use a Pareto Chart to help your team determine the cause to focus on first.

- ◆ Look at the “balance” of your diagram, checking for comparable levels of detail for most of the categories.
  - A thick cluster of items in one area may indicate a need for further study.
  - A main category having only a few specific causes may indicate a need for further identification of causes.
- ◆ Look for causes that appear repeatedly. These *may* represent root causes.
- ◆ Look for what you can measure in each cause so you can quantify the effects of any changes you make.
- ◆ Most importantly, identify and circle the causes that *you can take action on*.



**EXAMPLE:** Let's analyze the diagram we have been constructing.

- The level of detail is pretty well balanced.
- No causes are repeated.
- *Poor Maintenance* appears to be a cause for which you could develop measurements.
- Moreover, *Poor Maintenance* appears to be a cause that you can take action on. It is circled to earmark it for further investigation.



### Cause and Effect Diagram Example

This is an example of a cause and effect diagram that indicates possible causal factors of computer downtime in an organization. Notice the branches are labeled with appropriate tailored headers.

# Cause and Effect Diagram Exercise

## Cause and Effect Diagram Exercise

A practical exercise will enable your team to practice constructing and analyzing a cause and effect diagram.

 **Exercise:** Have each team construct a cause and effect diagram. Ensure each team follows the steps in constructing and analyzing their cause and effect diagram.

**Time: 20 minutes**

### **Other optional exercise topics :**

- What is causing the poor state of readiness of the fire control systems?
- What's causing our ship to drag anchor in heavy weather?
- What is causing us to fail our corrosion-control inspections?
- What factors affect the proper disposal of recyclable material on the base?
- What things do we need to consider in planning a perfect meeting?
- What factors affect the flow of information within our organization?
- What is causing the organization's vehicles to get poor gas mileage?
- What factors contribute to slow prescription service at the pharmacy?