LEANOhio

TOOL KIT

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LEANOhio Tool Kit for Improvement!

Welcome to the LEANOhio Tool Kit for Improvement!

Ohio state employees are using the best known methods to make government that works simpler, faster, better and less costly. Continuous improvement, Lean, and Six Sigma methodologies use a variety of tools to make improvements – big and small – for government's customers and Ohio citizens.

Inside this tool kit are detailed descriptions of the most often used tools you need to make significant improvements in your workplace. There are tools that help you to generate ideas, collect information, analyze and display data, reach consensus, and plan actions. You can use these tools as part of a formal process-improvement team, Lean Six Sigma projects, or an informal work group. These tools can even help you reach new levels of meeting effectiveness.

These tools represent the very best practices. They're routinely used in all world-class organizations because they work, and they're easy to use. You'll be amazed by the power of these simple tools! If you want the best results, then use the best practices. Make your LEANOhio Tool Kit for Improvement a routine reference source. It's a small book, but it can make a big difference in what you accomplish each and every day.

This tool kit was developed in collaboration with the Ohio Quality Network representatives.
Special thanks goes to OCSEA-AFSCME and SEIU 1199 for their leadership and contributions.

Table of Contents

Lean Six-Sigma

Lean Six Sigma is a systematic methodology to streamline process, reduce waste and deliver to the customer what the customer wants when the customer wants it. The Lean methodology focuses on streamlining processes and reducing waste including defects. The Six Sigma methodology utilizes information and statistical analysis to measure and improve operational performance, practices and systems to decrease process variation and prevent defects. The two complement each other and have overlapping synergies.

The Lean Six Sigma problem-solving method differs from the-way-we've-always-done it problem-solving in some key ways. In Lean Six Sigma nobody assumes that they know what is really causing the problem at the beginning of the project. All too often actions to improve are based on 100 hunches hoping that one hits the mark.

The Lean Six Sigma method shifts from "we've always done it that way" and gut theories to thoroughly defining and analyzing the problem to determine cause and effect relationships before improvement action is taken. The Lean Six Sigma method focuses on discovering root causes, validating those causes with data, and considering a range of solutions to test before acting. At the core of Lean Six Sigma is the DMAIC approach which provides a framework for improving existing business processes.

DMAIC is a systematic data-driven approach to improvement that focuses on improving, optimizing and stabilizing existing processes. DMAIC is shorthand for:

- **D**efine opportunities
- **M**easure performance
- **A**nalyze opportunity
- **I**mprove performance
- **C**ontrol performance

Define ("D" of the DMAIC model)
In the ***Define*** phase, the project team defines the purpose and scope of the project, the voice of the customer and the project goals. *Define* confirms that a DMAIC project is in fact appropriate. By defining clearly what you are trying to solve, you can dramatically improve the effectiveness of the problem solving process. The secret to defining the problem is really about attitude. Try to see every problem as an opportunity! *Define* also documents how the process is carried out. *Define* tools provide a way to frame your problem, to help you define what exactly the problem is, and why it is worth solving. Key tools are the project charter or project approval form (PAF) and process mapping.

Measure ("M" of the DMAIC model)
During ***Measure***, the focus is on collecting data to measure the existing system performance. It is critical to identify the appropriate process measures and gather sufficient baseline data so that once improvements are made, the impact can be verified empirically.

With this data the project team can begin to see some of the factors that may be affecting process performance.

Lean tools related to *Measure* involve creating graphs and charts that provide a visual representation of the data, including trends over time. The type of data will determine the type of visual tool that is used.

Analyze ("A" of the DMAIC model)
This step investigates the inefficiencies by finding and confirming the root cause using factual data. The question that the ***Analyze*** phase seeks to answer is "Why is this problem occurring?" or "What is the cause of the problem?" It is not possible to make improvements to the process until the causal factors are identified.

As in all phases of DMAIC, suspicions and hypotheses must be confirmed with data. Not only must the team confirm that these factors are present, they must also confirm that changes in these factors will substantially impact the outcome. The goal of *Analyze* is to determine root causes, which requires digging deeper than what is apparent on the surface.

Improve ("I" of the DMAIC model)
This step generates solutions to fix and prevent process problems, implementing solutions and verifying that the solutions result in substantial improvement. All of this is based on the data that has been analyzed rather than making decisions based on assumptions or preferences. Ideally proposed solutions will be tested and verified. A detailed implementation plan is developed as part of the ***Improve*** stage.

There are many tools that can be used during this stage of the process.

Control ("C" of the DMAIC model)
Key components of the ***Control*** phase include standardizing and documenting the new process, training, and creating a plan to monitor and measure performance in response to changes in the environment. This ensures that the gains obtained during the improve phase are maintained. Many of the tools used in *Control* are ones that have been used earlier. Specific to *Control* are Standard Work and Visual Management .

Following is a list of tools that are used at each phase of the DMAIC method. Some tools may be used in more than one phase, but they are listed here in the place they are either first used or most commonly used. All of these tools are listed alphabetically in the Tool Kit.

STAGES AND TOOLS TO USE IN DMAIC				
DEFINE	**M**EASURE	**A**NALYZE	**I**MPROVE	**C**ONTROL
Identifies the problem and develops a problem statement to solve.	Collects data to measure the existing system for inefficiencies, opportunities.	Analyzes the inefficiencies by finding the root cause.	Improves the existing system by generating solutions and implementing them.	Standardizes improvements and continues to measure performance.
Affinity Diagram Brainstorming & List Reduction Charter Criteria Rating Form CT Flowdown Nominal Group Technique Process Mapping SIPOC Surveys Trail Chart Weighted Voting Voices	Check Sheet Control Chart Histogram Run Chart TAKT Time	Benchmarking Cause & Effect (Fishbone Diagram) 5 Why Technique FMEA Force Field Analysis Impact Matrix/ PICK Chart Pareto Chart TIMWOOD	Action Register Balance Sheet Clean Sheet Redesign Five S GANTT Chart Impact Matrix/ PICK Chart Poke Yoke Tree Diagram	Control Chart Run Chart Standard Work Visual Management

Improvement Tools By Category

In addition to the DMAIC method, the tools in this toolkit can be used in a variety of other ways and settings. Here the tools are categorized according to purposes where they could be used.

GENERATING IDEAS
- Affinity Diagram
- Brainstorming & List Reduction
- Cause and Effect Diagram/Fishbone or Ishikawa Diagram
- Force Field Analysis

COLLECTING INFORMATION
- Check Sheet
- Interview
- Survey
- Run Chart
- Voices

PRIORITIZING
(see also Decision Tools)
- Impact Matrix/PICK Chart
- Nominal Group Technique

ANALYSIS TOOLS
- Flow Chart
- Process Mapping
- Five "Why" Technique
- CT Flow down
- SIPOC
- TIM WOOD

ANALYZING AND DISPLAYING DATA
- Control Chart
- Histogram
- Pareto Chart
- Run Chart
- Scatter Diagram
- Takt Time

DECISION TOOLS
- Balance Sheet
- Criteria Rating Form
- Force Field Analysis
- Nominal Group Technique
- Weighted Voting

PLANNING TOOLS
- Action Register
- Charter (PAF)
- FMEA
- Gantt Chart
- PERT Chart
- Tree Diagram

CREATING OR IMPROVING A PROCESS
- Affinity Diagram
- Clean Sheet Redesign
- Five S
- Poka Yoke
- Control Plans
- TRAIL Chart
- Visual Management

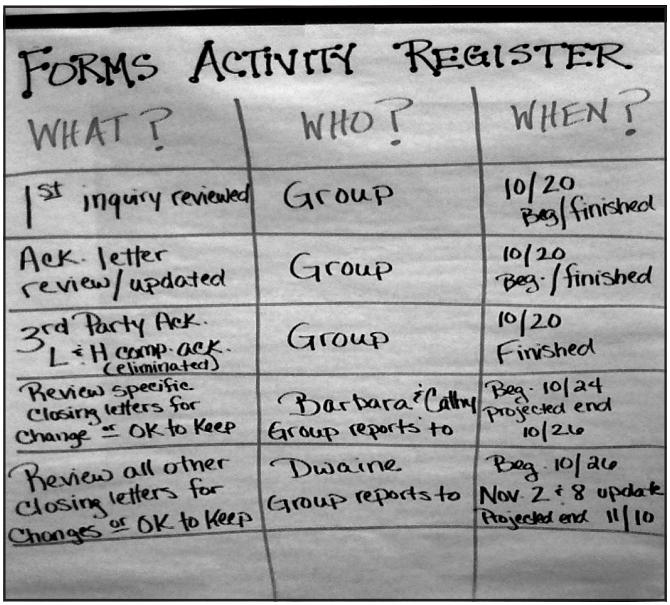
Action Register

*...Tool for **Improve***

The ***Action Register*** is a powerful tool used to document critical tasks, ownership responsibilities, and target completion dates. Action Registers provide transparency to the work being performed and completed. It is recommended that the Action Register be located in a common, central area as a highly visible accountability reminder to team members. For this reason, Action Registers can be scribed on large poster paper and hung on a wall. Typically action registers are used to plan follow-up action on an improvement, but also can be used as a follow-up for meetings.

The simplest Action Register contains just three columns:

1. ***What?*** *(action)*
2. ***Who?*** *(owner)*
3. ***When?*** *(deadline)*



FORMS ACTIVITY REGISTER

WHAT?	WHO?	WHEN?
1st inquiry reviewed	Group	10/20 Beg/finished
Ack. letter review/updated	Group	10/20 Beg./finished
3rd Party Ack. L+H comp. ack. (eliminated)	Group	10/20 Finished
Review specific closing letters for change or OK to keep	Barbara+Cathy Group reports to	Beg. 10/24 projected end 10/26
Review all other closing letters for changes or OK to keep	Dwaine Group reports to	Beg. 10/26 Nov. 2+8 update Projected end 11/10

Some Action Registers may further define the “When?”- (due date) column into two separate columns: the “***target date***”; and the actual “***completion date***”.

Action Registers may also include a “***comment***” column so team members can add important notes.

An alternative to the simple 3-column What/Who/When Action Register (pictured above) is a five column Action Register (pictured below):

1. ***The Action:*** *Define the task or assignment that is to be completed.*
2. ***The Owner:*** *Assign an owner* as *the person(s) responsible* for completion of the Action.
3. ***Target Date:*** *Set a target date for when the Action is to be completed.*
4. ***Completion Date:*** *Record the completion date* to show that the *Action* is finished.
5. ***Comments:*** *Add some notes to each Action to provide more clarity.*

LICENSING COMMUNICATION PROJECT for BUSINESS ENTITIES with SEPTEMBER 30TH EXPIRATION DATES				
ACTION	**OWNER**	**TARGET DATE**	**COMPLETION DATE**	**COMMENTS**
90-day certified letter	Michael	Mail on June 30th	July 2nd	Mailroom unable to deliver the entire job to the post office on June 30th due to complexity of certified mail receipt process
60-day post card	Sebastian	Mail on July 30th	July 30th	
30-day letter	Nicolina	Mail on August 30th	August 30th	
2-week E-blast	Carmen	Batch 1,000 per day beginning on August 13th until done	August 15th	There were just under 2,988 e-mails sent; 333 bounces

Action registers can be transcribed to an electronic format if all the team members have common access. Action Registers become the focal point of every meeting for many successful leaders. Action Registers are a simple, but extremely practical and useful tool!

Affinity Diagram

*...Tool for **Define***

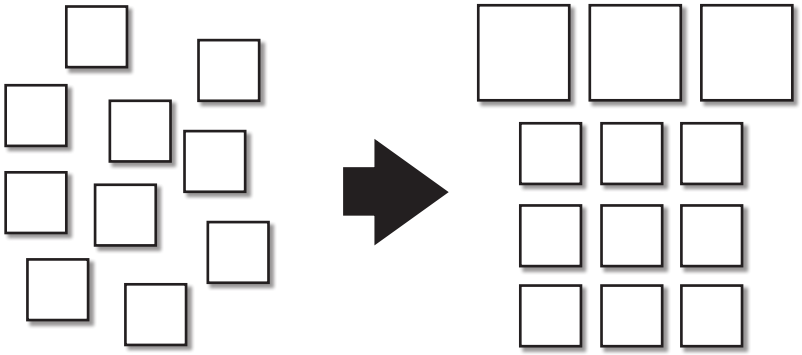
Affinity Diagram is a planning tool for brainstorming and then organizing ideas. It is designed to sort a large number of ideas, process variables, concepts, and opinions into naturally related groups. This tool helps to synthesize large amounts of data by finding relationships between ideas and can help support decision-making. Affinity diagrams can be used to:

- Identify an improvement project idea
- Brainstorm root causes and solutions to a problem
- Draw out common themes from a large amount of information
- Discover previously unseen connections between various ideas or information

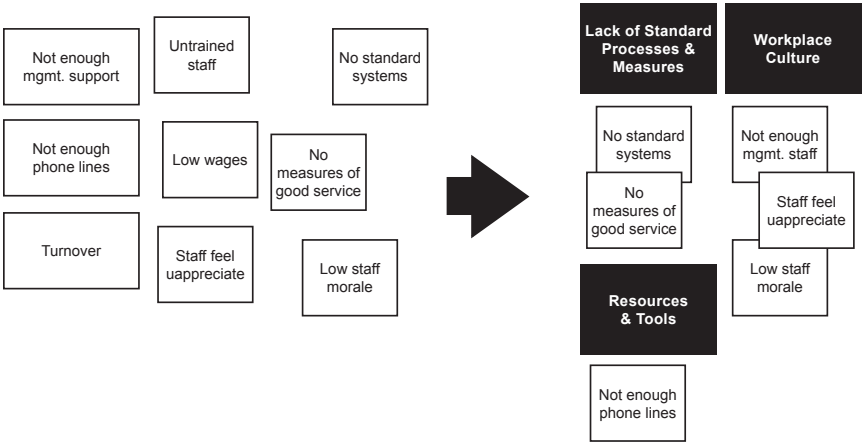
An affinity diagram starts to group ideas into themes. From the chaos of randomly generated ideas comes an insight into the common threads that link groups of them together. From there the best idea or solution often emerges.

Putting it to work

1. Identify the issue to be considered. Write it in concise and clear terms using 3-7 words on a flip chart so all can see. For example: What do our customers want from us? Or How do we ensure implementation of our project? Discussion will help the team to come to consensus on the exact phrasing.
2. Brainstorm ideas that address the issue identified. Remember that in brainstorming the quantity of ideas is more important than the quality – no judgments! Each person records one idea per Post-It Note. Be concise and thorough; express ideas in 3-5 words. Post all ideas on the wall randomly.
3. Silently, team members sort post-its into groupings that are related in some way. Post-It Notes may move back and forth between groupings until the final 5 -10 groupings emerge.
4. If some ideas do not fit into any theme, separate them as “stand-alone” ideas. If some ideas fit into more than one theme, create a duplicate Post-It and put it in both groups
5. Now you can talk! Discuss each grouping and identify the main idea or theme of that grouping. Place a “header” Post-It stating that idea or theme at the top of each group, again using 3-5 words. Do one last sort looking for groupings that are related and could be joined. Create a “superheader” for each of these. Limit the total number of themes to between five and nine.



Why is Customer Service Substandard?



Balance Sheet

*...Tool for **Improve***

Balance Sheets allow a group to identify and review the pros and cons of various options. Like the other tools for reaching consensus, balance sheets won't make decisions. They will, however, organize the information and facilitate discussion among group members. Balance sheet supports decision-making.

Putting it to work

1. Using a flip chart or marking board, set up a large grid consisting of three columns and a row for each of the options being discussed.
2. Label the columns + and - (or "pros" and "cons").
3. The team then "fills in" each cell of the grid, brainstorming and reaching consensus on positive and negative aspects for each option.

Example:

The balance sheet shown here was used to identify the pros and cons of three methods of training. Analysis and discussion of the balance sheet can help teams to make decisions and to identify ways to address barriers or cons.

METHOD	PROS +	CONS -
Classroom	• Highly interactive • Synergy from others/ dialogue with others • Immediate in-class feedback from instructor and participants • Immediate answers to questions in class	• Expensive • Rigid, not flexible • Work at the pace of the instructor • Could be a boring instructor • Inflexible time - must go when offered
On-Line (E-Learn)	• Time flexibility • Immediate electronic feedback • Can be done at home or anywhere • Go at own pace • Could be inexpensive for the participant	• Could be expensive • Might be forced to do at home • No immediate feedback from instructor • No dialogue or exchange of ideas
Book/ Independent Learning	• Time flexibility • Go at own pace • Do anywhere • Inexpensive for the learner	• No dialogue or exchange of ideas • May never finish • Some people are not book learners • No mechanism for instructor feedback

Basic Statistics
*Tool for **Measure***

To use data to make decisions, it must be turned into information. Many of the improvement tools in this book do just that. To use these tools effectively we need to start with some basics about data and how to interpret it.

Types of Data
Before data collection starts, classify the data into different types: Continuous or Discrete.

This is important because it will:

- Provide a choice of data display and analysis tools.
- Dictate sample size calculation.
- Provide performance or causal information.
- Determine the appropriate charts to use.
- Determine the appropriate method for calculation of standard deviation.

Continuous or variables data is measured on a continuum or scale. Usually continuous measures can be divided into parts and still make sense. For example:

- Time can be divided into days, hours, minutes, or seconds (cycle time)
- Money can logically be divided or specified in increments (sales, costs, losses)

Discrete, categorical, or attribute data are things that can be counted or have yes/no answers. For example:

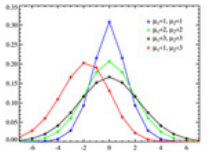
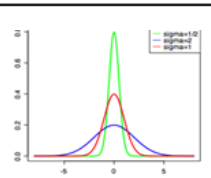
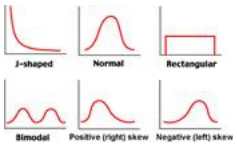
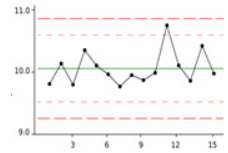
- Number of defects, approved/disapproved, pass/fail, met customer requirement/did not meet customer requirement
- Categories (days of the week, locations, type of customer, type of product, risk - low/medium/high).

Distribution: Four Key Characteristics of Data

To turn data into information and use it for decision-making, there are some key concepts or characteristics about the data that must be examined. Any set of data will have values that distribute across the measurement scale. This is called a data distribution, or simply "distribution." Except in the rarest of circumstances, data will vary…even when nothing in the process seems to be changing. Knowing the data type and distribution is critical to choosing the right statistical tools to interpret what the data is telling you. These data characteristics are:

- Center: Mean, Median, Mode
- Spread (Variation): Range, Standard Deviation, Variance
- Shape: Normal curve, Skew
- Stability over Time: Control Charts, Run Charts

Here is a table to help distinguish these key characteristics.

The Key Characteristics of Distribution			
Center • Mean • Median • Mode	Where on the measure scale does the data appear to gather or "clump"?	What is the center of the data?	
Spread • Range • Variance • Standard deviation	How does the data distribute around the center?	What is the spread of the data?	
Shape • Normal curve • Skew	What values are more frequent and less frequent?	What is the shape of the data?	
Stability over Time • In control • Out of Control	How do the above characteristics behave over time?	What is the stability of the data?	

Measurements of Center

- **Mean:** The mathematical average of a set of data point values. (Sum of all data points/number of data points).
- **Median:** The middle data point when the data is sorted by value, where 50% of the observed values are below and 50% are above. If there is an even number of data points, then average the two points in the middle.
- **Mode:** The most frequently occurring data point value.

Spread examines the variation or wideness of the data distribution. Measures of variation include:

- Range
- Variance
- Standard Deviation

Range: is the difference between the largest and the smallest data point values.

- Range = Maximum Value - Minimum Value
- The purpose is to measure the dispersion (range) between the highest and lowest values of a data set.

Variance is the average of the squared differences from the mean. To calculate the variance, follow these steps:

- Work out the Mean (the simple average of the numbers).
- Then for each number: subtract the Mean and square the result (the squared difference).
- Then work out the average of those squared differences.

Standard Deviation: Deviation means the distance from normal. It is the distance between a data point value and the mean. Deviations for each data point will be used to calculate and describe the variation in a set of data. The Standard Deviation is a measure of the average dispersion about the mean or how the data are spread. Understanding Standard Deviation is essential to using the tool Control Chart (page 31).

The symbol for standard deviation (SD) is **σ** (the Greek letter sigma)
The formula is easy: it is the square root of the variance.

"Population Standard Deviation": $$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i-\mu)^2}$$

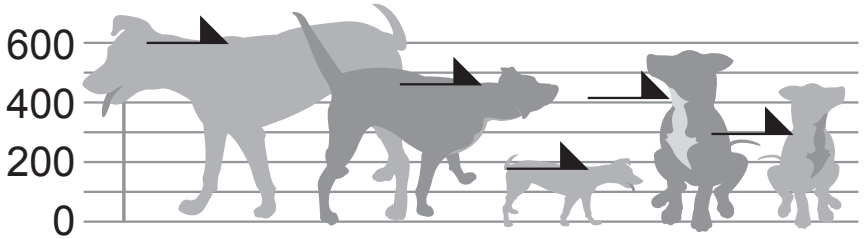
Population data means that the measures are for a distinct actual population , represented in the formula by **N**.

Sample data means that the measures are a selection taken from a larger population of data and the calculation is corrected by using **N-1**.

"Sample Standard Deviation": $$S = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(x_i-\bar{x})^2}$$

Example: from (*http://www.mathsisfun.com/data/standard-deviation.html*)

You and your friends have just measured the heights of your dogs (in millimeters, at the shoulder). We will use only this group of your dogs for our example, so this is a **population data set**. (If you were to use this group as representative of the entire population of dogs, then this would be a **sample data set**.)

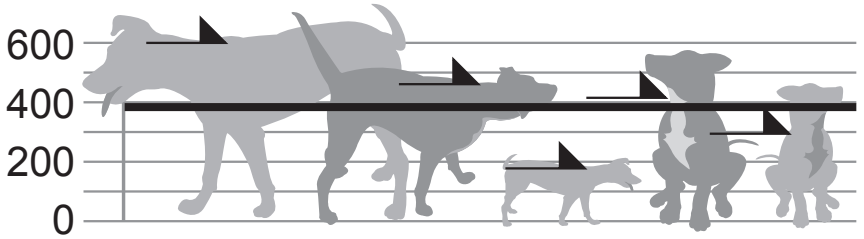


The heights (at the shoulders) are: 600mm, 470mm, 170mm, 430mm and 300mm.

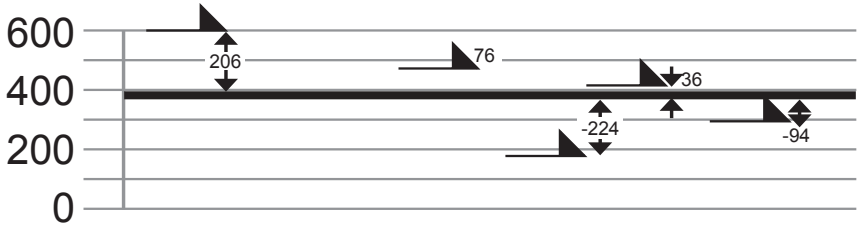
To find the mean:

$$\text{Mean} = \frac{600 + 470 + 170 + 430 + 300}{5} = \frac{1970}{5} = 394$$

so the mean (average) height is 394 mm. Let's plot this on the chart:



Now, we calculate each dogs' difference from the Mean:



To calculate the Variance, take each difference, square it, and then average the result:

$$\text{Variance: } \sigma^2 = \frac{206^2 + 76^2 + (-224)^2 + 36^2 + (-94)^2}{5}$$

$$= \frac{42{,}436 + 5{,}776 + 50{,}176 + 1{,}296 + 8{,}836}{5}$$

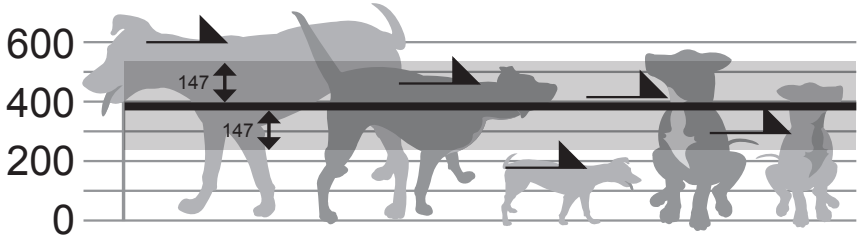
$$= \frac{108,\ 520}{5} = 21{,}704$$

So, the Variance is **21,704**.

The Standard Deviation is just the square root of Variance, so:

Standard Deviation: **$\sigma = \sqrt{21{,}704} = 147.32... = 147$** (to the nearest mm)

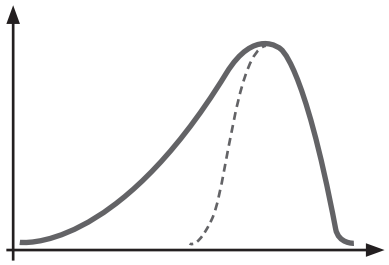
And the good thing about the Standard Deviation is that it is useful. Now we can show which heights are within one Standard Deviation (147mm) of the mean:

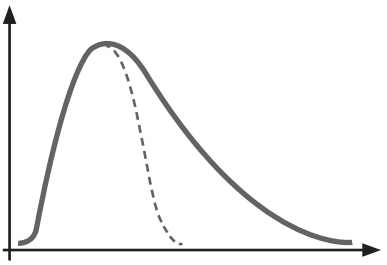


So, using the Standard Deviation we have a “standard” way of knowing what is normal, and what is extra large or extra small.

Shape
Examining the shape of the data gives you more information about how "normal" the distribution of the data is. Normal variation will look like the standard bell curve.

Skewness refers to a lack of symmetry. Normal distribution has no skew. A distribution is skewed if one tail extends farther than the other and this requires further investigation.





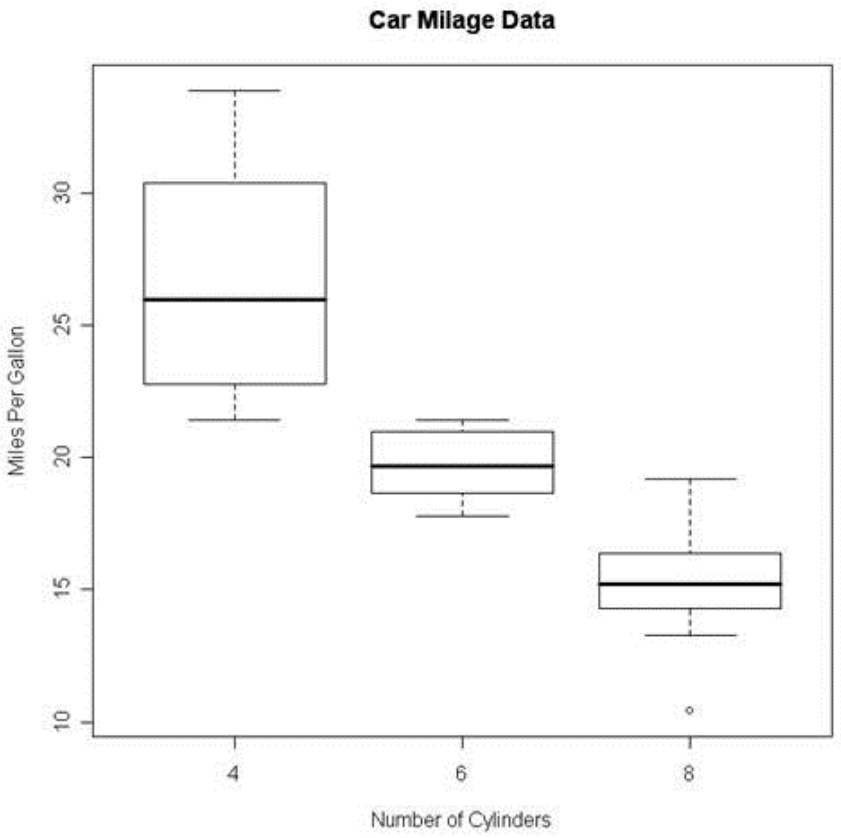
Stability
It is important to know if the process is changing over time. Are there any trends, clusters, oscillations, etc?. A stable process is free of assignable causes of variation which indicates that the process is in control. A process that is out of control has special causes of variation which must be investigated. A process must be in control (have only common cause variation) before it can be improved. Run Charts and Control Charts will help determine if the process is stable. See Control Chart and Run Chart tools for more information.

Box Plots

*...Tool for **Measure***

Box-and-Whisker plots use five key data points to graphically compare data produced from different sources.

- Ends of the box are the first and third quartiles.
- The **median** forms the centerline within the box.
- The high and low data points (illustrating the range) serve as end points to lines that extend from the box (the whiskers). Each whisker (including outliers) contains 25% of the data.
- The box serves as the middle half of the data containing 50% of the distribution.
- Asterisks or diamonds represent data outside the range (outliers).



Putting it to Work
Creating Box-and-Whisker Plots

1. Write the data in rank (numerical) order.
2. Calculate the median.
3. Identify the lower quartile (values below the median) and determine the median for that group.
4. Identify the upper quartile (value above the median) and determine the median for that group.
5. Plot the three quartiles, the lowest value, and the highest value (the 5-points) to a number line.
6. Draw a box through the points of the upper and lower quartiles.
7. Draw a vertical line through the box at the median point.
8. Draw the whiskers from each end of the box at the median point.

Box-and-Whisker Plots Benefits:

- Explores data and draws informal conclusions when two or more variables are present.
- Visually represents the center, the spread, and the overall range.
- Provides a graphic summary of a data set.
- Indicates if the distribution is skewed and offers possible unusual observations.
- Is useful with large number of data sets.
- Shows outliers.
- Helpful when comparing either two non-normal datasets or when at least one is non-normal in a comparison.

Use When:

- Analyzing important characteristics about the data set.
- Comparing two or more sets of data.
- Determining significance in an apparent difference.
- Lacking sufficient data for a histogram (< 30 data points).

Brainstorming
*...Tool for **Define and Improve***

Brainstorming is a powerful way to generate input. Working in a team setting, people express their ideas the moment they think of them. Brainstorming is an informal process in which:

- No one evaluates the ideas as they are announced.
- Creativity is important. Wild ideas are encouraged.
- People build on the ideas of others.
- Everyone strives for quantity. The more ideas, the better!
- Ideas are public; they go on chart paper visible to all.

Putting it to work
The team leader (or facilitator) presents the topic for which ideas are sought. The wording should encourage specific, tangible ideas — not abstract or vague thoughts. Make sure everyone on the team understands the topic that's the focus of the brainstorming, as well as the process to be followed.

There are many methods of brainstorming. The most familiar is **freewheeling**, in which:
- Group members call out their ideas spontaneously.
- The scribe records the ideas as they are suggested.

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 brainstorming.

The **slip method (aka silent brainstorming)** differs markedly from the other two approaches:
- The leader asks members to write down their ideas on small slips of paper or index cards or Post-It Notes.
- The ideas are then collected and organized.

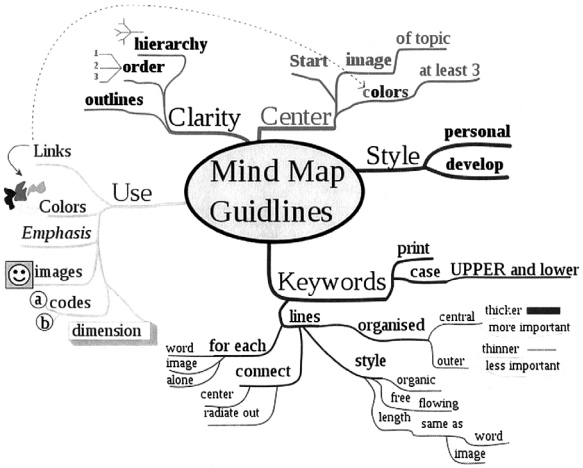
Reverse brainstorming helps you solve a problem by using reversal techniques:
- Clearly identify the problem or challenge, and write it down.
- Start with one of two "reverse" questions:
  - "How could I possibly cause the problem?"
  - "How could I possibly achieve the opposite effect?"
- Brainstorm the reverse problem to generate reverse solution ideas.
- Once you have brainstormed all the ideas to solve the reverse problem, now reverse these into solution ideas for the original problem or challenge.
- Evaluate these solution ideas.

Carousel brainstorming allows for new ideas to be generated through movement and conversation:

- Generate X number of questions for your topic and write each question on a separate piece of poster board or chart paper. (Note: The number of questions should equal the number of groups).
- Post question sheets around the room.
- Divide team into groups of 5 or less.
- Direct each group to stand in front of a question station. Give each group a colored marker for writing their ideas at the question stations (use a different color for each group).
- Inform groups that they will have 2-3 minutes to brainstorm and write ideas at each question station.
- When time is called, groups will rotate to the next station in clockwise order.
- Using a stopwatch or other timer, begin the group rotation. Continue until each group reaches their last question station.
- Before leaving the final question station, have each group select the top 3 ideas from their station or summarize the information to share with the entire group.

Mind mapping is a simple technique for drawing information in diagrams, instead of writing it in sentences:

- Generate a topic.
- Place that topic in the center of the page.
- Start writing/drawing what comes to mind and continue branching.
- Repeat branching until all ideas appear.
- When finished, carefully examine any connections.
- Use visual images rather than words where possible.
- After brainstorming, other tools can be used to determine the most important ideas.



List Reduction (Used with Brainstorming)

*...Tool for **Define and Improve***

This tool helps in processing the output of a brainstorming session. The objective is to clarify the items so that all team members understand them and then reduce the items to a manageable number.

Putting it to work

1. Before the list of items (for example, potential problems or solutions) can be reduced, everyone in the group must have a clear understanding of each item. The first activity, therefore, is to review the items, asking if anyone needs clarification. If so, the suggester should be asked to explain the meaning of the item. The discussion shouldn't go beyond simple clarification at this point.

2. The team then identifies some "filters" — criteria that should be satisfied for an item to remain in consideration.

   Some filters for selecting problems are:

   - Does this problem lend itself to being solved by a team?
   - Is the problem within our control or influence?
   - Is it worth solving?

   Some filters for selecting solutions are:

   - Is it likely to solve the problem?
   - Is it feasible?
   - Can we afford it?

3. Keeping the agreed upon criteria in mind, group members vote on each item: "yes" if it satisfies the criteria, "no" if it doesn't. A simple majority (one-half the number in the group, plus one) keeps an item on the list; fewer votes mean the item is bracketed.

4. Items are bracketed, rather than crossed out, so the team can go back to them later if necessary. In general, the group focuses on — and continues to evaluate — only the non-bracketed items on the list. However, since group members have not had an opportunity to discuss any of the suggestions on the list, an individual member may request that a particular item remain under consideration until all have been discussed.
5. The process may be repeated, with different or more stringent criteria, until the list is reduced to about a half-dozen options. This represents a manageable number of options for applying some of the other evaluative tools.

Example:

A maintenance team used list reduction to trim its brainstormed list of potential problems. Team filters included:

- Cost effective.
- Important to entire team.
- Able to implement quickly.
- Positive impact on quality.

Below is their final list. Note that the team has narrowed its focus to just two items.

[1. Lack of work available.]
[2. Inadequate work tables.]
[3. Bad lighting.]
4. Lack of incoming quality control.
5. Process out of date.
[6. Lack of safety precautions.]

Cause-And-Effect aka, Fishbone Diagram or Ishikawa Diagram
*...Tool for **Analyze***

The key to problem solving is finding the root cause. The Cause-and-Effect Diagram, developed by Kaoru Ishikawa in 1982, offers a systematic way to brainstorm the various factors that may be causing a problem. It prompts people to ask: *Why is this occurring?* As the diagram is developed, more and more potential causes come to light.

This tool is sometimes called a "fishbone diagram" because it takes the shape of a fish. The effect (the problem) is the "head" of the fish. Leading from this is the "backbone" and connected to this are the "main bones" which represent major categories of causes. Commonly used categories include: People, Process (or methods), Equipment, Materials and the Environment. These categories are only suggestions; you can use any major categories the team deems appropriate.

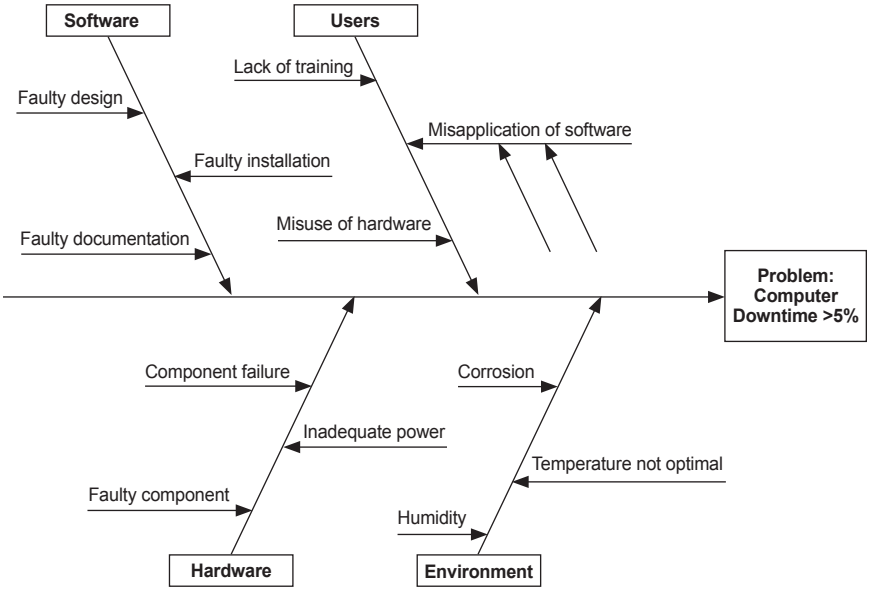
Putting it to work
Follow these steps when creating a cause-and-effect diagram:

1. Decide on the effect (problem) to be analyzed, being sure it's specific, well-understood and agreed to by everyone. Write it in a box on the right side of the flip chart or marking board; this is the "head of the fish."
2. Next, draw a horizontal line from the head across the paper, with several "major bones" drawn on a slant. At the end of each bone, write one of the major categories that contribute to the effect.
3. Brainstorm specific causes. Attach each specific issue to an appropriate category. Whenever possible, break down the specific cause into sub-causes by using the "5 Whys" tool to get to the root cause.
4. In most cases, it's not important where a cause is placed on the diagram. If in doubt, put it in more than one place. The important point is that it's identified.
5. To determine the validity of possible causes, verify your ideas with data.

Here are some additional tips:

- The cause-and-effect diagram can be useful when displayed publicly and people are invited to contribute. Think of this as a large-scale brainstorming effort.
- When creating the diagram, try to use as few words as possible. This will require team members to focus their ideas.

Example:
As you can see, the diagram does indeed have the shape of a fish. The effect is on the right, and the causes form the 'bones' of the fish. Note the four main categories of causes and then the causes identified on each of the bones. The next level of analysis will ask what's causing those causes which will be identified using lines coming off of each of those items.



Check Sheet

*...Tool for **Measure***

The ***Check Sheet*** is an easy-to-use tool for collecting data in a consistent, structured way. Most common check sheets are arranged in columns or in matrices, with the categories listed on the left side and space on the right to make tally marks. The collected data can be analyzed with other tools such as control charts, Pareto charts and histograms. All sorts of data can be tracked using check sheets, including:

- Frequency of occurrence — by unit, program, level, work area, etc.
- Length of time it takes to get something done
- Cost of a repeated operation over a period of time
- Impact of an action over a period of time

Check sheets are highly recommended when data are to be collected or organized to establish a base from which to measure improvement. They are also helpful when different people will be collecting or using the data, because the check sheet format involves a high level of standardization.

Putting it to work

1. Decide what you need to know. In other words, what data do you need to track?
2. Determine whether the information exists or if it needs to be collected.
3. Discuss and decide on the most reliable way to collect the information you need. As you do this, you'll be creating the appropriate matrix headings.
4. Decide who will collect the information, for how long, and from what sources.
5. Finalize the check sheet format.
6. Conduct a pilot test of the check sheet to see if it meets everyone's data-gathering needs.
7. Make any revisions to the check sheet, and if necessary, conduct another pilot test. Otherwise, begin using it on a full-scale basis.

Important Tips

Information on a check sheet is usually collected in categories: by work unit code, branch, date, shift, sub-process, and so on. When creating a check sheet, make sure categories are logical and easily understood. This is important not only for the people who will be interpreting the gathered data, but also for those who use the check sheet to collect the data. They should not have to make difficult judgments about when and where to enter a check mark on the form.

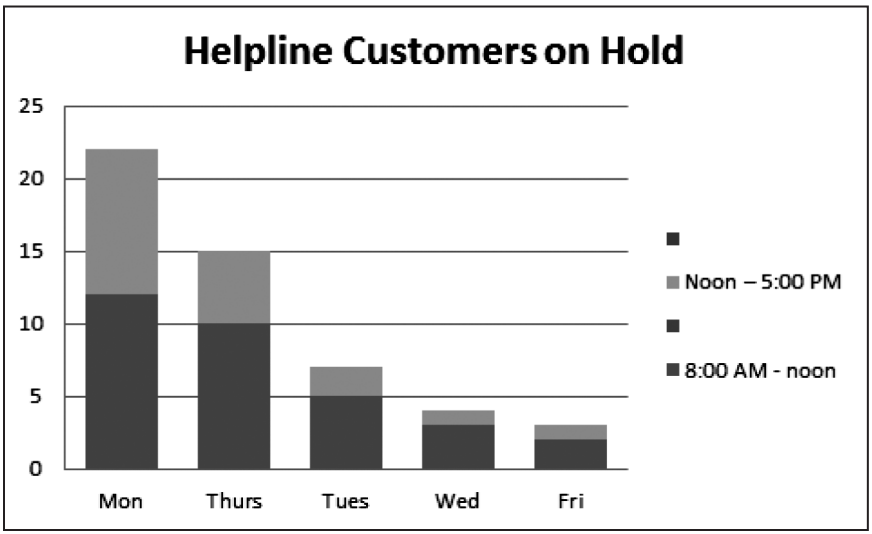
- Have clear instructions on what's to be collected and how.
- Keep it simple! Use clear, easily understood language. Be sure that the people who are using the check sheet to collect data know what you want and can ask for clarification if needed.
- When asking a group to use a check sheet, give them the bigger picture. Let them know why this is important. Later in the process, keep them informed on what you do with the data.

- Remember, you can also make check sheets from data you already have. Sometimes it's not necessary to collect new data.
- Make sure that 'bad news' is okay. In other words, there shouldn't be any pressure for people not to record 'bad' information or to skew the information as it comes in. What you are looking for here are just the facts.

Example:
Below is a check sheet prepared by a telephone coverage team. Their objective is to track the number of callers who had to wait 'on hold' when calling a help line.

Problem: Number of callers on hold when calling the help line			**Name of data collector:**			
Location			**Date:**			
	Mon	Tues	Wed	Thur	Fri	
8:00 AM - noon	𝍸 II IIII	𝍸	III	𝍸 𝍸	II	32
Noon – 5:00	𝍸 𝍸	II	I	𝍸	I	19
Totals	22	7	4	15	3	41

For visual impact the check sheet can easily be turned into a Pareto Chart. Depending on the type of check sheet you construct, the data may also be used to create a run chart, control chart, or histogram.



Clean Sheet Redesign

*...Tool for **Improve***

Clean Sheet Redesign begins when you have understood the process and identified waste to eliminate.**(TIM WOOD)** The goal of clean sheet redesign is transformational; not to marginally improve an old process, but to create a new process that's **significantly** better than the old one. This means putting aside the "as is" model and developing a new one that:

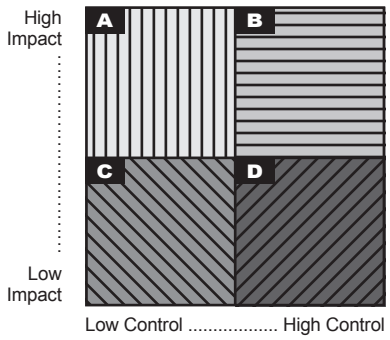
- Reduces process steps, cost, time by 50%.
- Delights the customers of the process.

There are some basic work structure principles to use when creating a new process.

- Design the process around value-adding activities.
- Work is performed where it makes the most sense.
- Provide a single point of contact for customers and suppliers.
- If inputs coming into the process naturally cluster, create a separate process for each cluster.
- Ensure a continuous flow of the "main sequence."
- Reduce waiting, moving, and rework time.
- Reduce or eliminate batching.
- Reduce checks and reviews.
- Push decision-making down to the lowest reasonable level.
- Build quality in to reduce inspection and rework.

To begin:

1. Brainstorm improvement ideas based on eliminating TIMWOOD and the above principles.
2. Categorize the ideas based on the impact the improvement would have and the control or influence the team has to be able to make the changes.



3. Examine the items in each category. Categories B and D are things that are in your control to implement. There might be some quick wins in either of these categories, but you do want to focus most of your efforts on Category B – those that will also have a bigger improvement impact.
4. Design from scratch a new transformative process using **Process Mapping**.

After categorizing the ideas, examine the items in each category. Categories B and D are things that are in your control to implement. There might be some quick wins in either of these categories, but you do want to focus most of your efforts on category B – those that will also have a bigger improvement impact.

Control Chart

*...Tool for **Measure and Control***

(**Note**: See **Basic Statistics** on page 14 for more information.)

A **Control Chart** can be considered a road map of…

- Where you have been.
- Where you are.
- Where you may be headed.

A control chart is a run chart (line graph) that tracks the performance of a process over time and applies statistically determined upper and lower control limits. Control charts are used to show the variation of a process, distinguishing between common causes and special causes of variation. Common causes of variation are those data points that fall between the control limits which mark the statistically normal distribution. Special causes are when data points fall outside of the control limits. A process is said to be stable or "in control" when only common cause variation exists. Likewise, a process is unstable or "out of control" when special causes of variation exist.

Control Chart allows you to visually see how your process varies within the control limits and observe if the variation within the data is common cause or special cause. Every process inherently has some variation (or noise) - control charts allow the user to know when the variations in the data are common cause or special cause. With a control chart, you can:

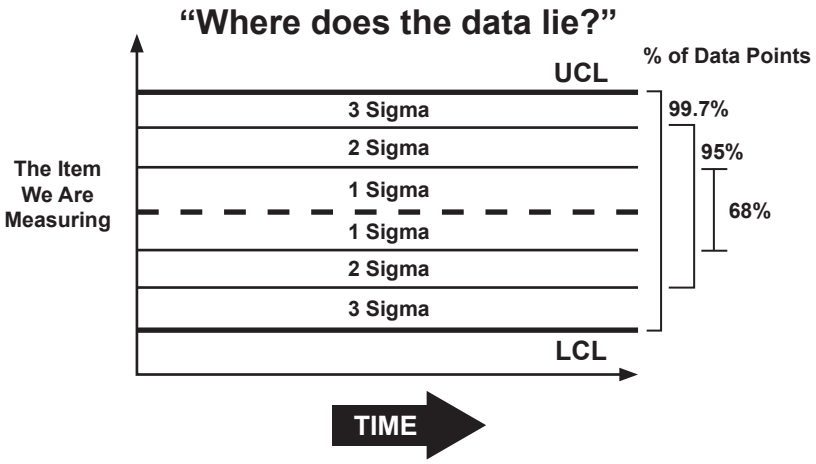
- Find out a system's capacity so that normal variations are not misinterpreted as significant, thus causing tampering with results.
- Detect non-random variation in a process or "special causes" of variation (those that fall outside of the control limits) or when a process is "out of statistical control."
- Know when changes have actually improved the system.
- Monitor the system after improvements have been made.

There are different kinds of control charts based on the kind of data that you have. Most teams in state government measure items like time to process an item or the number of items produced in a given time period or the number of errors - single data points tracked over time. Therefore X charts and Individuals charts are the most commonly used.

Process Control Limits are calculated based on data from the process itself. They are based on +/- 3 Standard deviations (SD) on either side of the Mean (average). (99.73% of the process variation is expected to fall between these limits – the Upper and Lower Control Limits or UCL and LCL

There are two types of variation – Common vs. Special

Common Cause (Noise)	Special Cause (Signals)
▪ Present in every process ▪ Produced by the process itself (it is the way we do business) A process is stable, predictable, and In-control when only common cause variation exists in the process.	▪ Unpredictable ▪ Typically large in comparison to Common Cause variation ▪ Caused by unique disturbances or a series of them ▪ Can be removed/lessened by basic process control and monitoring A process exhibiting special cause variation is said to be out-of-control and unstable.



Control Charts Characteristics:

The data needs to be charted in chronological order. Please note that product or customer specification limits are **not** found on the control chart. These are determined using a different process. There are several types of control charts that can be utilized based on the type of data. For the purpose of this example we will look at one of the most common control charts that utilizes on continuous individual data points: The Individual Control Chart.

The importance of the individual control chart is to determine if the process is in control by seeing if special causes are present. Special cause variation indicates uncontrolled

factors are influencing your process. Eliminating the influence of these factors will improve the performance of your process, and bring it into control.

Putting it to work:

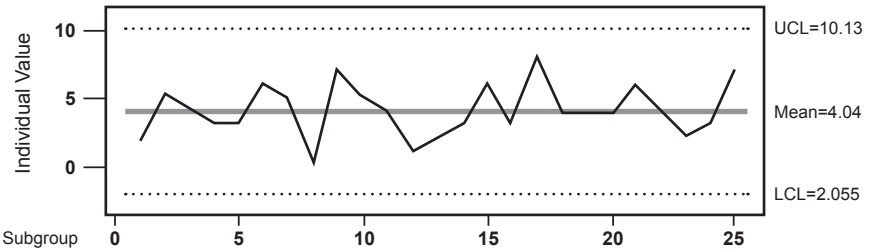
Creating an Individual Control Chart:

1. Start with data collected on a run chart. You need at least 30 data points, charted in chronological order.
2. Calculate the mean value (average of all the data).
3. Calculate the standard deviation (SD) for your data.

$$\sigma = \sqrt{\frac{\sum_{i-1}^{N} (x_i - \mu)^2}{N}}$$

4. Calculate the Upper and Lower Control Limits (UCL and LCL) which indicate the threshold at which the process output is considered statistically 'unlikely' and are drawn at 3 standard deviations from the center line (+ or – 3 SD).
5. Mark these points on the vertical axis and draw horizontal lines from their respective values. For clarity use a thick horizontal line for the average and dotted lines for the control limits.

See the graph below as an example of an Individual control chart:



Interpret the chart

Check to see if the process is stable or "in control" – in other words, whether the data break any of the four main rules. If there are data points that break the rules, this "special cause" should be investigated and addressed. Everything else is normal variation.

Control Chart Rules: Rules of Detection
When one of these rules is broken, we say that the process is "out of statistical control." Although there are many rules the ones most often used are:

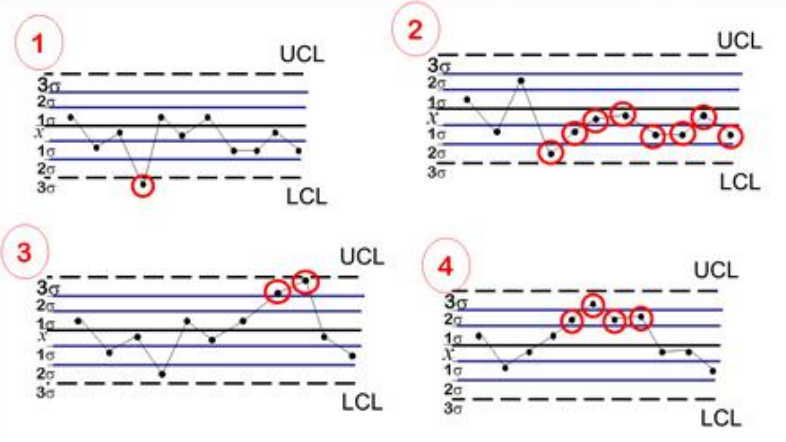
Rule 1: One point more than 3 sigmas(SD) from center line.

Rule 2: Nine points in a row on the same side of center line.

Rule 3: Two out of three points more than 2 sigmas (SD) from center line (same side).

Rule 4: Four out of five points more than 1 sigma (SD) from center line (same side).

Pattern Rule: A pattern repeats itself: Identify any non-random or cyclical patterns.



Control Charts will not pinpoint what or why something has changed, but they can help show the real story including special vs. common cause variation. If your chart breaks one of these rules, additional investigation into the special cause should be conducted.

Control Charts can be used in:

- **Measure** phase to separate common cause variation from special cause variation;
- **Analyze & Improve** phase(s) to ensure process stability before completing a hypothesis test; and
- **Control** phase to verify the process remains in control after making improvements.

Control Plans
...Tool for **Control**

Control Plans are about holding the gains. Control plans exist to ensure the process consistently meets customer requirements. They should provide predictive information, so adjustments can be made before defects or issues arise. Formal control plans are one of the major differences between Six Sigma and other previous quality initiatives.

Control Plan Elements

- *Who is going to keep the process functioning properly?*
- *When will monitoring of the input variables occur?*
- *How will the input variables be monitored?*
- *When will the plan be updated?*
- *Where will the monitoring be conducted?*
- *Where should the plan reside?*
- *What will be done if the monitoring detects a condition outside of the customer's specifications?*

Putting it to Work

Control Phase Deliverables

1. Prepare control plan: Capture all of the elements of what will make the process improvements last.
2. Plan for measurement displays – visual management.
3. Prepare process documentation: These are the instructions about how the job should be performed.
4. Prepare implementation plan: Detail how the rest of the project's gains will be achieved:
   a. Updated improvement activities.
   b. Process documentation & training.
   c. Process monitoring (i.e. dash board).
5. Prepare transition communication plan; Indicate how the responsibility of the project will transfer from the team to the process owner.
6. Execute implementation and transition plans.
7. Document leverage opportunities; detail where other improvement projects might be sought.
8. Prepare final report: There should be enough information that the project's logic can be clearly followed.
9. Conduct final review.

In the Control phase, detailed process mapping will be used to record the improved process. Process Mapping (deployment flowchart) clearly shows the sequence of events, handoffs, and the job descriptions of people performing all tasks. This document is part of the Control Plan.

Control Plan - Simplified

	What	Who	When	Where
Measure				
Monitor				
React				
Revise				

Transition Communication Plan

As part of the control plan, communication with stakeholders is essential.

- Who needs to know and what do they need to know?
- When do they need to know?
- Which communication methods will be most effective?

Message	Audience	Media	Who	When/Where
Equipment Maintenance Training	Maintenance Workers	Work Session	Sandy Johnson & Tech. Support	Location 005 6/16/00
Employee Process Training	Pizza Cooks	On the job training	Rose Stein	Each Location 6/00 (2/wk)
Handoff to the Process Owners	All Location Managers	Formal Presentation & follow-up visits	Rose Stein & Sandy Johnson	Corp 6/15/00 & Ea. Loc. 6/00
Overview of Changes	All Managers and Directors	Copy of Report	Sandy Johnson & Miguel	6/14/00

Criteria Rating Form

...Tool for **Define**

If you've ever made a major purchase, such as a car or a house, you've probably used a **Criteria Rating Form**. Well, maybe you didn't create the actual form, but you most likely went through the exercise in your mind. When hiring a candidate for a job, for example, nearly everyone considers criteria such as experience, education, the interview, and computer skills. If you listed these criteria on a sheet of paper and rated the options you were considering (on a scale of 1 to 5) against each of the criteria, you'd be constructing a criteria rating form. Adding the scores for each candidate gives you a relative rating of the candidates under consideration. Here is how it would look:

Example: Hiring for a job

OPTIONS (Candidates)			
CRITERIA	**Bob**	**Sarah**	**Jill**
Education	5	4	1
Experience	3	4	5
Interview	3	3	4
Computer Skills	5	3	2
TOTAL	16	11	12

Rating Scale:

5 = Very Good
4 = Good
3 = Fair
2 = Poor
1 = Very Poor

Criteria can be treated equally, or they can be weighted relative to each other. In the next example, weights have been added to each criteria. They indicate that experience is three times as important as education and the interview. And computer skills are twice as important. Each rating is then multiplied by its respective weight.

Example: Hiring for a job

OPTIONS (Candidates)				
CRITERIA	**WEIGHT**	**Bob**	**Sarah**	**Jill**
Education	1	(5x1=) 5	(4x1=) 4	(1x1=) 1
Experience	3	(3x3=) 9	(4x3=) 12	(5x3=) 15
Interview	1	(3x1=) 3	(3x1=) 3	(4x1=) 4
Computer Skills	2	(5x2=) 10	(3x2=) 6	(2x2=) 4
TOTAL		27	25	24

Putting it to work
Follow these steps when creating a Criteria Rating form:

1. Decide what factors or criteria are to be considered. Normally, three to six criteria will be sufficient. However, it's up to the team to define the criteria and decide the optimal number. Having too many criteria will seriously complicate the exercise — without adding much value. Some commonly used criteria include:
    - Customer satisfaction
    - Effectiveness
    - Importance (to the organization)
    - Time (to implement)
    - Cost
    - Ease of implementation
    - Acceptability (to employees)
    - Feasibility
2. Reach agreement on the definitions of the criteria.
3. Agree on the scale to be used (1 - 3 or 1 - 4 or 1 - 5,) to rate the options. Determine what (if any) weights should be assigned.
4. Discuss each "cell" on the form to arrive at a consensus rating. It's best to look at all the options being considered and to rate them on a particular criterion at the same time. Therefore, you work the cells across (by criterion) not down (by option).

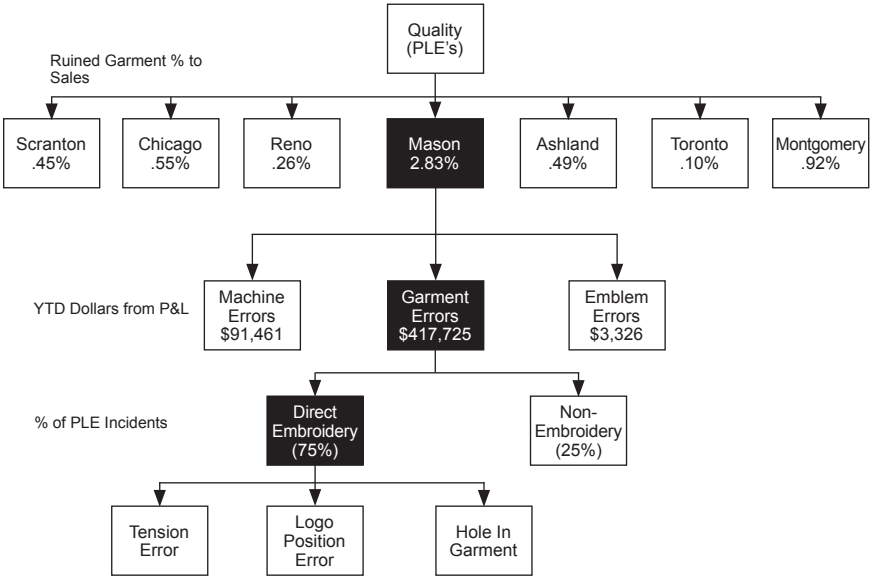
Note: When using the scales, remember that a higher scale number always indicates a better rating. This can be a bit confusing with a criterion like cost. In this case, a higher number (say 5) represents a lower cost. In contrast, if the cost of the option was very high, the scale rating would be very low.

Note: Some people prefer not to total the numbers for each option. This way, they guard against the risk that the criteria rating form will become just another mechanism for win-or-lose voting. The tool is not the decision-maker, people are.

CT Flowdown

*...Tool for **Define***

In business and government some of problems are too broad or daunting to handle on first glance. One great way to start is a ***CT Flowdown***. This tool is related to the Five Why's where you start with a specific problem and ask "why" five times to probe deeper and deeper into the cause of causation for any process, problem, or issue. The upper branches of the CT Flowdown become the project bases, while the lower branches become individual focus areas. CT Flowdown is a great tool for defining from the highest level to the lowest level the details of the process and identifying where it makes sense to focus a project.



CT Flowdown helps define the scope of a project by breaking it down into critical pieces and identifying the biggest potential for improvement.

Failure Mode and Effects Analysis (FMEA)

*...Tool for **Analyze***

Failure Mode and Effects Analysis (FMEA) is a tool used to identify potential defects/issues in a design or a process based on severity, expected frequency, and likelihood of detection. A FMEA can be used to proactively identify weaknesses in the design or process. It can help teams prioritize and organize continuous improvement efforts by focusing in on areas which offer the greatest return.

Putting it to work

1. Identify all of the probable failure modes (issues). This analysis is based on experience, review, and brainstorming, and should use actual data if available.
2. Assign a value on a scale of 1-10 for the: **severity of failure, probability of occurrence** and **probability of detection** for each of the potential failure modes.
   - **Severity** (S) is rated 1-10 with 10 being most severe.
   - **Probability of Occurrence** (P) is rated 1-10 with 10 being highest probability of occurrence.
   - **Probability of Detection** (D) is rated 1-10 with 10 being lowest probability of detection.
3. After assigning a value for each, multiply the three numbers for each failure mode to yield a **Risk Priority Number** (RPN).
4. The RPN becomes a priority value to rank the failure modes, with the highest number demanding the most urgent improvement activity.

Example: Here is an example of a simplified FMEA for a billing process at a state agency.

Process Input	Potential Failure Mode	Potential Failure Effect	Severity	Potential Cause	Occurrence	Current Control	Detection	RPN
Invoice received	Long wait times	Unable to start payment process	**5**	Inconsistent mail pick-up; wrong address	**3**	None	**5**	**75**
Info verified by Account Owner	Incorrect and/or incomplete info provided; wait time	Unable to start payment process	**8**	Cumbersome database; not a priority	**3**	None	**5**	**120**
Info logged in by Account Owner	Incorrect and/or incomplete info keyed	Unable to complete payment process	**8**	Cumbersome database; not a priority	**3**	None	**5**	**120**
Invoice approved & coded by Account Owner	Incorrect and/or incomplete info keyed; wait time	Unable to complete payment process	**5**	Cumbersome database; not a priority	**3**	None	**3**	**45**
Info verified by Accounting & sent to OAKS	Wait time	Unable to complete payment process; late fees assessed	**2**	Staff too busy	**1**	None	**2**	**4**

RPN = (S x P x D)

As you can see in the example, potential failure modes in the second and third rows both have a RPN of 120, and are therefore the highest priorities for process improvement.

RPN minimum targets may be established to ensure a given level of process capability. In that event, it is wise to establish guidelines for assessing the values for Severity, Occurrence, and Detection to make the RPN as objective as possible.

Five S

*...Tool for **Improve***

Five S is a lean tool that can be used anytime, anyplace. 5-S is the foundation for continuous improvement, zero defects, cost reduction, and a safe work area. In order to produce high quality you have to maintain standards and eliminate the things that interfere. The 5-S method enables increased quality, waste identification, standard process, visual control, and promotes employee satisfaction.

The intent of 5-S is to have only what you need available in the workplace, a designated place for everything, a standard way of doing things and the discipline to maintain it. Created in Japan, the components of 5-S are: seiri, seiton, seiso, seiketsu and shitsuke. Translated to English:

- **Sort:** Remove all items from the workplace that are not needed for current production.
- **Straighten** (Sometimes referred to as Set in order): Arrange needed items so that they are easy to find and put away. Items used often are placed closer to the employee's workspace.
- **Shine:** Make sure everything is clean, functioning and ready to go.
- **Standardize:** This is the method you use to maintain the first three S's.
- **Sustain:** Make a habit of properly maintaining correct procedures.

Putting it to work:

Step 1: Sort

- Survey the work area and red tag things that are broken or unused.
- Remove all trash.
- Move out the unnecessary items to a red tag (holding) area.
- When in doubt, move it out.

Step 2: Set in Order for ease of use

- Define item placement by frequency of use. Ask: What do I need to do my work? How many do I need? Where should I put it?
- Label as appropriate.
- Note minimum and maximum quantity (if appropriate).
- A place for everything and everything in its place.

Step 3: Shine

- Identify cleaning activities and routine maintenance required.
- Develop standard operations and work standards.
- Implement a daily 5S checklist.
- "A clean workplace enhances quality, safety, and pride."

Step 4: Standardize

- Conduct frequent 5S audits to uncover 5S abnormalities.
- Determine root cause(s) of any 5S abnormalities.
- Implement countermeasures for abnormality prevention.
- Do it daily.

Step 5: Sustain

- As a team, develop daily (or weekly) 5S checklist.
- Make sure a score sheet and performance board are visible to all.

Five Whys

*...Tool for **Analyze***

One of the most powerful tools for problem solving does not require number-crunching, graphing or analysis. We refer to that old standby question: "Why?" By asking "Why," we can peel back the layers to discover the root cause of a problem. The answer to the first why becomes the second question. Why did this happen? The answer to that becomes the next question and so on. Keep going deeper to find why the problem is occurring. After five whys you will likely have arrived at the root cause.

EXAMPLE

PROBLEM: SUPPLY ORDERS AREN'T FILLED ON TIME

1st Layer	**WHY aren't supply orders filled on time?** Because the supplies are not in stock
2nd Layer	**WHY aren't the supplies in stock?** Because the supply shipment has not been received
3rd Layer	**WHY hasn't the supply shipment been received?** Because the order was placed late
4th Layer	**WHY was the order placed late?** Because the order request takes 3 weeks to get approved
5th Layer root cause	**Why does the order request take 3 weeks to get approved?** Because it is in transit for 12 days, going from one approval authority to another to another. Total approvals needed = 5

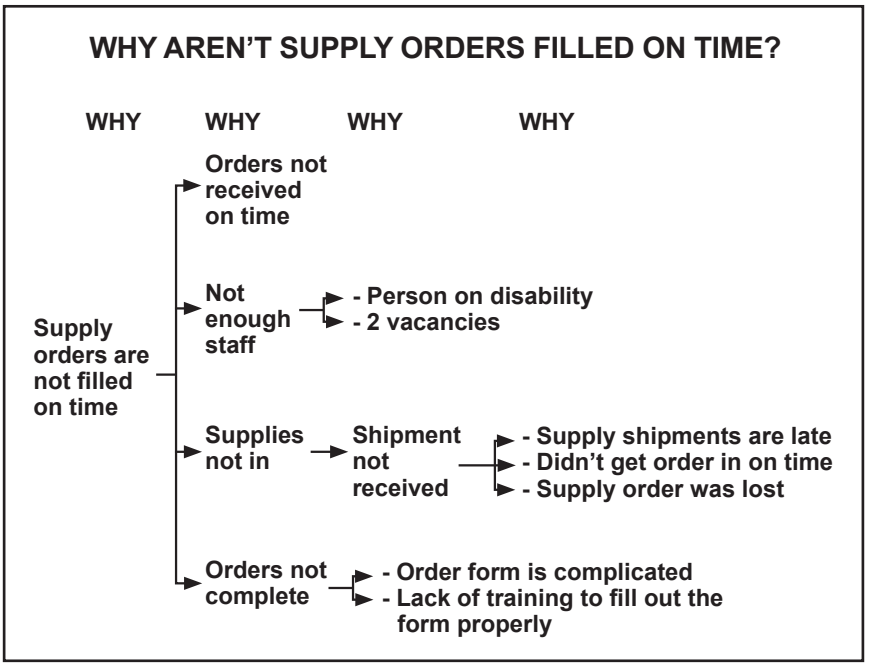
Putting it to work

1. Once you have identified a problem, ask the question "Why did this problem occur?" (This is the first column). There may be multiple answers to that question.
2. Then take the answers to that question and ask the question again.
3. Continue to do this until you have uncovered the possible root causes of the problem. It may be necessary to ask "Why" several times before you uncover all the root causes.

A VARIATION on the FIVE WHY TECHNIQUE:
Sometimes you may want to use the Five Why Technique to examine multiple potential root causes. Combining the use of a tree diagram with the Five Whys provides the flexibility to do that.

Example:

The example below shows the use of this variation on the Why Technique using a Tree Diagram approach.



Flow Chart
*...Tool for **Define***

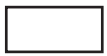
Flow charts are step-by-step schematic pictures used to describe a process being studied, to develop an improved or entirely new process, or to plan the implementation of an improvement. As outlines of a sequence of actions, they provide team members with common reference points and a standard language to use when talking about a process.

Flow charts can be applied to anything from the travels of an invoice or a flow of materials, to the steps in issuing a license or delivering a service. Flow charts are completed by a team of people who work in the process.

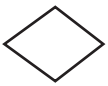
Putting it to work

In creating a flow chart, follow these steps:

1. Decide where the process begins and ends. These become the "begin" point and "end" point of the flow chart.
2. Brainstorm the main activities and decisions in the process. Write these on a flip pad, marking board or somewhere else so the information is visible to everyone in the team. You can even write them on Post-It notes, which makes it convenient when you get to the next step.
3. Arrange the activities and decision points in the order in which they occur. If there's a lengthy list on the flip pad, this step can be simplified by writing a number in front of each activity and decision — 1 for first, 2 for second and so forth.
4. Now it's time to translate your written step-by-step description into a flow chart. Draw the chart using the following common symbols.



- A rectangle designates an activity. Write a brief description of the activity directly in this box.

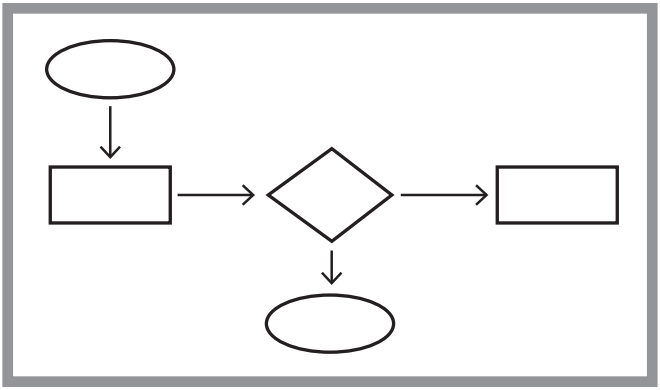


- A diamond indicates a decision point from which the process branches into two or more paths. The path taken depends on the answer to the question that appears within the diamond. Each path is labeled to correspond to an answer to the question. Usually Yes or No.

- "Start" or "begin" are used to designate starting point of process flow; "stop" or "end" are used to designate the end of process flow.

- The document symbol represents a document pertinent to the process.

- The flow line represents a process path connecting the various process elements: activities, decisions and so on. The arrowhead on the flow line indicates the direction of process flow. Flow lines are added after the process map has been confirmed.



5. Analyze the flowchart for such items as:
   - Time-per-event (cycle time)
   - Process repeats (rework)
   - Duplication of effort
   - Unnecessary tasks
   - Value-added versus non-value added tasks

Important Tips
When developing the initial flow chart, avoid excessive detail. Otherwise, the team is likely to get confused and frustrated. Early on, keep the flow chart simple — then add detail as necessary to understand the process.

Flow chart is a simple way of capturing a picture of a process. Process Map (p.64) is a much more detailed approach to understanding a process and is recommended for Lean Six Sigma.

Force Field Analysis

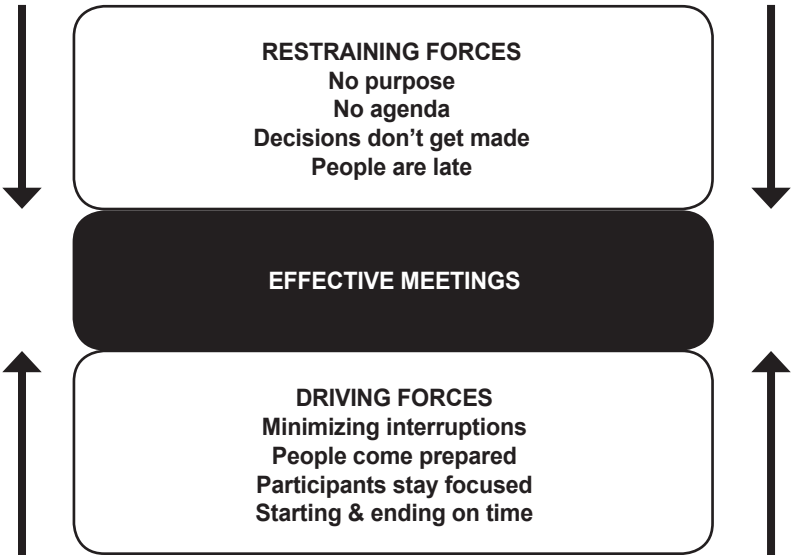
*...Tool for **Analyze***

Force Field Analysis identifies two sets of forces: those that help you close the gap between where you are now and where you want to be (driving forces), and those that hinder you (restraining forces).

Putting it to work

1. Begin by drawing a horizontal line through the middle of a flip chart. This line represents a goal you want to achieve. Write a descriptor place on the line. Label the top of the chart “restraining forces” – those that keep the level from moving higher. Label the bottom “driving forces” – thosethat push up the level.
2. Start with the top half of the sheet. Brainstorm all the different restraining forces that are holding or pushing down the current level or goal. Write all ideas above the horizontal line. Next, brainstorm to identify all the positive driving forces. Write these below the line to show that they push up the current level or goal.
3. Evaluate each factor and assess the strength of each of the forces and its relative impact. Use this information to develop and prioritize specific actions for increasing or adding to the driving forces (bottom half) and reducing or eliminating the restraining forces (top half).

Example:
To improve the effectiveness of meetings, we’d want to use the driving or helping forces – or add new ones – while decreasing, overcoming or eliminating the restraining or hindering forces shown above the horizontal line.



Gantt Chart

*...Tool for **Improve***

The ***Gantt Chart*** helps to organize a team's plan for implementing its proposed solution. It documents what is to be accomplished, by whom and when. The chart also allows a group to document the assumptions underlying their plan. For example, if success is based on installation of equipment by May 15, that assumption can be noted. The group can develop contingency plans in case the deadline slips.

Putting it to work

What occurs before the chart itself is created is crucial to the effectiveness of this tool. Here are the steps:

1. Brainstorm all the tasks that need to be carried out as part of implementation.
2. Decide how long each task will take, when it can be started and when it is to be completed.
3. Assign responsibility for each task to a team member and/or to people outside the team.
4. Enter this information on the chart, sequencing and overlapping the various steps as appropriate.
5. Document the assumptions on which the plan is based and the contingency plans to implement if those assumptions are not valid.

Example

The Gantt chart below shows part of one team's test implementation. Notice the sheer volume of information you can easily absorb simply by looking at this chart. Consider its value as a tracking tool once implementation is under way.

Schedule		Week Number								
Task	Assigned to	1	2	3	4	5	6	7	8	9
Submit draft for review	Team Leader									
Review draft	Review Committee									
Submit comments	Review Committee									
Revise manual	Team									
Create camera ready materials	Team Leader									
Print 100 copies of manual	Print Shop									
Circulate copies to employees	Team leader									

Histogram

*...Tool for **Measure***

A ***Histogram*** is a specialized type of bar chart that shows the distribution of measurement data. It is a snapshot of a data set. A histogram shows the frequency of occurrence and basic information about the data set, such as central tendency (mean, median, and mode) and the amount of variation occurring in the process. A team uses the histogram to assess the current situation and to study results. The data is grouped into bars based on the amount and distribution of the data. The histogram's shape and statistical information will help the team know how to improve the process.

Putting It to Work

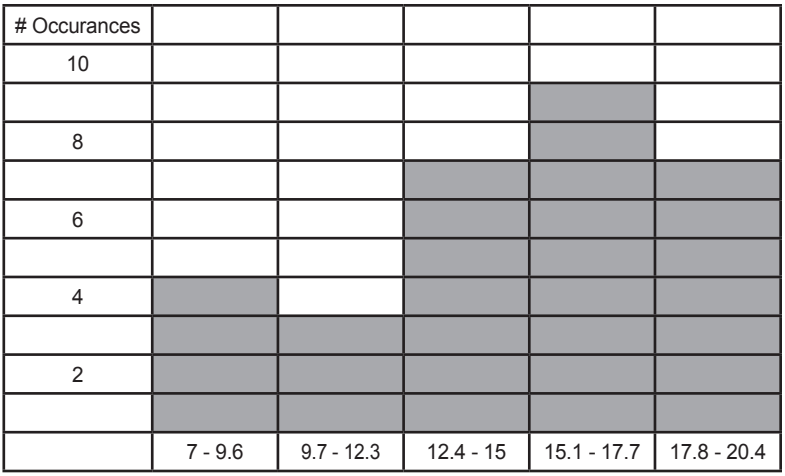
1. Gather and tabulate data on a process, product, or procedure. This could be time, size, frequency of occurrences (such as error rate), number of days to complete a cycle, and so on. Use a checksheet.
2. Determine the number of classes by first counting the number of data points in the data set. Use the following table to select the number of classes.

# of data points	# of classes
under 50	5-7
50-100	6-10
100-250	7-12
Over 250	10-20

3. Determine the class width and boundaries by dividing the range of the data set by the number of classes. The range is found by subtracting the smallest value in the data set from the largest. The classes begin with the lowest point in the data set. Note that classes are exclusive.
4. Record the data by creating a check sheet listing the classes along the left side with space to the right for tally marks. To record the data, make a tally mark beside the class in which each data point falls. Then total the frequency column.

Class #	Class Boundaries	Mid-point	Frequency	Total
1	7.0 – 9.6	8.3	////	4
2	9.7 – 12.3	11.0	///	3
3	12.4 – 15.0	13.7	~~////~~ //	7
4	15.1 – 17.7	16.4	~~////~~ ////	9
5	17.8 – 20.4	19.1	~~////~~ //	7

5. Draw the histogram labeling each axis by writing the description of the measured data on the horizontal axis and the frequency of occurrence on the vertical axis. Divide the horizontal axis into the same equal number of divisions as the number of classes. Divide the vertical axis into the same number of equal divisions to fit the frequency of occurrence range.
6. Draw a bar for each class with the height of each bar corresponding to the frequency of occurrence shown on the check sheet.

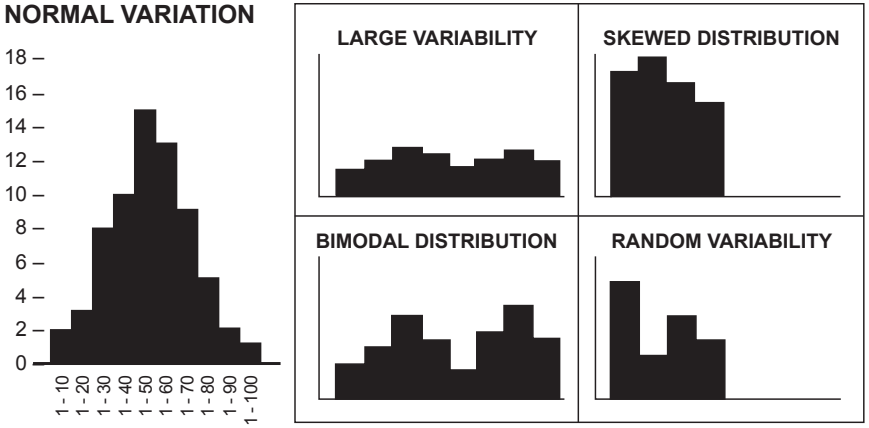


Minutes time in to time out

7. Interpret the histogram. Histograms form several common shapes. A bell-shaped picture is usually a normal distribution and indicates a generally stable system. Any other shapes would indicate some special causes of variation and invites further inquiry. Keep a watchful eye for skew and clustering problems.

Skew problems
Data may be skewed to the left or right. If the histogram shows a long tail of data on the left side of the histogram, the data is termed *left* or *negatively skewed*. If a tail appears on the right side, the data is termed *right* or *positively skewed*. Most process data should not typically appear skewed. Data that is seriously skewed either to the left or right may be an indication that there are inconsistencies in the process or procedures, etc. It should be noted, however, that some process data is, by its very nature, skewed. This situation occurs in arrival processes (for example, people arriving at a McDonalds within a fixed unit of time) and in service processes (for example, the time it takes to wait on a customer).

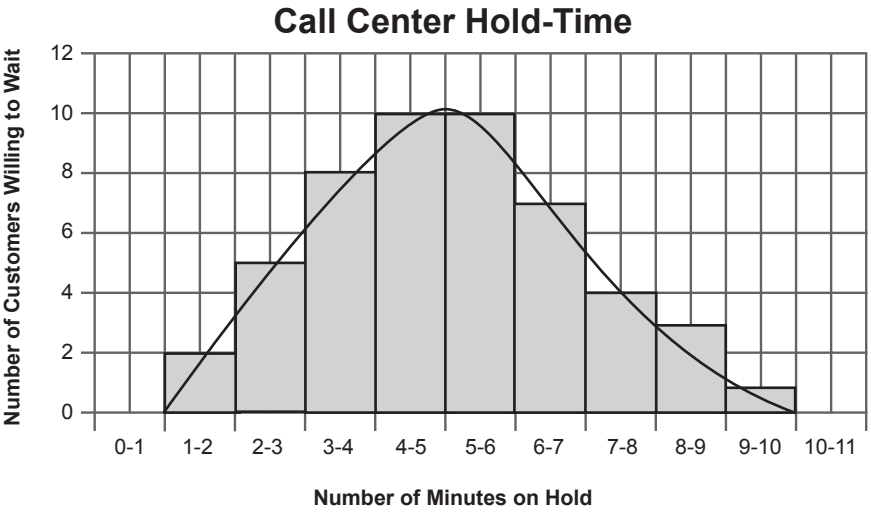
Clustering problems
Data may be clustered on opposite ends of the scale or it may display two or more peaks indicating serious inconsistencies in the process or procedure or the measurement of a mixture of two or more distinct groups or processes that behave very differently. All require further investigation.



Example: Case Study of Call Center's Failure for Rapid Response

A call center agency wants to improve its system as an inbound call center and service agency. Although there's no specific industry standard to which handling of calls should adhere, the agency's goal is to sustain its ability to respond rapidly to customers' calls. Currently, the hold-time it takes for their agents to respond has been falling short of the previous track record of less than a minute.

A study was conducted in order to determine if the agency needs more staff to attend to the customers. Fifty (50) inbound calls for technical support took more than a minute before a help-desk technician could attend to the customers' requests for assistance. In fact, it was observed that half of the fifty calls took more than five minutes, which can be gleaned from the following data gathered during the course of the observations.



At a glance, the histogram illustrates the wait time for 50 customers. You can readily perceive that:

- The data distribution has relatively normal distribution (bell-shaped).
- The hold-time for calls can last up to 10 minutes.
- Half of the customers were observed to have waited for 5 minutes or more.
- Two classes of data had 10 counts each and these customers waited between 4-5 and 5-6 minutes.

With this understanding of the data, the team can now begin to identify improvement opportunites and has baseline data for comparison. **Note**: See ***Basic Statistics*** for more information.

Impact Matrix aka PICK Chart

*...Tool for **Improve***

This tool is used to compare multiple potential solutions against two key variables in order to select the items the team should begin to implement first. Usually the potential solutions are evaluated against the impact of the solution on the problem and control or authority to implement the solution(s). This tool is typically used when there is a long list of good ideas but a limited amount of resources available to work on the improvements.

Putting it to work

1. Brainstorm solutions. Then number them.
2. Using this matrix, evaluate and categorize each of the potential solutions, weighing the **impact** of the solution on the problem and how much **control** the group has to implement the solution.

    - Box I are solutions with high impact, low control (big payoff, hard to implement).
    - Box II are solutions with high impact, high control (big payoff, easy to implement).
    - Box III are solutions with low impact, high control (small payoff, easy to implement).
    - Box IV are solutions with low impact, low control (small payoff, hard to implement).

Place each proposed solution in the appropriate box. When the matrix is completed, the team will have prioritized its entire list of solutions. The first solutions to implement should be the ones with the highest impact and highest level of control.

Here is an example of four improvement ideas placed in the appropriate quadrant.

Records Retention

Impact			
High ---	**I. Possible** *Implement a new- paperless system with retention built in*	**II. Implement** *Re-assign responsibility of maintaining records to one person*
Low ---	**IV. Not Worth The Effort** *Management place a higher emphasis on records filing*	**III. Consider** *Better training of employees on current procedures*
	Low Control	High Control

Interview

*...Tool for **Voice of the Customer***

The interview is a structured technique for collecting information from individuals or groups, including (perhaps most importantly!) your internal and external customers. 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 effective means of data collection. It's often the best way to learn about your customers' needs and expectations. The interview protocol has to be carefully developed.

Putting it to work

Tackle the interview just as a reporter would:

1. Before the interview, develop a list of carefully constructed questions. Ideally, this should be done with others to provide a broad perspective and clarity. Write down a "clean" version of the question list and take it to the interview.
2. Be sure to include follow-up questions to get at the information you really need.
3. When you conduct the interview, take notes of the responses. Remember to keep listening while you write.
4. If possible, bring along a note taker who can do the writing — allowing you to zero in on asking the questions and listening. Also consider bringing a tape recorder.
5. Stick with the list of questions, but don't get too locked in.
6. Verify your understanding of the interviewee's responses. Restate what you're hearing and ask whether your interpretation is accurate. (You are seeking information and testing understanding.)
7. If you're collecting sensitive information, ensure the confidentiality of the responses. Do not use respondents' names, identifiable quotes or other "identifier" information.

Remember: When you ask for the Voice of the Customer, you need to be prepared to respond in some way, to be willing to change.

Nominal Group Technique

*...Tool for **Define and Improve***

The Nominal Group Technique (NGT) is a structured method for working toward consensus. Its strength is that it gives everyone in the team an equal voice in sharing ideas. This tool is particularly useful when:

- Some group members are much more vocal than others.
- Some group members think better in silence.
- There is concern about some members not participating.
- All or some group members are new to the team.
- The issue is controversial or there is heated conflict.
- There is a power imbalance among the group; the structure of the Nominal Group Technique can balance this out.

Putting it to work

NGT unfolds in two phases.

In Phase 1, Idea Generation, the team follows these steps:

1. Write a statement that describes an established goal, problem, or other subject.
2. Put it on a flip chart or marking board, making sure all participants understand it.
3. Each participant, working individually, proceeds to list as many ideas as they can in response to the statement, putting each idea on a separate Post-It Note.
4. The ideas are then transposed to the flip chart.
5. If confidentiality is an issue, the written ideas can be passed on to a recorder — who would then write them on the flip chart. This way, specific ideas are not linked to specific people.

To facilitate the next phase of NGT, it's suggested that the recorder leave space between items and that no more than five or six be on a page.

In Phase 2, Priority Setting, the group indicates its preferences. Here's how it happens:

1. Go over the list and ask for clarifications. Fine-tune the wording as needed. Combine duplicates.
2. Number each of the items starting at the top.
3. For lists of 20 or fewer items, give each participant five Post-It Notes. Ask each person to pick the five items that she or he feels are the highest priority. (For lists of 20 to 30 items, you may want to use seven Post-It Notes; for lists of 30 or more you may want to use nine).
4. Instruct participants to write in the upper right-hand corner of a Post-It Note, the number (from the list) of each chosen item. Also write a word or phrase in the middle of the note to describe the item. Remember, each item is on a separate note.

5. When the participants are finished, they place their Post-It Notes in front of themselves for ranking. Before giving a ranking, each participant should consider what makes this a priority item — such as cost, value added, importance to the customer and so on.
6. Participants are asked to prioritize the items they selected.
    a. Choose the highest priority item from the ones selected and give it the highest number. If each participant has five Post-It Notes, this number would be 5. The number is written in the lower center of the note and circled.
    b. Next, select the lowest priority item from the remaining items and assign it a value of 1.
    c. Of the remaining items, participants select the next highest-priority item and give it a four. This process continues until the other remaining items have been ranked.
    d. When the rankings are complete, place each of the Post-It Notes on the flip chart — directly next to the corresponding item written on the flip chart during Phase 1.
7. For each numbered item on the flip chart, add the rankings on the Post-It Notes and record the total. Then count the number of Post-It Notes for each item and record the total. The results show the team's ranking of all the items. The item with the largest number of points is deemed to be most important or significant to the team. (Knowing how many Post-It Notes were received for a given item can prove useful in the event there's a tie in the rankings.)
8. Before finalizing, the team should discuss the results to be sure there were no misunderstandings.
9. Create a table showing (in descending order) the item number, a brief statement of each item, the number of votes it received and the number of participants voting for the item.

Example:
Five team members are trying to decide among 10 options. One person's Post-It Notes might look like this:

Item #4	**Item #1**	**Item #3**
Name of the Item (yyyy)	Name of the Item (aaaa)	Name of the Item (xxxx)
Rank Score: (5)	Rank Score: (1)	Rank Score: (4)

This person ranked Item # 4 with a 5 which is the highest score if each person has 5 items.(This person would have 2 more cards identifying their other top items and ranking them 2 & 1). Here is how the team scores might tally up listed from highest total score to lowest.

Options	Total Score	# of Votes
3.xxxxx	18	4
4.yyyyy	13	3
7.zzzz	12	3
5.aaaa	11	4
2.bbbb	7	3
9.dddd	5	2
6.ffff	3	3
10.cccc	3	2
1.sssss	2	1
8.rrrrr	0	0

Obviously item number 3 has the highest score and appears to be a fairly clear preference. Items #2,9,6,10,1,8 could probably be eliminated from consideration and the team could further discuss the remaining items (3,4,7,5) before coming to consensus.

Alternative method for Phase 2: Sticky dots
After the items have been clarified and you have determined how many votes each participant has to distribute among the options, each participant is given colored sticky dots.

- If you have a limited number of items (less than 20) and want to end up with the top 3, each person is given 6 sticky dots and asked to pick the three items they feel are the highest priority, placing them using three colored sticky dots for their first choice, two dots for their second choice and one dot for their third choice.
- If you have a lot of items (more than 20) and want to end up with the top 5, each person is given 15 sticky dots and asked to pick the five items they feel are the highest priority. They then place five colored sticky dots by their first choice, four dots by their second choice, three by their third choice, two by their fourth choice and 1 by their last choice.
- Tally the dots on each item. The results show the group's ranking of all the items as shown above.

Another variation on Sticky Dots is to give people sticky dots and instruct them to distribute the dots among the options however they want, with the caution to not place them all on any one item.

Operational Definitions

*...Tool for **Define***

Data collection is a key component of Six Sigma and clear *Operational Definitions* can help ensure the data being collected is accurate and reliable. An operational definition, when applied to data collection, is a clear, concise detailed definition of a measure. Operational definitions are fundamental when collecting all types of data and are important when a decision is being made about whether something is correct or incorrect. When collecting data, it is essential that everyone in the system has the same understanding and collects data in the same way. Operational definitions should therefore be made before the collection of data begins.

According to W. Edwards Deming, "An operational definition puts communicable meaning into a concept."

Good operational definitions help guide the team's thinking on what they need to measure and ensures any person using the agreed-on definition will be measuring the same thing. *Operational Definitions* add consistency and reliability to the data collection process and describe the scope of the measure (what is included and what is not included). An operational definition statement might be:

> *"Cycle time is from when we receive the application until it is sent to accounting for payment."*

Putting it to Work

1. Identify the characteristic of interest to be measured.
2. Select the measuring instrument: The measuring instrument is usually either a physical piece of measuring equipment or a visual check.
3. Describe the test method: The actual procedure used for taking the measurement. When measuring time, the start and finish points of the test need to be specified. When taking any measurement, the degree of accuracy also needs to be stated. For instance, it is important to know whether time will be measured in hours, minutes, or seconds.
4. State the decision criteria: Does the problem exist? Is the item correct? Whenever a visual check is used, a clear definition of acceptable versus unacceptable is essential. Physical examples or photographs of acceptable and unacceptable, together with written support, are the best definitions.
5. Document the operational definition: It is important that operational definitions are documented and standardized. Definitions should be included in training materials and job procedure sheets as well as data collection plans.
6. Test the operational definition before implementation: Input from those that are actually going to perform the tests is particularly important. Ask different people to complete the test on several items by following the operational definition. Watch how they perform the test. Are they completing the test as expected? Are the results consistent? Are the results correct?

Operational Definitions should include a precise description of the:

- Specific criteria used for the measures (the what)
- The methodology to collect the data (the how)
- The amount of data to collect (how much)
- Responsibility to collect the data (the who)

Operational Definition: Quick Sheet

	Who	What	How	Where	When
Data: Cycle Time Begin	All Processors	Date/Time Stamp on email submission	Record times in database	XX Database on C Drive	Each receipt for two weeks
Data: Cycle Time End	All Processors	Date/Time stamp on emal package sent to accounting	Record times in database	XX Database on C Drive	Each submission for two weeks
Data: Backlog	All Processors	Total # of unprocessed requests at the end of the day	Record in database before log-out	XX Database on C Drive	End of day for two weeks

Operational Definitions help to ensure common understanding and that the team does it right the first time when it comes to data collection.

Pareto Diagram
...Tool for **Analyze**

A ***Pareto Diagram*** is a vertical bar graph that breaks a problem into its parts and identifies where improvement efforts should be focused. It's effective because it graphically demonstrates how seemingly small matters can cause big problems. The tallest bar or "big leg" of the Pareto represents the part that contributes most to the problem, and targets where the team should focus its efforts for the greatest results. The name of the chart is derived from the Pareto Principle: 80% of the trouble comes from 20% of the problems.

Pareto diagrams are usually shown with a "cumulative line." This represents the percentage sum of the vertical bars, as if they were stacked on top of each other from left to right, to show the percentage of the total problem that a category or multiple categories contribute to the problem.

Putting it to work

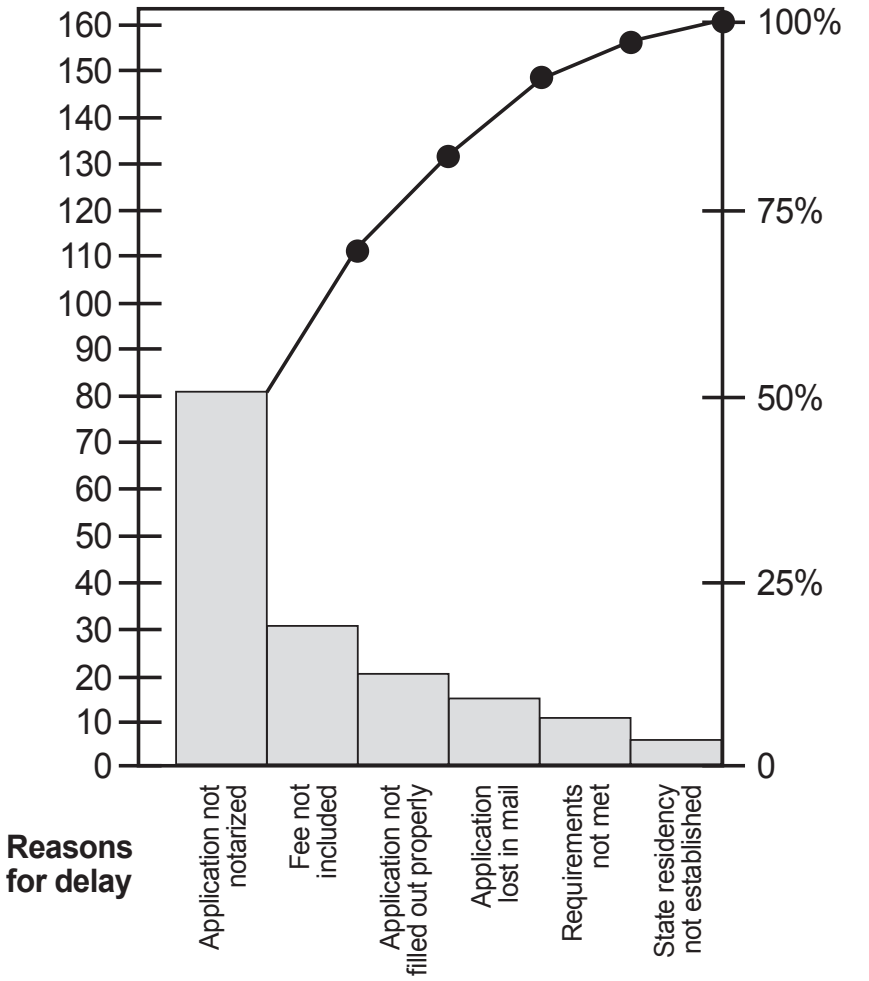
Follow these steps when creating a Pareto chart:

1. Select the problem or cause to be studied. This can be done through brainstorming, examining data or other means.
2. Define the categories and select the appropriate unit of measurement for the categories to be assessed. Determine the time period for data collection.
3. Collect the data by category for the specified time period (a check sheet is a useful tool here).
4. Draw horizontal and vertical axes on graph paper. On the left hand vertical axis, label the measurement values in equal increments.
5. On the horizontal axis, order and label the bars by category, **starting with the biggest category on the left** and the others to the right in **order of decreasing frequency**.
6. To include a cumulative line, label a percentage scale on the right-hand vertical axis making sure the left and right axes are drawn to scale. Plot the percentage line showing the cumulative total with the addition of each category. All categories totaled should reach 100%.
7. Compare the frequency or other measure of each category relative to all the others.

THE PARETO PRINCIPLE:

80% of the trouble comes from 20% of the problems

Example:



By looking at the Pareto chart above, it becomes obvious why application processing is being delayed. Much of the problem would be solved by eliminating the one cause that's most responsible for the problem.

Pert Chart

*...A Tool for **Improve***

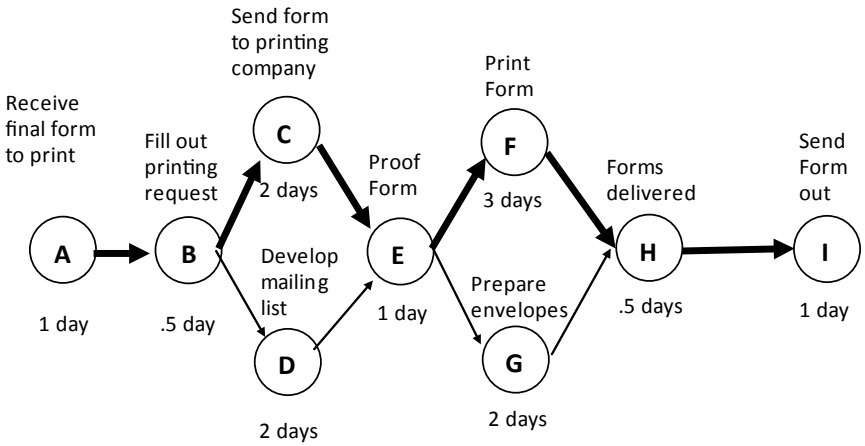
A PERT chart (**P**rogram **E**valuation and **R**eview **T**echnique) is a tool used for project planning and is designed to manage time, particularly when there are several parts of a project that have to come together at a particular point in time. PERT charts are also known as critical path analysis, as they show the "critical path" or the minimum amount of time that is required to complete a project, and illustrate dependencies in the project.

Putting it to work

1. Before drawing the actual PERT Chart, you need to identify all the activities in your process or plan and how much time is required for each. Then put the activities in the order that they must occur. Determine if there are any activities that can be completed simultaneously. Label each of the activities in the order that they must occur, using either numbers of letters.
2. You are now ready to draw the diagram. Place each number/letter in a circle. Use an arrow to connect each of the circled numbers/letters in order of occurence. Above each circle write in the activity and below each circle write the estimated time to complete the activity. Depending on the project, time can be minutes, hours, days or months.
3. Once the chart is complete you can identify the critical path of your project and the minimum amount of time that will be necessary to complete the project.

Example:

The Pert Chart below maps out the critical path for printing and distributing a new form.



As you can see, path A-B-C-E-F-H-I- is longer than path A-B-D-E-G-H-I by one day so this is the critical path that needs to be managed.

Poka-Yoke
*...Tool for **Improve***

Poka – inadvertent error
Yoke – avoidance

Poka-Yoke is a lean a tool that can be applied to any type of process. It is mistake proofing the process by changing the method or equipment to ensure that a particular error cannot happen. The step that causes the error is eliminated and replaced by a step that is error-proof. If you cannot make it impossible for the error to occur, devise ways to detect the error early and minimize its effects. This tool is used very effectively with FMEA (Failure Mode and Effects Analysis).

Putting it to work

Poka Yoke involves analyzing a process for all the ways mistakes could potentially happen, and then designing the process to prevent those errors.

- Build a system with appropriate information.
- Never pass a defect on to the next process.
- Identify how to detect abnormalities early in the process.
- Respond immediately.
- Eliminate root causes.
- Establish clear decision rules.

Examples:

- “Required fields” in computer data entry applications that don’t advance to the next screen until all required fields are completed.
- Gasoline dispensers for diesel fuel will not fit into the tank opening of vehicles that are engineered for regular gasoline.
- Cars that automatically turn off the lights when the engine is turned off.

Process Map (aka Business Process Map)
*...Tool for **Define, Analyze***

The Process Map is a tool used to display the current process and information flow from the customer request to the delivery of the product or service to the customer. The purpose is to understand the current process in order to identify opportunities for improvement by mapping all of the steps in the current process and identifying the job function that completes each step. It is a more detailed approach than a simple flowchart.This approach is BIG, BOLD and VISIBLE.

Here is an example of a Process Map created by a team — the walls are covered with flip chart paper filled with Post-It Notes.

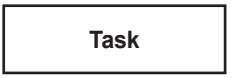
Putting it to work

1. Begin with a SIPOC Diagram (page 70) that identifies the Supplier, Inputs, Process (on a macro level—no more than five or six steps), Output and Customer.
2. Place a large piece of paper on a wall.
3. Determine the functional areas, those that do something in the process. Identify a horizontal band (aka swim lane) for each functional area involved in the process.
4. To ensure the proper scope of the process, identify the first and last steps in the process first.
5. Start with the first step and ask what comes next? Write each step in a verb-noun format. Have group members write the steps on Post-It Notes. Place each note on the process map in order and in the correct swim lane (functional area). Move the Post-It Notes around until the group is satisfied that all the steps are identified and that each step is in the correct order.
6. Be careful to maintain the same level of detail throughout the process.
7. Connect the steps in one swim lane with single straight arrows. Hand-offs between functions are shown with box arrows and electronic hand-offs are shown with jagged arrows.

The symbols used in process mapping are very similar to the flow chart symbols. Use these symbols when Process Mapping. Using color coded post-it notes helps to make the process more visible.

Beginning and ending points of the process. Use green Post-It Notes.

Any task/activity where work is performed. Use yellow Post-It Notes.



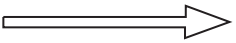
Places where information is checked against established criteria (standards) and a decision is made on what to do next. Use blue Post-Its.

Any time there is a wait before the next process or decision. Use pink Post-Its.

When information/product is placed in inventory to be used at some point in time. Use purple Post-Its.

Single straight arrow – used between tasks performed by same person or work unit or function.

Box arrow—indicates movement of information or product from one function to another.



Jagged arrow—indicates electronic movement of information from one person or function to another.

After the process map is drawn, it is time to analyze it.

- Identify value-added activities – those that transform materials and information into products or services that the customer wants.
- Identify non-value added activities – those that use resources but do not directly contribute to a product or service.
- Identify non-value added but necessary steps – those that are non-value added but mandated by regulation or statute and cannot be changed unless the statute or regulation is changed.
- Identify waste, rework, handoffs, things that could be eliminated from the process to make it simpler and of more value to the customer.

Project Charter aka Project Approval Form (PAF)
*...Tool for **Define***

The ***Project Charter*** or Project Approval Form is a tool for clarifying why a team is being created, what the team will be working on, what the scope of the project is, what the expected outcomes are, and how they will be measured. A written project charter ensures that everyone involved with the project has a high-level understanding of the current process and is aware of the defined team goals and authorizes the project. The project charter is also utilized as a daily reference point for settling disputes, avoiding "scope creep," judging new ideas as they arise, measuring progress, and keeping the team focused on the end-result.

Putting it to work
The project charter should include the following:

- ***Project resources:*** Project resources identify the senior leadership person of the area where the project has been identified, the team sponsor, the team leader, and the facilitator for the project.
- ***Project details:*** Project details include:
  - ***Problem statement*** identifies the problem the team will be addressing. It includes the magnitude of the problem and the baseline performance.
  - ***Business objective*** identifies how the project relates to a customer or business requirements and the business impact of improving this process.
  - ***Project Scope*** identifies the beginning and end point of the process to be improved and what is in and what is out of bounds.
  - ***Measurements*** identifies what measures will be used to determine success, what metrics are available, the baseline data and the metrics to be improved.
  - ***Risks/constraints*** identifies anticipated challenges to completing the project and the risks of not completing the project.
- ***Project Goal:*** Identifies the goal of the project and should be SMART, Specific, Measurable, Actionable, Realistic and Time-bound.
- ***Project schedule:*** Identifies milestones in the project and expected completion dates for each, including follow-up meetings.
- ***Participants*** — List the name, title and department of the team members.
- ***Project charter approvals:*** includes signature and date of the team sponsor, team leader and facilitator.

Run Chart

*...Tool for **Measure***

A ***Run Chart*** displays data over time and identifies trends over a specified time period. Run charts are easy to construct and use. Points are plotted on the graph in the order in which they become available. It is common to graph the results of a process such as delays, errors, rework and so on as they vary over time.

Putting it to Work

Here are steps to developing a run chart:

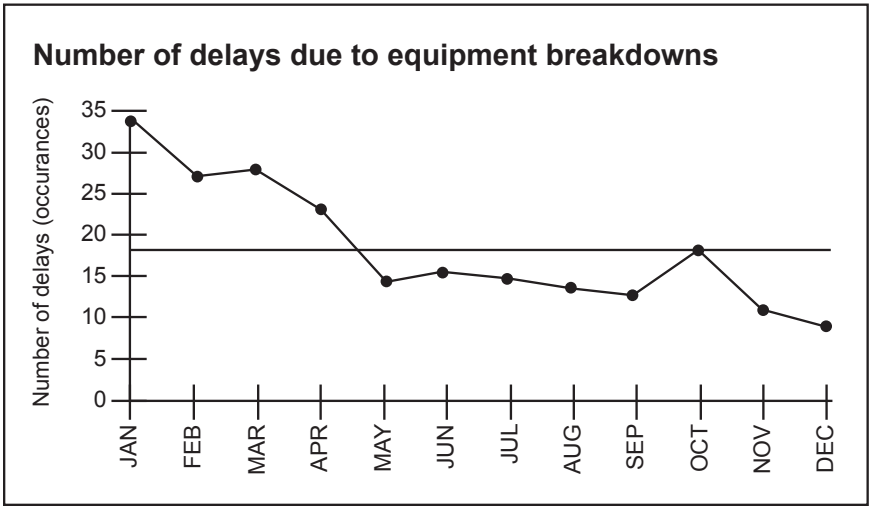
1. Decide on what data to collect.
2. Gather the data. Collect a minimum of 25 -30 data points to detect meaningful patterns.
3. Build a graph, and on the vertical line, draw the scale related to the variable you are measuring – such as the number of defects, delays, waiting time, complaints, and so forth.
4. On the horizontal axis, draw the time or sequence scale: hour, day, week, month, etc.
5. Plot the collected data. (Be sure to plot the data in the order it was collected). Connect the data points to create a line.
6. Calculate the average, which is the sum of the measured values divided by the number of data points.
7. Interpret the data.

Interpret the Chart

- A danger in using a run chart is the tendency to see every variation in data as being important. The run chart, like other charting techniques, should be used to focus attention on truly vital changes in the process. For example, when monitoring any process, it is expected that we should find an equal number of points falling above and below the average. When six or more points “run” on one side of the average, it indicates a statistically unusual event. Such changes should always be investigated. If the shift is favorable, it should be made a permanent part of the system. If it is unfavorable, it should be eliminated.
- An alternate type of pattern that can occur is a trend of six or more points steadily increasing or decreasing with no reversals. Neither pattern would be expected to happen based on random chance. Such a significant change calls for some research and analysis — and possible action.
- Look at the average. Is this really where you want to be relative to customer satisfaction?
- Turn the run chart into a control chart by adding statistically derived upper and lower control limits to see if the process is in control.

Example

The example below shows a year's worth of data. The team is using this run chart to track delays caused by breakdowns in equipment. The solid line identifies the mean (average). Although it looks like the process is improving, more data and analysis is needed.



Tip: A Run Chart is the basis for a Control Chart.

Scatter Diagram
*...Tool for **Measure***

A Scatter Diagram is used to interpret data by graphically displaying the relationship between two variables. A scatter diagram can be used to validate “hunches” about a relationship between two variables. It displays the direction and strength of the relationship. For instance, it can help to answer the question: Will our error rate increase if we speed up the processing time?

Putting It to Work

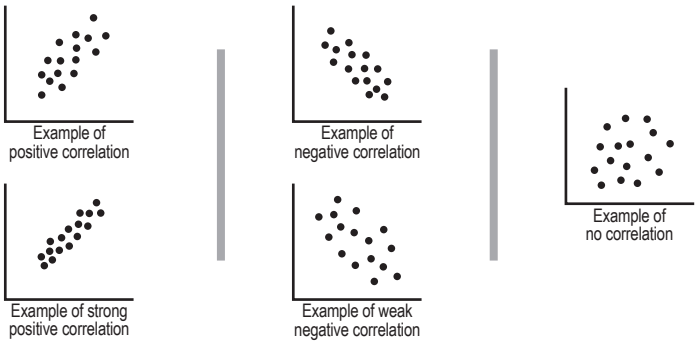
1. Start with a check sheet containing paired observations of the two factors – two continuous data sets, (a minimum of 25 pairs of data). Create a summary table of the data.
2. Draw a diagram labeling the horizontal and vertical axes. It is common that the “cause” variable be labeled on the horizontal (X) axis and the “effect” variable be labeled on the vertical (Y) axis. The values should increase up the vertical scale and toward the right on the horizontal scale. The scale on both the X and Y axes should be sufficient to include both the largest and the smallest X and Y values in the table.
3. Plot the data pairs on the diagram by placing a dot at the intersections of the X and Y coordinates for each data pair.
4. Interpret the scatter diagram for direction and strength.

Interpreting the Chart

A narrow band of points extending from the lower left to the upper right suggests a positive correlation - as one factor increases, so does the other. Negative correlation means that the factors react opposite to each other; as one increases, the other decreases.

A diagram with random points or a circular pattern, indicates that there is no relationship between the two variables.

Data patterns, whether in a positive or negative direction, should also be interpreted for strength by examining the “tightness” of the clustered points. The more the points are clustered to look like a straight line, the stronger the relationship.



SIPOC
*...Tool for **Define***

A SIPOC Diagram is a tool used to identify all relevant elements of a process improvement project before work begins. SIPOC is a high-level picture of the process that depicts how the given process serves the customer. SIPOC is an acronym for Suppliers - Inputs - Process - Outputs - Customers. Use this tool before starting your Process Map.

Suppliers are individuals or organizations that provide inputs to the process. These can be internal (e.g. department, division or individuals) or external (e.g. vendors or individuals). It is also possible for a supplier to also be a customer.

Inputs are material, information and/or services that are required by the process to produce the outputs. It can even include factors that influence the process. For example, in a paint shop, environmental factors such as humidity can affect the process.

Process is the step by step method that produces the output. In the SIPOC, the process is defined at a very high level, only 4-5 steps, starting with defining the beginning and end.

Outputs are typically products, information, services and/or decisions that are produced because of the process execution.

Customers are those who pay for the process output or receive the process output, or those who are directly impacted by the process output.

Advantages of SIPOC

- Helps to understand the purpose and the scope of a process.
- Lists all the suppliers clearly.
- Provides insight in to all the inputs of a process.
- Provides insight in to all the outputs of a process.
- Graphically shows the process as a sequence of actions.
- Clearly identifies all the customers who will use the process outputs are clearly identified.

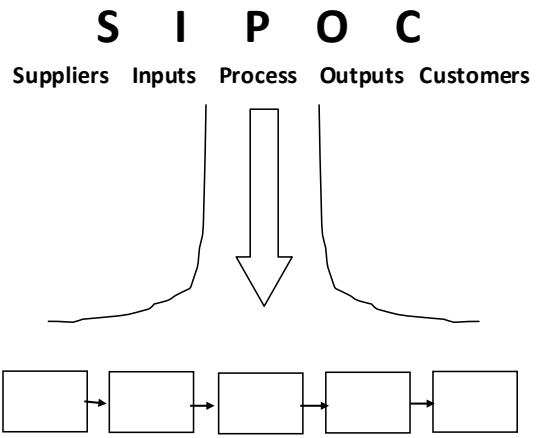
Putting it to work

SIPOC diagrams are very easy to complete. Here are the steps to follow:

1. Create an area for the team to post additions to the SIPOC diagram.
2. **Begin with the Process. Identify the start and end points of the process.**
3. Identify the major four to five high level steps.
4. Identify the Outputs of this Process.
5. Identify the Customers that receive the Outputs of this Process.
6. Identify the Inputs required for the Process to produce the Outputs.
7. Identify the Suppliers of the Inputs that are required by the Process.

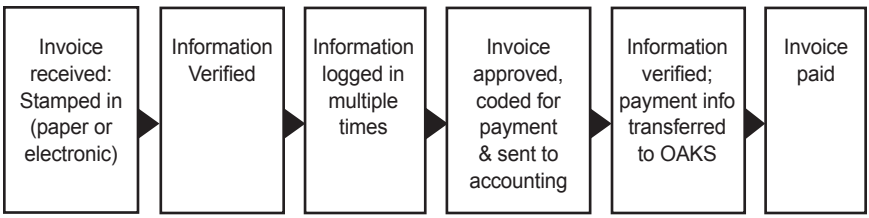
Questions to Ask:

- **Outputs:** What information, data, report, eligibility status, etc., comes out of this activity or is produced as a result of this activity?
- **Customers:** Who receives whatever it is that comes out of this activity?
- **Inputs:** What data, supplies, system, tools, etc., are required for this activity, or who is needed to perform the action?
- **Suppliers:** Who or what functional organization, system, report, database, etc., supplies or provides whatever is needed as an input to this activity?



Example: Here is a SIPOC for an invoice payment process.

Suppliers	Inputs	Process	Outputs	Customers
Vendors	Invoice		Received invoice	Account owner
Divisions	Information		Verified Information	Account owner
Divisions	Information, Data entry person		Spreadsheets, databases	Account owner
Divisions	Codes, approvers		Paper invoice	Accounting
Accounting	Invoice		Payment information	OAKS
OAKS	Payment Information		Paid invoice	Vendors



TIPS for creating a SIPOC diagram

- SIPOC creation is a team activity.
- **Start with the Process**.
- Brainstorming must be done to discover details about a process, especially if it's a new process.
- All the stakeholders of the process must be part of this brainstorming.
- Brainstorming must be done for each of the five elements: *suppliers, inputs, process, outputs and customers of SIPOC.*
- For an existing process that needs to be documented, SIPOC diagram is best created by first defining the process, and then identify outputs, inputs, customers, and suppliers.
- If the process is new, it is a good idea to start SIPOC from customer and move backwards to supplier.

Standard Work

*...Tool for **Define***

Standard Work is one of the most powerful but least used lean tools. Standard Work is a defined process that describes the safest, highest quality, and most efficient way known to perform a particular process or task. Standard Work defines the resources, steps, and time required to provide a service to the customer. Furthermore, Standard Work provides the baseline for continuous improvement and stability through reduced variation. As the standard is improved, the new standard becomes the baseline for further improvements, and so on. Improving standardized work is a never-ending process.

Standard Work is composed of:

- The steps required to provide the product or service to customer.
- The sequence or order in which elements need to be executed to produce the product.
- The expected time to complete the steps based on the lowest repeatable time observed to complete elements in the defined sequence.
- The quality criteria.

The first step in Standard Work development is understanding customer requirements. To provide goods and services "in the right quantity, at the right time," customer demand must be understood. (see Takt Time on page 76)

Standard Work Documentation can be completed using a Time Observation Sheet. The time observation sheet lists elements in the sequence as they are performed. Numerous cycles are observed and the time to complete each element is recorded. A lowest repeatable time is identified for each element and other waste observed is recorded. Benchmarking can also be done to identify best practices.

Standard Work should be a document subject to change; however, a process should be defined for making changes to the standard work. Revisions should be recorded each time Standard Work is changed and old Standard Work documentation should be filed for future reference.

Survey
*...Tool for **Voice of the Customer***

Surveys are most often used to find out what customers are thinking. Surveying is much like interviewing — but on paper. Instead of responding to interviewers, 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 downside is that people may interpret the questions somewhat differently than intended. Their answers may be ambiguous as well, and there's no opportunity to test understanding.

Putting it to work

Follow these simple steps to ensure a successful survey:

1. Identify the information you need.
2. Decide who has this information in its most reliable form.
3. Plan how you will use the information when you have it in hand.
4. Develop a series of questions and response format that will enable respondents to provide the information accurately and unambiguously.
5. Keep the questionnaire short, simple and clear.
6. Test your questions with several people to uncover any unclear questions. Conduct several "test surveys" to work out the bugs.
7. Administer the survey.
8. Analyze the results. What do they mean for your process, product or service?

Questions can be "closed" with a limited number of responses from which to choose: *How long have you worked in your present job?* Circle one:

- Less than 1 yr.
- 1 - 3 years
- more than 3 years

Or questions can be "open": *How do you use the information combined in the monthly progress report?*

Putting together a good, valid survey is an art and a science. It's a good idea to find an expert to assist in this process.

Example:
This sample questionnaire was used by a team to test reactions to a proposed Combined Petty Cash/Local Travel form.

COMBINED PETTY CASH/LOCAL TRAVEL QUESTIONNAIRE		
Please take a minute to answer the following questions. If there's an area of concern that has not been covered, please let us know. 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 form 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 a advantage with this uniform size combination for filing purposes?	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? Indicate minutes or hours	Yes	No
Comments:		

Takt Time
*...Tool for **Measure***

Takt Time is used to calculate the maximum allowable time necessary to produce the required output for the customer. If a product is not made within the determined Takt time, a demand will go unfilled. Takt time can also be used to determine the number of people necessary to meet the customer demand.

$$\text{Takt Time} = \frac{\text{Net Available Time}}{\text{Required Output}}$$

Putting it to work

1. Determine the amount of net time available to produce product by subtracting lunch, breaks, etc. from total scheduled time.
2. Determine the number of products required.
3. Take the Net Available Time and divide it by the Required Output. This will give you the Takt time.

Example:
Here is an example of how to determine the amount of time one person will have to process each application in order to meet the demand for 42 applications a day (required output).

Takt Time = $\frac{\text{Effective working time per time period}}{\text{Required output during the time period}}$

Takt Time = $\frac{\text{420 minutes per day *}}{\text{42 applications}}$

- One person working an 8 hour shift, minus 30 minutes for lunch and two 15 minute breaks.

Takt Time = 10 minutes per application

Here is an example of how to determine the number of people that will be needed to meet the required output.

1. Determine how long it takes to process one application from start to finish by timing the operator processing the applications (use an average time taking into consideration that not everyone will process the applications at the same speed).
2. Take the average time and divide it by the Takt Time. This will give you the number of operators that will be needed to meet the demand.

$$\text{Number of operators} = \frac{15 \text{ minutes} * (\text{average time})}{10 \text{ minutes} \quad (\text{Takt Time})}$$

Number of operators = 1.5 (round up to 2)

**Amount of time it takes the average operator to process one application.*
It will take two people to meet the demand of the customer.

Takt time is useful in stabilizing production. By limiting overproduction, it stabilizes the system and prevents buildup of inventory and the subsequent stops and starts. Takt time also helps work cell designers. In an ideal work cell, all tasks are balanced, they all require the same time to execute and that time equals the Takt time. If any operation requires more than the Takt time, the cell cannot produce at the necessary rate.

TIM U. WOOD Plus Talent

*...Tool for **Improve***

TIM U. WOOD is a way of identifying waste in a process. Each letter stands for some kind of waste. Examine the process map and data along with employee observations to search out TIM U. WOOD. Improvements should eliminate or limit TIM U. WOOD in a process.

Transportation: involves unnecessary movement of materials, such as the movement of "work in process" from on operation to another. Causes of transportation waste:

- Poor plant layout
- Large batch sizes
- Long lead times
- Large storage areas

Inventory: consists of excess materials not directly required for current customer orders. Examples are parts, raw materials, work-in-process (WIP), supplies, and finished goods. Inventory is considered waste since it does not add value to the product. Costs are incurred for environmental control, recordkeeping, storage, and retrieval. Excess inventory will run the risk of gathering dust, deteriorating, becoming obsolete, or getting damaged.

Motion: is the inefficient and unnecessary movement of workers and machines. Workers should not have to walk excessively, lift heavy loads, bend abnormally, reach or repeat motions. Causes of motion waste:

- Poor people/ machine effectiveness
- Inconsistent work methods
- Unfavorable facility or cell layout
- Poor workplace organization
- Busy work

Underutilization:

- Underutilization waste refers primarily to underutilizing employee time or talent. Examples include staff members that might be gifted at writing or editing, but aren't being used in this capacity. Or Individuals using a fax machine – even though they have all been assigned individual email fax numbers that send the files straight to their email account. Other underutilization could include office space being used to house outdated items or not being used efficiently or systems not being completely used to their full capability (i.e. auto notifications, customized reports, IT turned something off at the request of one individual and never turned it back on even though it is needed).

Waiting: periods of inactivity in a downstream process occur because an upstream activity does not take place or deliver on time. Causes of waiting waste:

- Delays
- Upstream quality problems
- Unplanned maintenance
- Poor planning
- Needed information not in place

Overproduction: producing more than demanded, or producing it before it is needed resulting in visible storage of materials. Overproduction is the result of producing to anticipated demand; making more, making earlier, or making faster than is required by the next process. Causes of overproduction waste:

- Just-in-case logic
- Misuse of automation
- Long process set-up times
- Unleveled scheduling
- Unbalanced workload
- Redundant inspections

Over-processing: is due to additional steps or unnecessary activities in a process, such as rework, reprocessing, or re-handling. Over-processing waste should be minimized by asking why a specific step is needed and why a specific product is produced. Causes of over-processing waste:

- Lack of communication
- Redundant approvals
- Extra copies/excessive information
- Just-in-case logic

Defects (Defective Products): this waste involves products or aspects of your service that do not meet the customer expectations or requirements, resulting in returns, rework, or repair. Causes of defects:

- Weak process control
- Poor Quality
- Poor equipment maintenance
- Inadequate training/work instructions
- Poor product design
- Misunderstood customer needs

Many people add an additional waste defined as talent.

Talent: this waste occurs when workers' skills and abilities are not used effectively. Causes of underutilized workers:

- Culture of the organization
- Hiring
- Low or no investment in training
- Turnover

Trail Chart
...Tool for **Define**

The ***TRAIL Chart*** is a tool used to help determine your team members and the time commitments needed at various stages of the project. This tool is used at the start-up of a team.

T = Team members – partners/co-workers who are actively involved with the project.

R = Resource to the team who provides expertise, skills, or clout.

A = Approver – approves decisions that fall outside the Team's authority.

I = Informed – anyone who needs to stay abreast of the direction and findings of the project.

L = Leader – the team leader of the project.

Putting it to Work:
To create a TRAIL Chart:

1. List everyone that you think needs to be involved with the project.
2. List at what phase the people listed should be involved.
3. Determine what role each person should play.
4. Determine the time commitment for each member.

Example:

Key Stakeholders	**Project Phase**				
	Define	Measure	Analyze	Improve	Control
Joanne	A	A	A	A	A
Susie	T - 10%	T - 30%	T - 10%	T - 10%	T - 30%
Jane	T - 25%	T - 25%	T - 25%	T - 25%	T - 25%
Anand	T - 25%	T - 25%	T - 25%	T - 25%	T - 10%
Adam	T - 25%	T - 25%	T - 25%	T - 25%	T - 10%
IT	R	R - 20%	R - 20%	R - 10%	
Customer	R - 10%	R	R	R - 10%	
Leader	L - 25%	L - 25%	L - 25%	L - 25%	L - %

TRAIL Chart helps to plan for and communicate personnel needs for a project.

Tree Diagram

*...Tool for **Improve***

A ***Tree Diagram*** can be used in a variety of ways for a variety of purposes. One way is to help in finding root causes of a problem as seen on page 44, used with the Five Whys Technique.

Most commonly, ***Tree Diagram*** has been used as a planning tool for breaking down a broad goal into many levels of increasingly detailed and specific actions that need to be done in order to achieve the stated goal. As its name implies, the tree diagram consists of branches that specify the actions required at each level of detail. These branches further branch out into smaller branches that break these actions into more detailed or specific actions. The branching continues until the desired level of detail is reached and who will be responsible and when the tasks will be completed can be defined. Tree diagram takes a broad goal to the nitty-gritty details and describes the methods by which every purpose is to be achieved.

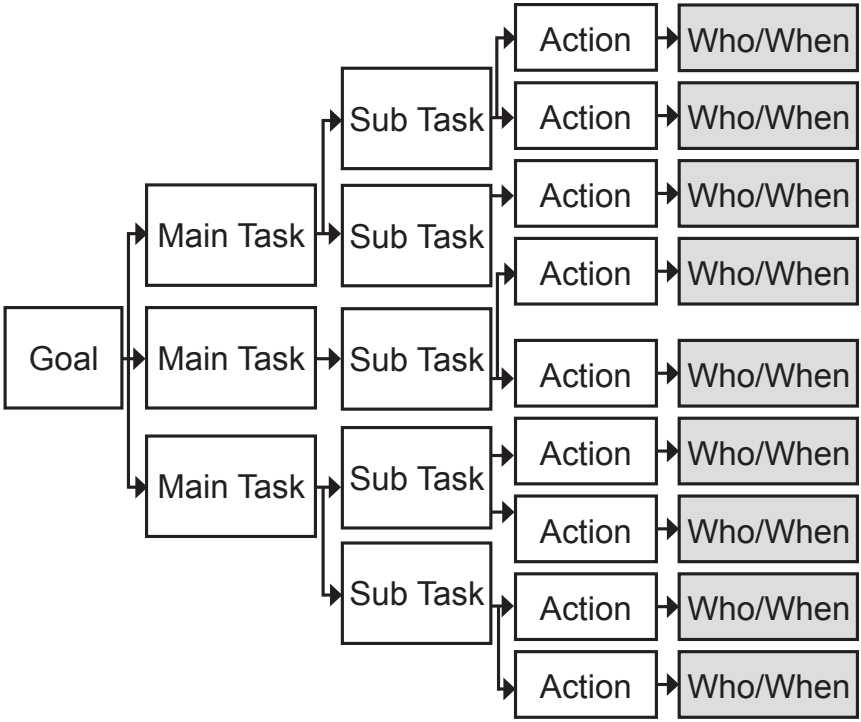
The tree diagram ensures that the goals and actions are in alignment and support the primary goal of the team and reveals the 'true' complexity level of a goal by systematically identifying the actions and resources needed to attain that goal. The use of this tool enables the distribution of assignments or responsibilities to team members and makes it easy for people to volunteer for specific tasks. Tree diagrams facilitate the monitoring of the progress of various activities since these are organized at different levels that have their own sub-goals and assigned persons and deadlines.

Putting it to Work

1. Clearly identify the goal. Be sure everyone agrees on the goal.
2. Generate the main tasks involved in accomplishing the goal and place them on the tree.
3. For each main task, brainstorm the sub-tasks that will be required to accomplish the main task and add them to the tree.
4. Continue this process until there are specific tasks or actions that can be assigned.
5. Assign who will do which specific actions.
6. Examine the tree diagram for logical flow and sequences.
7. Examine it for any potential conflicts in different branches of the tree.
8. Identify potential barriers or problems.
9. Plan counter measures to ensure a successful implementation.

Tips

- Start with the big ideas, not the details
- Use post-it notes to develop the tree diagram
- Draw lines only when finished
- Look for potential barriers & develop counter measures
- Review regularly to monitor progress


Goal
Main Task
Main Task
Main Task
Sub Task
Sub Task
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Action
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Who/When
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Visual Management
*...Tool for **Control***

Visual Management is a Lean tool for increasing efficiency and effectiveness simply by making things visible. When things are visible, they are kept in the conscious mind.

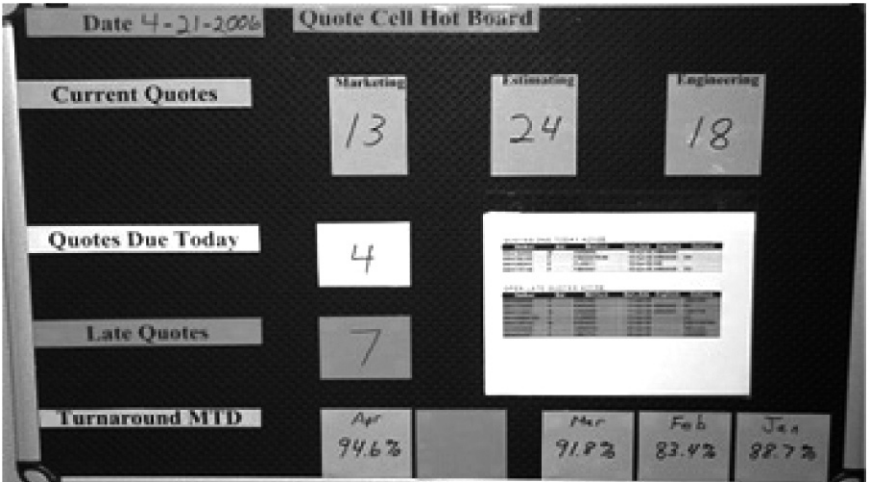
Common reasons why visual management is used:

- To make problems, abnormalities, or deviation from standards visible to everyone and thus corrective action can be taken immediately.
- To display the operating or progress status in an easy to see format.
- To provide instruction.
- To convey information.
- To provide immediate feedback to people.

Replacing text or numbers with graphics makes information easier to understand at a glance, making it a much more efficient way of communicating a message.

Examples:

- Schedule or status boards
- Color Coded files / transactions
- Appropriate signage to direct people to areas
- Control charts
- Scorecards



Visual Controls can be used to track key agency metrics and task lists. To be effective, visual controls should not be 'hidden away'. Key metrics should be defined and tracked with targets or goals and corrective action should be taken if any metric or target is off track. Visual controls do not need to be high tech to be effective.


30 24 23
23 22 19 24 29
19 18 30
34 39
34

Voices
*...Tool for **Define***

Four Voices: Listening to Voices

- Voice of the Customer - VOC
- Voice of the Business - VOB
- Voice of the Process - VOP
- Voice of the Employees - VOE

Voice of the Customer (VOC)
Before beginning any project or process map it is important for the team to determine the customer. Lean Six Sigma is a customer driven methodology and your customer needs should be in the forefront in every decision (including project selection) you make. Customer focus is one of the foundation blocks of Lean Six Sigma. Furthermore, it is imperative that you identify your customer needs including:

- What your customers want.
- What your customers think of the current services.
  - Are the services fast enough?
  - Additional services?
  - What are their reactions to the staff?

You may obtain the ***Voice of the Customer*** in several ways; whenever possible focus on immediate feedback. The closer the feedback is to the service the more valuable or trusted the feedback. VOC feedback examples:

- Written Survey (surveymonkey.com)
- Phone calls
- Complaints
- Focus groups
- Interviews
- Utilize social media
- Web utilization
- Twitter

The voice of the customer tells us what the customer wants. Often the Voice of the Customer (VOC) is not specific and not in technical language. Sometimes the Voice of the Customer is stated as solutions; therefore VOC needs to be translated to the Critical Customer Requirements (CCRs) that can be used to assess the performance of the process. CCRs must be defined such that a clear target with specifications is established to be useful in determining our current defect levels. CCR can be measured whereas the VOC may not be measurable. CCR establishes a target, customer specifications, and an acceptable range of performance.

Voice of the Business (VOB)
The Voice of the Business can be looked at in two ways: Top-Down Approach and the Bottom-Up approach.

The Top-Down Approach is driven by Key Business Goals and Objectives:

- Key objectives being met?
- Changing business conditions.
- New objectives that challenge current reality.

Bottom-Up Approach is driven by known problems and operational issues:

- Activity-level objectives not being met.
- Excessive use of resources.
- New objectives that challenge current reality.
- Changing business conditions.

A valuable tool to use in capturing the Voice of the Business is conducting performance benchmarking and process benchmarking. Performance benchmarking is the process of determining what other organizations are doing in providing products and services. It helps an organization assess its competitive position. Process benchmarking is the process of finding how "world-class" organizations provide their products and services to determine opportunities for improvement. It relies on process improvement efforts to produce bottom-line results.

Voice of the Process (VOP)
Voice of the Process is what we observe from the process and what the data tells us. The Voice of the Process leads us to areas that need attention and to best practice areas. You need to continually scan your processes and observe areas for improvement. A Scorecard/Dashboard can be employed to help quickly identify metrics that are out of specifications or areas that need improvement. The goal is to proactively prevent problems based on "listening" to the data.

Voice of the Employee (VOE)
The Voice of the Employee is crucial to carrying out the message and mission of the organization. The employee voice brings about personal ownership and a sense of responsibility that employees are directly contributing to success of the organization. Through their voice, employees provide a dialogue with management that sheds light on areas of success within the organization or areas of concern. The Voice of the Employee is also linked to the Voice of the Process in that problem areas can be identified along with the Voice of the Customer and Voice of the Business to identify potential opportunities.

Weighted Voting

*...Tool for **Define** and **Improve***

Weighted Voting enables teams to quantify the various positions and preferences of team members. It differs from criteria rating forms in two ways: first, no decision factors or criteria are used; second, individual member's votes are recorded, without discussion or effort to reach agreement on a single number.

Putting it to work

Using a flip chart, set up a grid as shown below, with the options listed horizontally and team members listed vertically.

1. Give each person 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.
2. Members then decide how to distribute their votes among the options to indicate their relative preferences. Keep in mind these few guidelines:
   a. Have members decide how they will distribute their votes (preferably jotted down on paper) before any votes are recorded on the chart.
   b. Encourage people to spread their votes to represent their relative feelings about the options, rather than lump all their votes on a single favorite.
   c. Ask members to show their votes for each option all at once by raising the number of fingers that represent their vote.
   d. 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 the votes so the team can see where agreements and disagreements occur. This information provides a basis for discussion that can lead to consensus.

Team Members	Option 1	Option 2	Option 3	Option 4
Jim	2	1	2	1
Clara	1	0	1	4
Justin	3	1	1	1
Mark	2	1	1	3
Totals	8	3	5	9

NOTE: Some people prefer not to total the numbers for each option. This way, they guard against the risk that weighted voting will become just another mechanism for a win-or-lose outcome. The tool is not the decision-maker; the team makes decisions. Regardless of whether you total the numbers, the most important thing is that you use weighted voting as a vehicle for moving more closely to consensus.

A Shorthand Guide to When to Use Various Tools

Use...	When you need to...
Action Register	Document and track critical tasks, ownership responsibilities, and target completion dates.
Affinity Diagram	Organize into groups a large number of ideas, opinions, issues, or other concerns.
Balance Sheet	Identify the pro's and cons' of various options.
Basic Statistics	Understand and use data for making improvements.
Box Plot	Quickly compare the data distribution of two or more data sets.
Brainstorming and List Reduction	Generate, clarify and evaluate a sizable list of ideas, problems or issues. Process the output of a brainstorming session to a manageable number
Cause and Effect Diagram	Systematically analyze cause and effect relationships and identify potential root causes of the problem.
Check Sheet	Gather a variety of data in a systematic fashion for a clear and objective picture of the facts.
Clean Sheet Redesign	Transform, not marginally improve, but create a new process that's **significantly** better than the old one.
Control Chart	Monitor the performance of a process to determine if its performance reveals normal variation or out-of-control conditions.
Control Plan	Measure, monitor and adjust the improved process to ensure customer requirements are being consistently met.
Criteria Rating Form	Evaluate various options based on selected criteria.
CT Flow down	Break a problem down with increasing detail to determine where to focus a project.
Five S	Organize a workplace to increase quality, identify waste, identify standard process, and promote visual control.
Five Whys	Investigate the root cause of a problem.
Flow Chart	Picture and document a process to examine how various steps in a process relate to each other.
FMEA: Failure Mode and Effects Analysis	Identify potential defects/issues in a design or a process based on severity, expected frequency, and likelihood of detection.
Force Field Analysis	Identify the driving and restraining forces that affect process performance.
Gantt Chart	Explain implementation plans to management and workers, and ensure an organized, objective implementation.
Histogram	Display the dispersion or spread of data.
Impact matrix aka P.I.C.K. Chart	Compare multiple potential solutions against two key variables (impact and control) in order to select where to focus the team's efforts.

Interview	Gather information from individuals or groups, especially your internal and external customers.
Nominal Group Technique	Work toward consensus ensuring that everyone on the team has an equal voice.
Operational definition	Clearly and concisely define an issue or problem to create common understanding; especially used to define data collection so that it is consistent.
Pareto Diagram	Break a problem into its parts and clarify where improvement efforts should be focused (Identify the 80% of the problem).
Pert Chart	Plan an implementation in a detailed way identifying dependencies and time frames.
Poka Yoke	Mistake proof a process by changing the method or equipment to ensure that a particular error cannot happen.
Process Map	Understand the current process in order to identify opportunities for improvement by mapping all of the steps in the process and identifying the job function that completes each step.
Project Charter	Start an improvement team: clarify what the team will be working on, why the team is being created, the scope, the expected outcomes and measures.
Run Chart	Display data over time.
Scatter Diagram	Compare the relationship between two factors.
SIPOC	Identify a high-level picture, all relevant elements of a process - the Suppliers - Inputs - Process - Outputs and Customers.
Standard work	Define the resources, steps, time and quality requirements necessary to provide a service to the customer.
Surveys	Gather a great deal of information from a lot of people economically.
TAKT Time	Calculate the maximum allowable time necessary to produce the required output for the customer.
TIMWOOD	Identify waste in a process in categories of Transportation, Inventory, Motion, Waiting, Overproduction, Over-processing, and Defects.
TRAIL chart	Identify the members of your improvement team and their roles: Team members, Resources, Approver, Informed, and Leader, and define how much time they will need to commit to the project in the various phases.
Tree Diagram	Plan accomplishment of a broad goal by breaking it down into many levels of increasingly detailed and specific actions that need to be completed in order to achieve the stated goal.
Visual Management	Increase efficiency and effectiveness by making things visible – often in graphic or scorecard form.
Voices	Determine requirements of the process by listening to the Voices of the Customer, the Business, the Process, and the Employees.
Weighted Voting	Quantify the various positions and preferences of team members to support consensus decision-making.

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