Quality Tools

Online Course Workbook

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Introduction to Quality

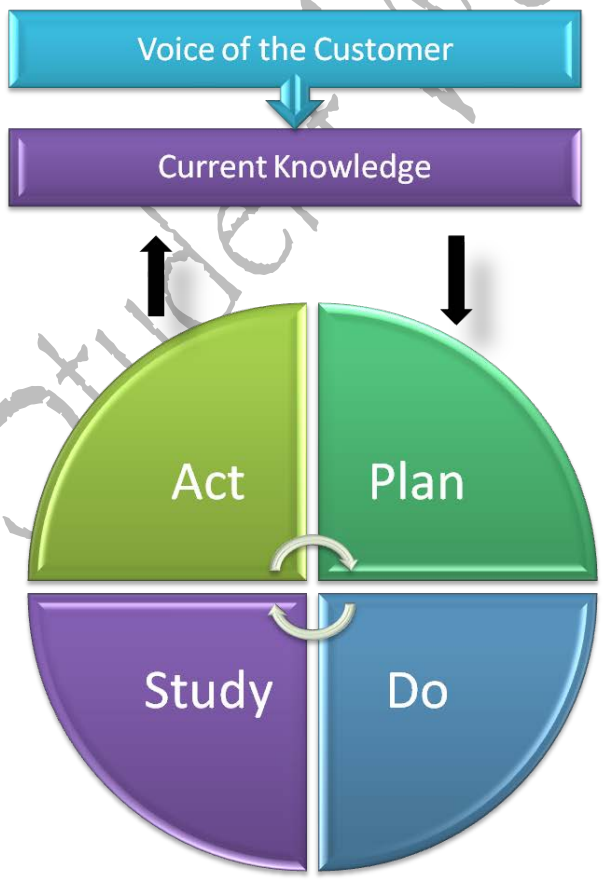
The American Society for Quality defines the term Quality as a subjective term for which each person has his or her own definition. In technical usage, quality can have two meanings: 1. The characteristics of a product or service that bear on its ability to satisfy stated or implied customer needs, and 2. A product or service free of deficiencies. Pure and simple, quality is not an option for companies who want to stay in business. Learning about quality tools and the understanding of how to apply these tools within an organization ensures that the organization produces quality goods and services.

Change towards continuous improvement cannot happen without quality tools. As organizations move towards quality and change, they need a solid understanding of quality tools and a plan for how they are going to approach the change. Quality tools give them the ability to collect and analyze data, but before data can be collected and analyzed, a plan must be in place. One of the best ways to plan for quality is to use the Shewhart Model.

The Shewhart Model

The Shewhart Model is also sometimes called the Deming Cycle. This model was popularized by the late W. Edwards Deming, a noted statistician and quality leader. So it is sometimes associated with Dr. Deming.

The foundation for continuous improvement was laid by Dr. Walter Shewart working in the Bell Telephone Laboratories in the 1920s conducting research on methods to improve quality and lower costs. He developed the concept of control with regard to variation, and came up with continuous improvement. Doctor Deming built upon Shewart's work and took the concepts to Japan following World War II. There, Japanese industry adopted the concepts whole-heartedly. The resulting high quality of Japanese products is world renowned.



Details of a PDSA Plan [1]

Plan:

The planning phase of the improvement cycle should contain;

- *The specific objective and the questions to be answered*
- *The prediction of the results of the cycle*
- *The plan for carrying out the cycle*
- *The plan for the data collection*

Once the methods have been identified, the team should decide who has the responsibility for collecting and studying the data. The team should maintain controls over the collection of data, especially, if the responsibilities are outside of the team. That is, they should be aware of such things as the training that is needed, any problems that occur, and whether the method of measurement has been studied. The team must also decide when, where, and by whom the plan will be implemented.

Consideration should be given to whether the plan can be carried out on a small scale so the impact can be studied with minimal disruption. For example, a change might be made and studied on one assembly line first before being implemented throughout the entire plant.

The team should review the plan to assure that it is consistent with their charter. Special attention should be given to the boundaries for the activities contained in the charter.

Do:

This phase begins when the plan for the cycle is put into place. In any collection of data, there are many opportunities for error and many opportunities for special causes to occur. Plotting of the data as they are obtained (i.e. in order of time) is vital to recognize problems.

The team should be informed about and note things that occurred during the data collection that were not part of their plan. For example, the operators might not have been adequately trained or the procedures used not standardized. This would also include unusual or unexpected situations that occurred, especially things that went wrong. For example, a power failure may have occurred or an observation may have been missed. When studying the data, the team should consider these occurrences. If it is not possible to take action on such items during the present cycle, they should be considered in future cycles.

Study:

In this phase, the data are analyzed to help answer the questions which were posed during the planning phase. Since most data from well-planned studies can be analyzed using simple graphical methods, many teams will be able to analyze their own data. There will be times, however, when help from a statistician or someone else with special expertise is required. The information gained from the analysis of the data is combined with the "current knowledge".

It is in the study phase of the improvement cycle that learning takes place. To assist the team in assessing what was learned, the results of the analysis of the data should be compared with the predictions made during the planning phase. The predictions were based on the team's current knowledge. If the analysis of the data confirm the predictions, the degree of belief in the current knowledge is increased.

Act:

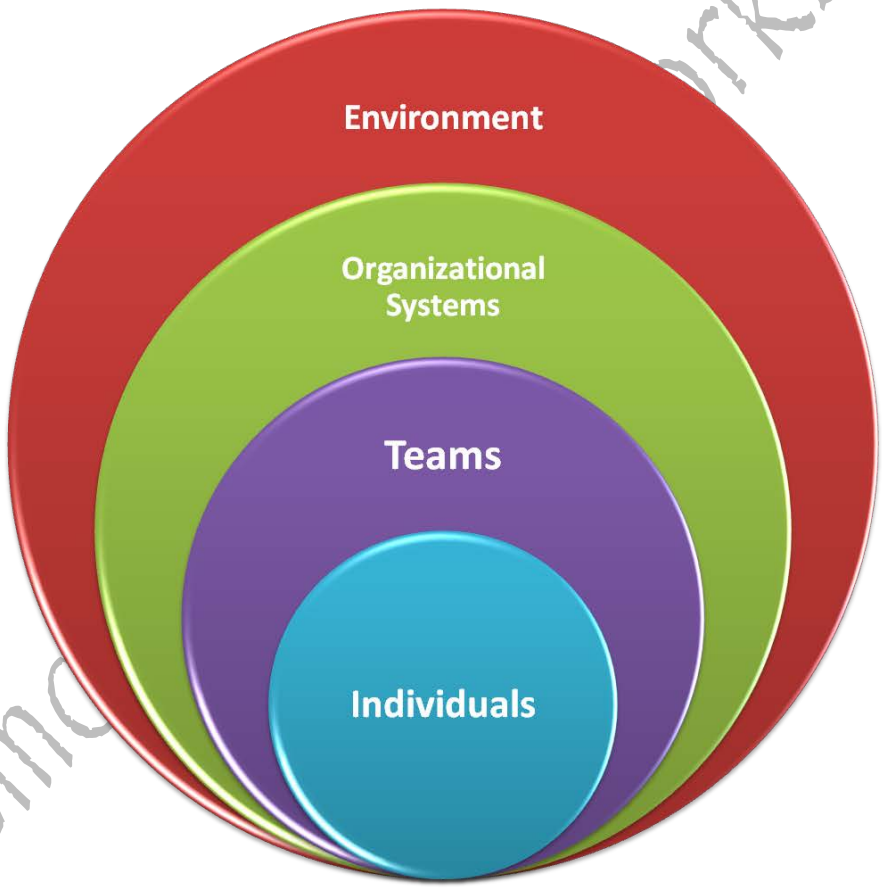
In this phase of the improvement cycle, the team decides whether changes are to be made to the process or product. If there are any changes, the team should plan and implement them.

What was learned in a cycle may not result in sufficient knowledge to make a change. For example, the cycle may have identified an important quality-characteristic for use in developing a cause and effect diagram, confirmed existing knowledge, or identified new technology that could impact on the design of a new product. In some cases, a cause may be identified which does impact a quality-characteristic but the cause and effect system may not be sufficiently understood to take action.

[1] *Associates in Process Control, Jerry Langley, 1999.*

The Model for Change

Change happens regardless of whether we do something or not. Change is inevitable - it is a constant. To manage effective organizational change the approach must be at several different levels. It must first start on an individual level, move to teams or groups, and then analyze the systems that support both the individual and groups. The final aspect of organizational change is the environment where the change is taking place. If all of the other components to an organization have been addressed, positive change towards quality will occur.



Keys to Effective Change

Create a Clear Vision - *Create a clear vision that helps people understand and keep focused on needed changes.*

Clearly Demonstrate Top Management Support - *Create opportunities for top management to demonstrate support through their involvement, decisions, and actions.*

Empower One or More Champions to Manage the Change Process - *Designate and empower a person or team to manage the change process and champion the needed changes.*

Communicate, Communicate, Communicate - *Use various methods and opportunities to communicate with those who can influence and are impacted by the changes, keep them informed about progress and successes, and listen to and respond to their concerns.*

Strategic Involvement - *Involvement in understanding and influencing the change process breaks down resistance and increases ownership for the success of needed changes. Use creative approaches to efficiently involve the right people at the right time.*

Use Data to Drive Change - *Relevant internal or external data collected from surveys, interviews, research, or site visits to discover best practices can provide a strong incentive for change and overcome resistance to change.*

Education and Training - *Education and training are often necessary to unfreeze old ways of thinking and acting, learn new ways, and overcome fears of not having the skills to adapt to the desired changes.*

Reward and Showcase Successes or Efforts to Change - *Tangible rewards that reinforce change and recognition for successes or bold efforts to make needed changes increases the incentive for change. How management treats efforts that do not succeed may send equally strong messages.*

Provide the Resources to Drive Change - *Directing resources towards needed changes provides an incentive for change.*

Acknowledge and Prepare for the Stress of Change - *It is sometimes helpful to acknowledge that change can be stressful, to prepare people for the highs and lows of the change process, and to provide training in how to manage the stress of significant change.*

Pilot Projects - *Smaller pilot projects are less risky and will often stimulate interest in larger scale projects.*

Be Sensitive to Time and Action Requirements - *Some resistance comes from new demands on already busy schedules. Make meetings count, utilize Change Champions and Action Teams as much as possible to accomplish change.*

Take a Positive Approach to Change - *Negative approaches that seek change through coercion, force, manipulation, placing blame, or looking for scapegoats increase resistance to change. Attack problems and not people and create positive reasons and opportunities for change.*

Confront the Resistance - *It is usually best to get resistance out into the open and confront it in a constructive and direct way. Resisters won over often become Change Champions. Even if they continue to resist, the issues will be clear.*

Know When to Bite the Bullet - *Sometimes change needs to be made even though many of the alternatives mentioned above are not possible or did not work. There are times when people either need to join the changes or move aside.*

Effective Team Work

The most critical component to creating change in an organization is to include the people who work in the system in the change. Without a team effort, change rarely happens and if it does, usually will not be maintained. Teams make change happen!

Teams are a critical component to organizational change. What makes an effective team?

- *They have a defined charter listing expectations and goals.*
- *They understand how to manage conflict.*
- *Effective teams have an understanding of group dynamics.*
- *Have good communications skills.*
- *Define group norms, values and expectations.*
- *Practice good decision making and have a defined process for how they make decisions.*
- *Defined team member roles and responsibilities.*
- *Use quality tools to collect and analyze data.*

Think back to a time you worked on a team that functioned very efficiently. What were some of the characteristics of that team that made it work so well?

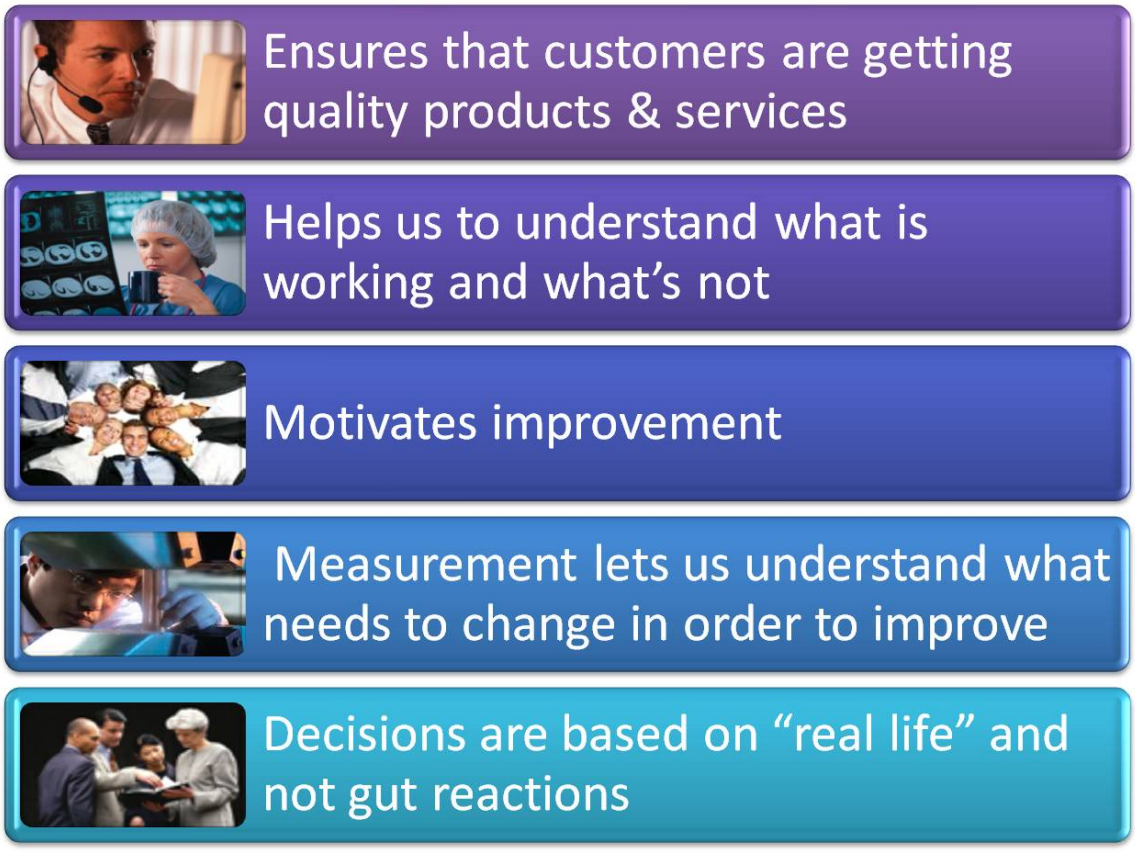
List them below.

Tools Overview

Different tools produce different results. Some tools generate information that helps to identify issues. Other tools analyze the information after it has been generated. And finally, some tools do both--identify issues and analyze problems at the same time. A highly performing quality team needs to have mastery of all these tools.

Although it is acceptable to use a tool in isolation, quality tools used in combination with each other can provide a much more dynamic effect. By using the tools in concert with each other, a team can ensure that they have comprehensively evaluated a situation.

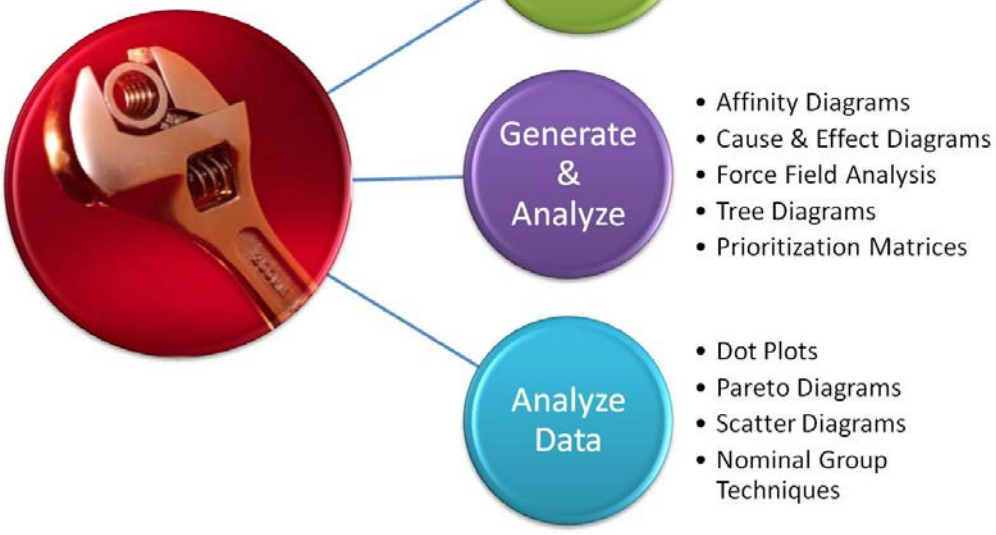
The Importance of Tools



All the Quality Tools!

Also, some tools are designed to be used in a team setting so that members can participate in the documentation of data, while other tools require data be collected from the organization outside the team meeting. Brainstorming, nominal group techniques and flow charting are tools that identify issues. Affinity diagrams, cause and effect diagrams and force field analysis help a team to generate information and analyze it at the same time. Dot plots, tree diagrams, Pareto diagrams, scatter diagrams and prioritization matrices all help a team to analyze data after it has been generated.

An example of how tools are used in combination with each other might include brainstorming a list of issues, using an affinity diagram to group the data, prioritizing the most important group, and then taking the most critical group of data. The team can then use a Pareto diagram to conduct further analysis.



Data Types[2]

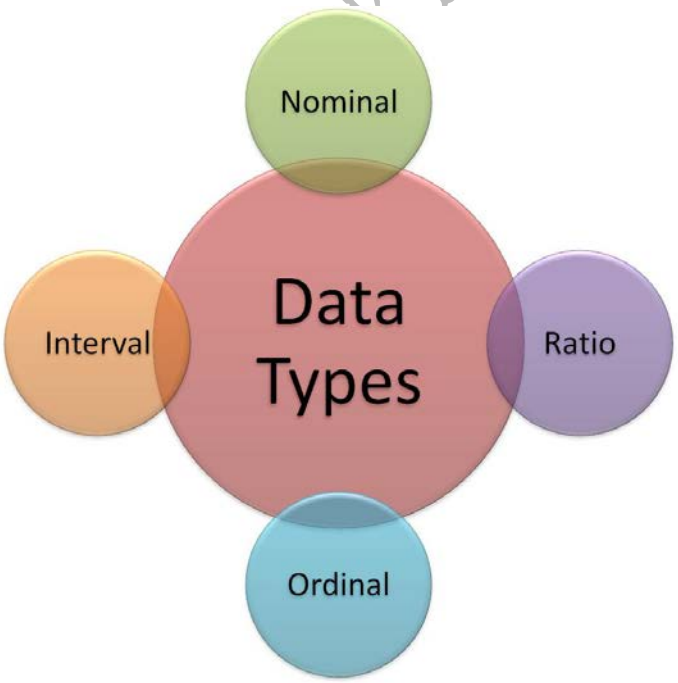
Nominal Data

Nominal data basically refers to categorically discrete data such as name of your school, type of car you drive, or the name of a book. It is easy to remember because nominal sounds like name (they have the same Latin root).

Ratio Data

Ratio data is interval data with a natural zero point. For example, time is considered ratio data, since 0 time is meaningful. Degrees Kelvin has a 0 point, an absolute 0, and the steps in both these scales have the same degree of magnitude.

Ordinal Data



Ordinal data refers to quantities that have a natural ordering. The ranking of favorite sports, the order of people's place in a line, the order of runners finishing a race are more often the choice on a rating scale from 1 to 5. With ordinal data you cannot state with certainty whether the intervals between each value are equal. For example, we often use rating scales like the Likert scale. On a 10 point scale, the difference between a 9 and a 10 is not necessarily the same difference as the difference between a 6 and a 7. Ordinal data is easy to remember, because ordinal sounds like order.

Interval Data

Interval data is like ordinal except we can say the intervals between each value are equally split. The most common example is temperature in degrees Fahrenheit. The difference between 29 and 30 degrees is the same magnitude as the difference between 78 and 79.

[2] *Measuring Usability LLC*

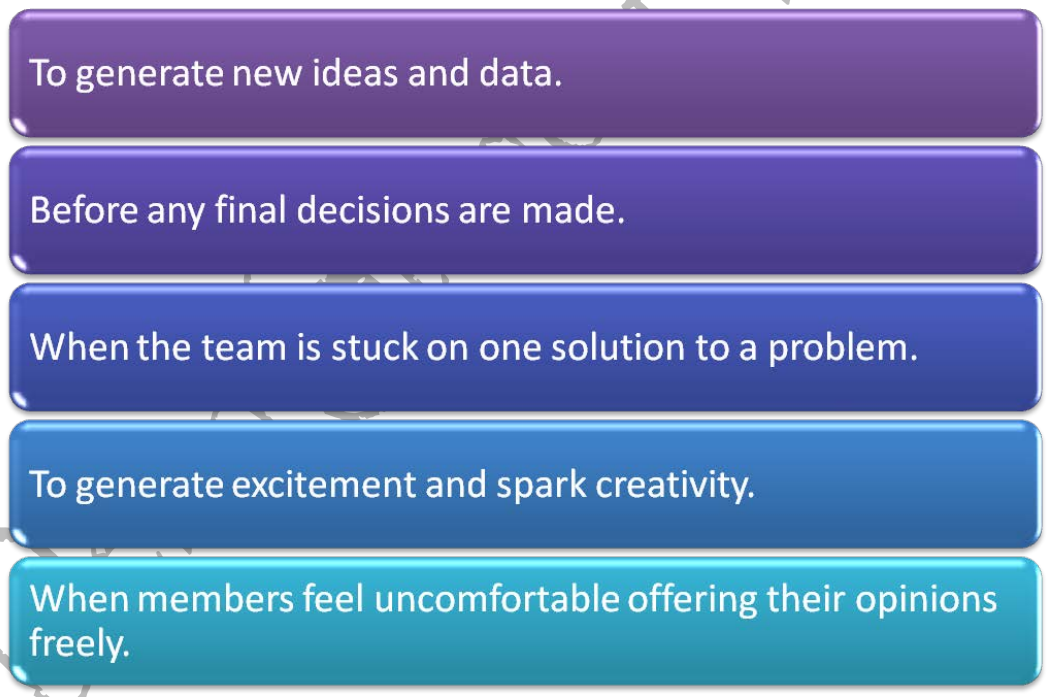
Brainstorming

What is Brainstorming?

Brainstorming is a technique used to maximize creativity. It is basically an activity that teams use to get their ideas on paper and open to discussion. It is founded on the idea that groups of people come up with better ideas than just one person. Unlocking the creative power of a team leads to better information and more ideas in less time.

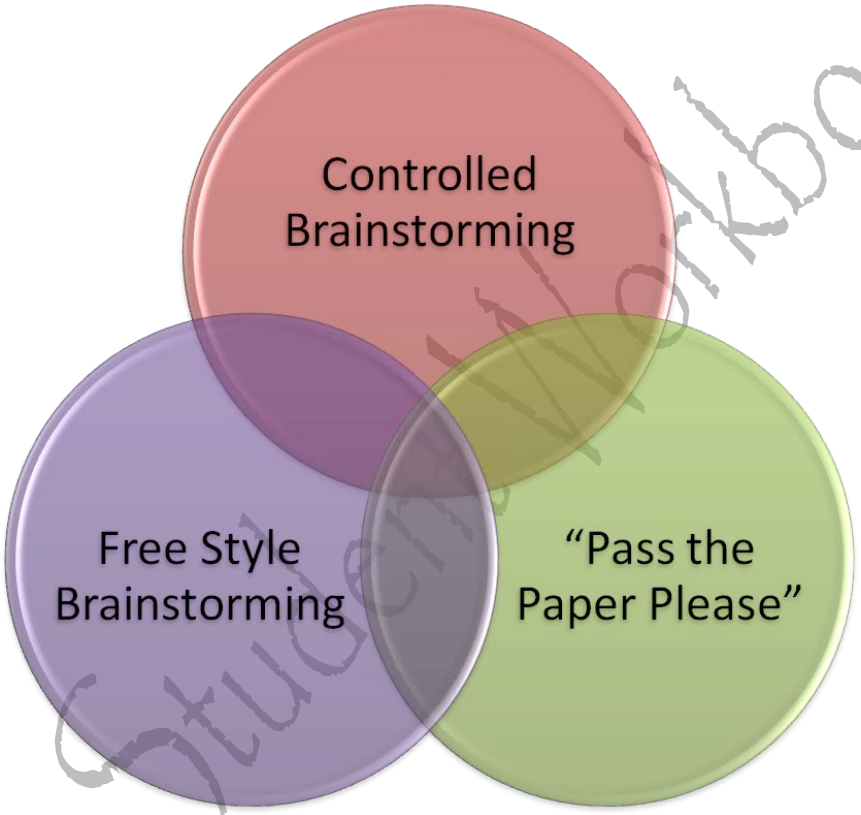
The purpose of brainstorming is to ensure that all options are explored before a decision is made. Brainstorming is one of the easiest and most enjoyable ways to generate information that can then be discussed, evaluated and prioritized. To increase creativity and productivity, it is important the team feels comfortable and that they are having a good time as they are brainstorming.

When to Brainstorm



How to Brainstorm

There are many ways that a team can brainstorm. We're going to cover three of the most common ways:



Also, three of the quality tools that we'll be covering later in this module are also considered structured ways to brainstorm. Those tools are cause and effect diagrams, force field analysis, and tree diagrams.

Controlled Brainstorming

1. *The facilitator reviews and operationally defines the subject to be brainstormed.*
2. *The facilitator reviews the guidelines for the brainstorming session.*
3. *Everyone takes a couple of minutes in silence to think about the question, and then write down their ideas on paper.*
4. *One-by-one, and going in order, team members give one of their ideas to the group.*
5. *The facilitator records each idea on flip chart paper for the entire team to review.*
6. *Once their list has been exhausted, team members are encouraged to use other peoples' ideas to spark new ideas that haven't been recorded.*
7. *At the end of the session, the team discusses all ideas that have been recorded.*

Freestyle Brainstorming

1. *The facilitator reviews or operationally defines the subject to be brainstormed.*
2. *The facilitator reviews the guidelines for freestyle brainstorming.*
3. *For about fifteen minutes, team members randomly begin verbalizing their ideas.*
4. *So that everyone can see the data being generated, the facilitator writes down ideas as fast as he/she can on a piece of flip chart paper in front of the team.*
5. *The team facilitator encourages team members to use other peoples' ideas to spark new ideas that haven't been recorded.*
6. *At the end of the session, ideas are reviewed and discussed.*

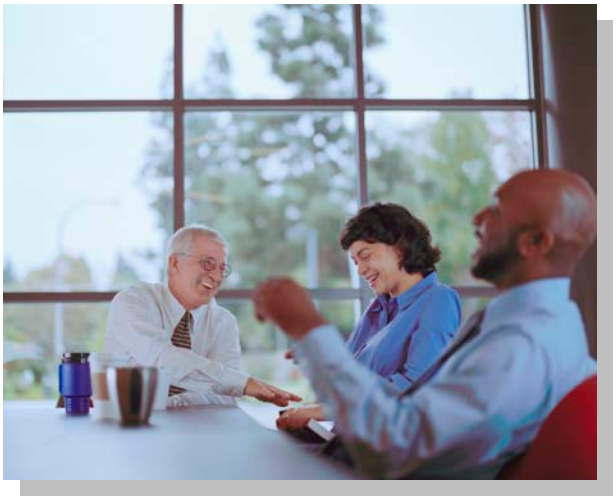
"Pass the Paper Please"

1. *The facilitator reviews and operationally defines the subject to be brainstormed.*
2. *The facilitator reviews the guidelines for the brainstorming session.*
3. *Sitting in a circle or at a table, everyone takes a couple of minutes in silence to think about the question, and write down one idea at the top of a piece of lined paper.*
4. *After a team member has written down their idea on the first line of the paper, they simultaneously pass the paper to the person sitting to their right.*
5. *That person reads what has been written at the top of the paper and adds their idea next to the list.*
6. *Team members are encouraged to use other peoples' ideas to spark new ideas that haven't been recorded.*
7. *At the end of the session, each team member takes a piece of flip chart paper and posts all the ideas from the piece of paper that they have been left with.*
8. *The team discusses all ideas that have been recorded.*

Guidelines for Brainstorming

- No judgment or criticism.
- No discussion during the session, the only comments made should be for clarification of an idea.
- People should hitch-hike ideas, adding a word to previous ideas.
- No one should hold back any ideas no matter how silly.
- Record all ideas on flip chart paper.
- If paraphrasing is necessary, the giver of the idea must approve.
- Set a time limit for how long the session will last, or a minimum number of ideas that will be generated during the session.

Key point to brainstorming—have fun!



Flow Charting

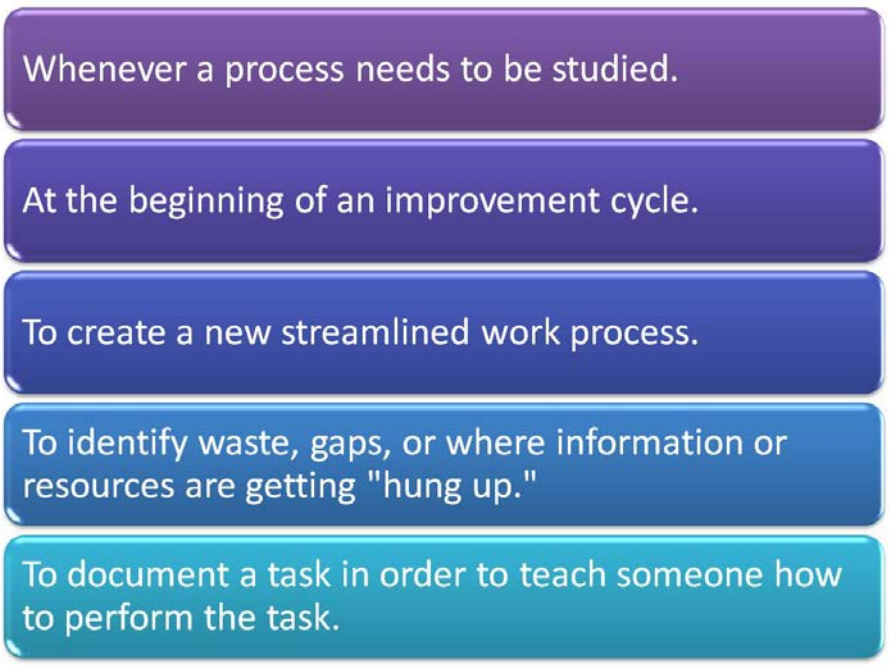
What is a Flow Chart?

Flow charts are a graphic depiction of sequences of events or operations. Using a flow chart also defines the boundaries of a process, making this quality tool an invaluable method for defining a new process. Flowcharting should be the first thing a team does in order to analyze a process, both because it generates a lot of great information in a relatively short amount of time and because it creates details that a team needs to understand where to begin improvement efforts.

Flow charting can define the relationships in a work process. Flow charts describe the process detail and make the whole thing viable. Using a flow chart to document a complex process helps a team understand where resources are and how information flows through the organization. Flow charts also identify who the operators are in the process, where data and/or resources come from and go to, any gaps in a process, and how much time is associated with this step in the process.

There are several types of flow charts. They range from very detailed charts involving the documentation of time and functional area to much simpler "top down" charts that only capture high levels of activity. Graphically, steps in the process are documented using shapes that indicate meaning. These shapes are usually rectangles, diamonds, or ovals. Shapes are then connected with flow arrows.

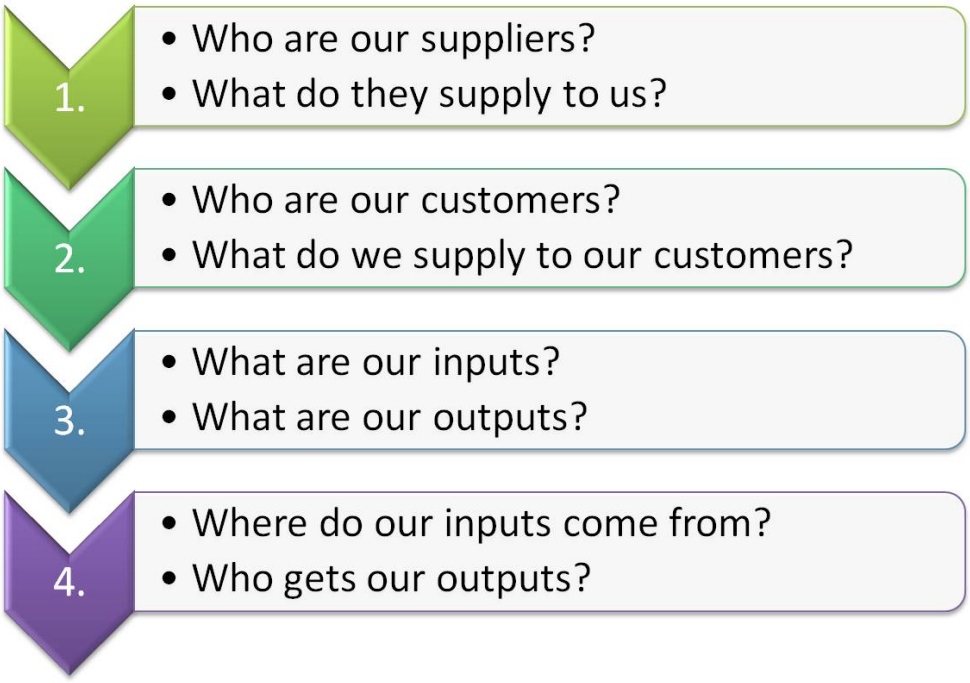
When to Use a Flow Chart



How to Create a Flow Chart

1. *Using sticky notes brainstorm a list of all the activities tied to the process under study.*
2. *Write a brief description of how the process begins by documenting it on a sticky note and then drawing an oval around it. Document all remaining activities with rectangles.*
3. *Anywhere there are decisions along the way, document those with a diamond.*
4. *Lay the sticky notes on flip chart paper that is taped together either on a wall or on a large table.*
5. *Arrange the sticky notes (activities) in the order that they occur within the organization.*
6. *Using a pencil or marker begin to connect the activity boxes and decision triangles with connector arrows.*
7. *Review your chart to make sure that all steps are captured and that each activity box has a connector coming in and one going out.*
8. *When the process has been accurately documented, end the activity with an oval symbol.*

Questions to Start the Flow Chart Process

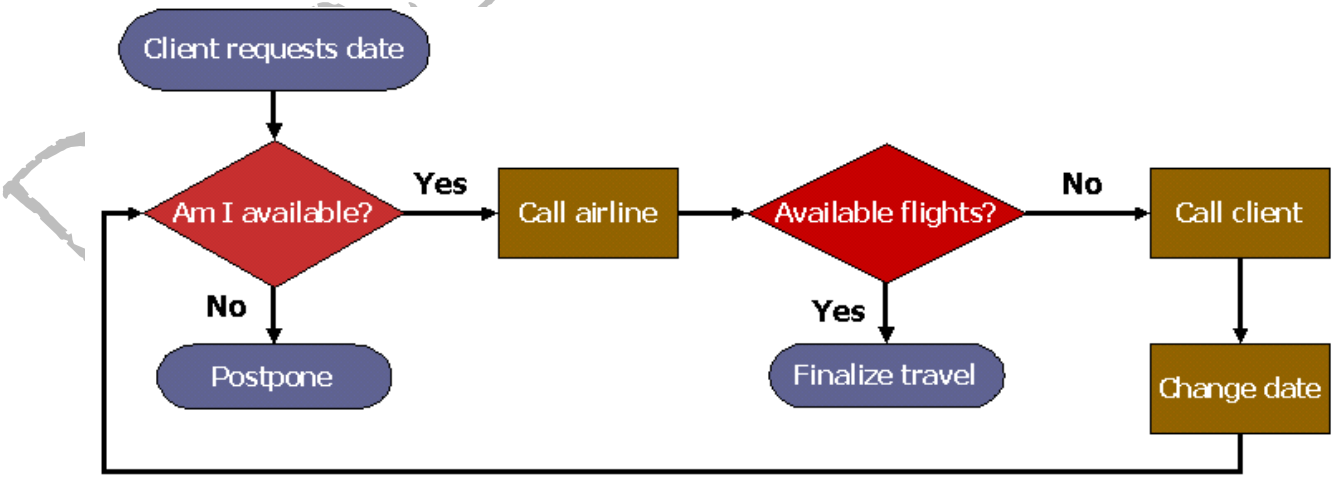


Guidelines for Creating a Flow Chart

- Work with sticky notes and flip chart paper.
- The pattern of information should go from left to right.
- Using flow chart symbols, connect steps indicating the beginning, ending, tasks, and decision points.
- Symbols should be connected with arrowhead flow lines indicating a direction of movement.
- Symbols should have one flow line going in and another flow line going out. The exception to this rule is a decision box, which will have a "yes" line or a "no" line.
- Try not to cross flow lines in a flow chart.

1. **Rectangles** *indicate a step in the process.*
2. **Ovals** *indicate the beginning or ending.*
3. **Diamonds** *indicate a decision point.*

Example of a Flow Chart



Affinity Diagrams

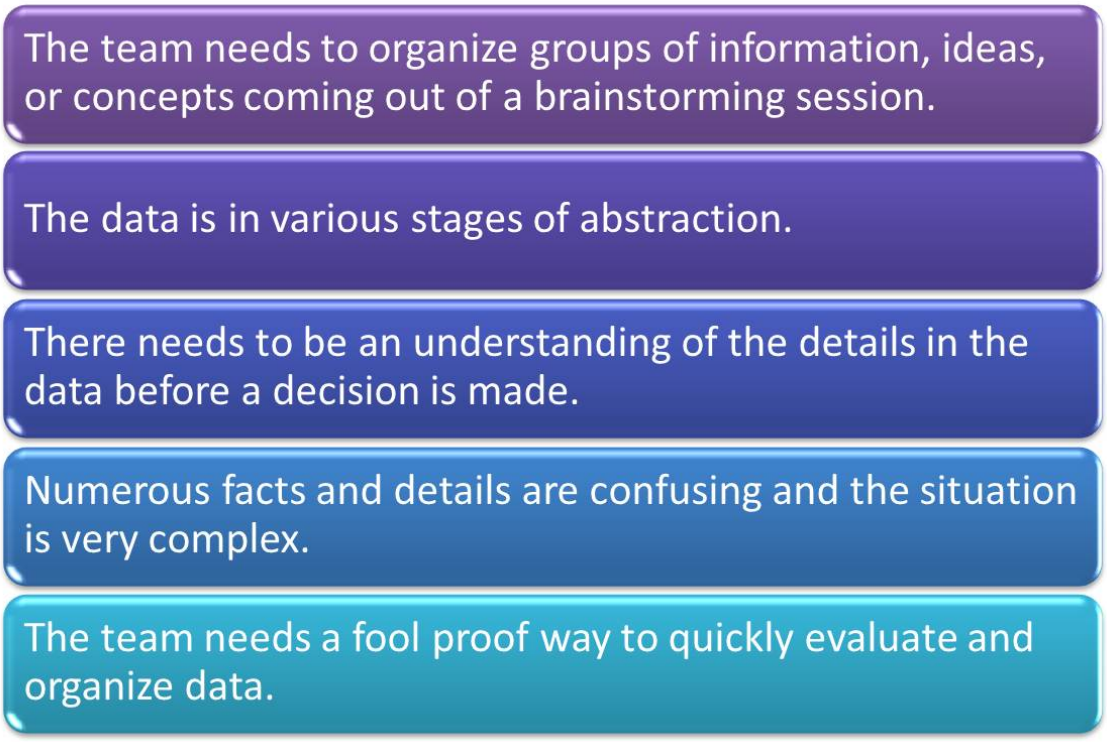
What is an Affinity Diagram?

Affinity diagrams were created in the 1960's by a Japanese anthropologist, Jiro Kawakita. He was involved in studying hundreds of facts about societies and social institutions. When he had completed his research he faced the monumental task of trying to organize the information and draw conclusions from his research. He created a tool called KJ methodology®, which is also called an affinity diagram.

Affinity diagrams have several purposes. First, they spark a team to generate information. Then, they help organize and categorize the information. Affinity diagrams are usually a team facilitator's first choice for problem solving because they are such a great tool for generating and organizing information. Since the team is usually involved in generating data that will later be organized, team members are allowed to be creative and express their gut reactions to issues or problems. This can be very informative! Think of it like brainstorming with structure.

Also, they are one of the quickest team tools around. A team can sift though and organize large volumes of data in record time.

When to Use an Affinity Diagram



How to Complete an Affinity Diagram

1. *The facilitator defines the topic that the team will be investigating.*
2. *In silence, each team member works for **ten to fifteen minutes** writing one idea or thought on a sticky note.*
3. *Sticky notes are posted on flip chart paper and placed on a large table in the center of the room or taped to a wall.*
4. *Once all ideas have been exhausted, the team stops and surveys sticky notes for related or like items.*
5. *They eliminate duplicates and clarify "fuzzy" terms they don't understand.*
6. *At this point, the affinitizing begins and the team starts to group sticky notes according to like themes or like categories.*
7. *Once the notes have been grouped, a header note is created that best describes the group of sticky notes. Sometimes a single note from the group that best represents a common theme can be used.*
8. *If the team feels that groups can be grouped, create an additional "header" sticky note and place it above the grouped sticky notes.*

Guidelines for Creating an Affinity Diagram

If the team feels that groups can be grouped, create an additional "header" sticky note and place it above the grouped sticky notes.

Everyone on the team should be standing around a large table placing their sticky notes on the table. Or, you can also work on a wall, with flip chart paper taped to the wall.

No explanations for why you or anyone else is writing something on a sticky note during the exercise.

Keep each grouping of sticky notes to a maximum of 7 - 8. If a group starts to get too big it probably indicates that there are two issues in that group.

Piggybacking off of someone else's idea on a sticky note is encouraged.

A facilitator should guide the team when they are finished to review any duplicates or to clarify information.

Once the team has finished use transparent tape to secure the sticky notes to the flip chart paper.

Example of an Affinity Diagram

We asked our customers what they wanted on a great cheese burger. And we found that the information came back with individual pieces of data on sticky notes that looked something like this! Lots of data and all different types of categories. When you ask for data in no particular order, it is confusing and doesn't make a lot of sense. This example demonstrates how confusing random information can be. We REALLY need to use an affinity diagram to make sense of this data!

Fresh

Lots of cheese

Thick patty

All meat

Not greasy

Melted cheese

Good selection of cheese

Bun not larger than the meat

Fresh meat

Our job was to take these random pieces of data and group them into common themes. Once the data has been grouped, identify "headers" for the groups. Headers are the main titles that a name for the data in the group. Our headers in this case were "Toppings," "Bun," and "Hamburger Meat."

Toppings

Many condiments

Melted cheese

Lots of cheese

Selection of cheese

Bun

Fresh

Toasted

Not larger than the meat

Hamburger Meat

All meat

Pink inside

Not greasy

Fresh meat

Thick

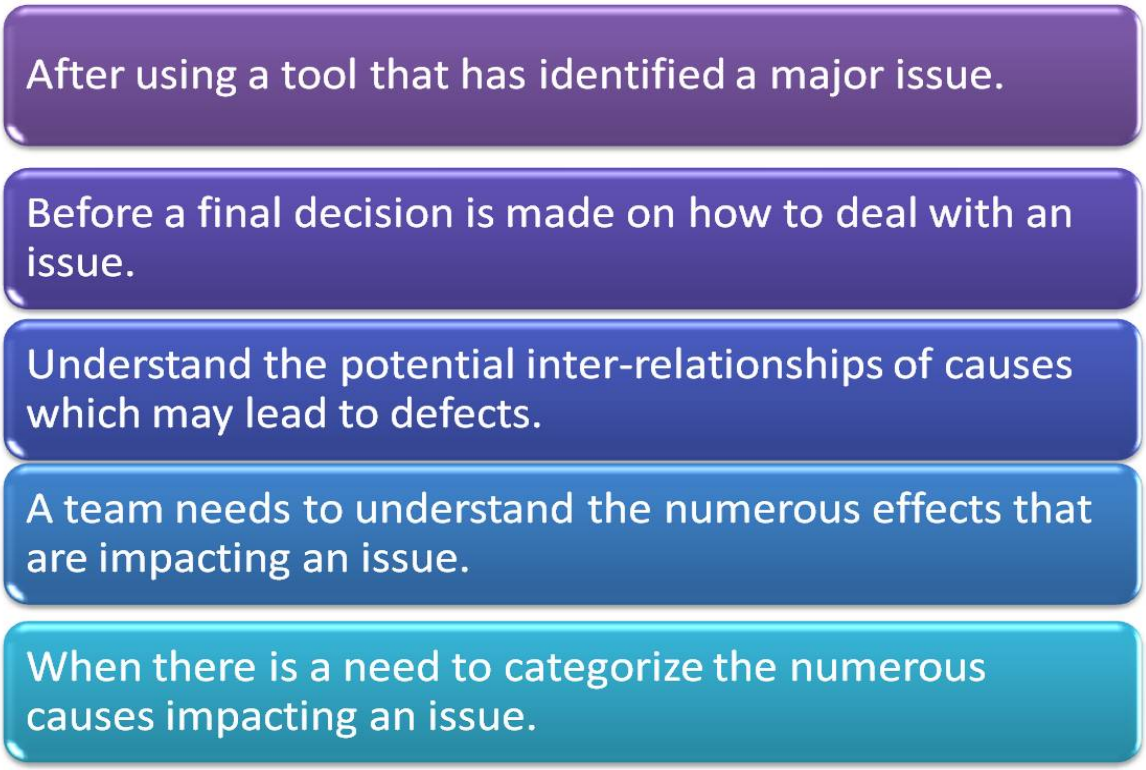
Cause & Effect Diagram

What is a Cause & Effect Diagram?

A cause and effect diagram provides a visual documentation of potential causes related to a specific effect. A team can use cause and effect diagrams as a way to analyze a problem or plan a complex change. Cause and effect diagrams are also called fishbone diagrams and/or Ishikawa diagrams. A completed diagram does resemble a fish and Dr. Kaoru Ishikawa came up with the methodology for this great quality tool.

Both problem situations and project definitions can be analyzed using a cause and effect diagram. Use of the diagram reduces the tendency to look for the one true root cause at the expense of ignoring other causes and/or interactions of causes. The diagram indicates the relationship of each "cause" and "sub-cause" to each other and to the "effect" being addressed.

When to Use a Cause & Effect Diagram



How to Complete a Cause & Effect Diagram

1. *Choose an "effect" to be studied.*
2. *Develop an operational definition for the "effect."*
3. *Tape two to four pieces of flip chart paper together. On the far right hand side of the flip chart paper write down the "effect."*
4. *Draw the skeleton of the diagram using the classic headings for causes: materials, environment, management, man/woman, measurement, methods, and machines.*
5. *Brainstorm ideas that may be contributing to the effect. For each category ask, "Why does it happen?" Place responses under the headings of materials, environment, management, man/woman, measurement, methods, and machines.*
6. *Continue brainstorming for links to each category until the team feels that everything is out on the table.*
7. *Look for commonality between causes that appear repeatedly. The next step is to determine the frequency of "causes" that show up under several categories.*

Guidelines for Creating a Cause & Effect Diagram

Use sticky notes on flip chart paper so you can fold up the piece of paper and take it with you.

Everyone should have their own pad of sticky notes and a dark colored marker to jot down their brainstormed ideas for causes.

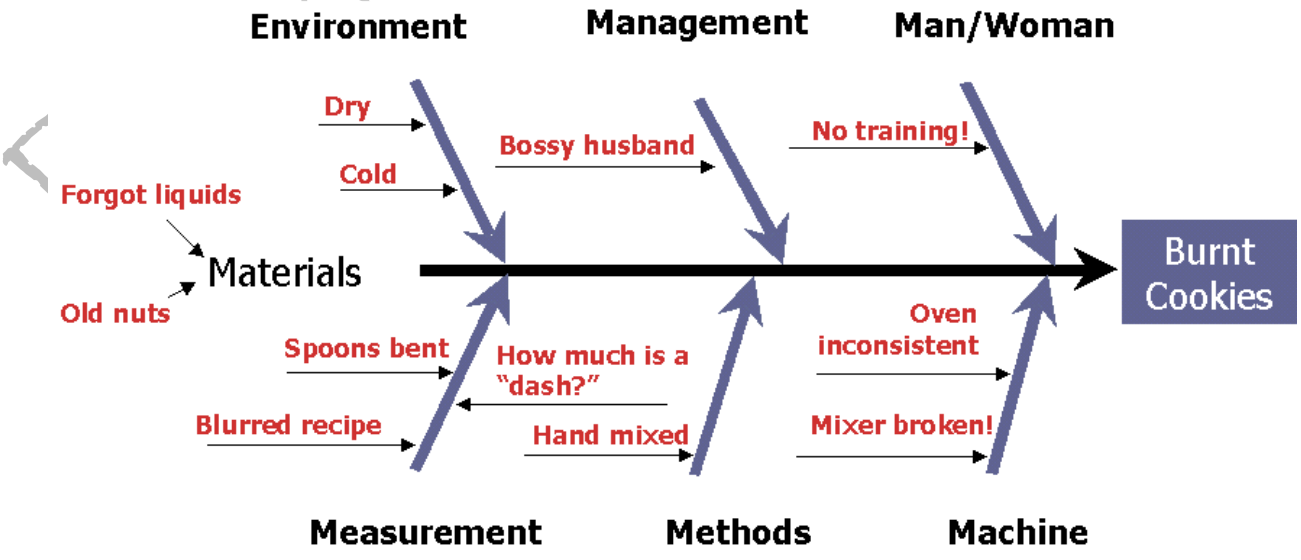
Work at a table that is big enough to hold two pieces of flip chart paper, but small enough so that everyone can move around the table. Or tape the flip chart paper to the wall.

If the team wants to use this tool for planning purposes, the "effect" is then phrased in positive terms.

Once the diagram is finished, look for causes that tend to appear over and over again.

Tools that are commonly used after a cause and effect diagram are Pareto charts or scatter diagrams. They help to determine how often a cause is occurring.

Example of a Cause & Effect Diagram



Force Field Analysis

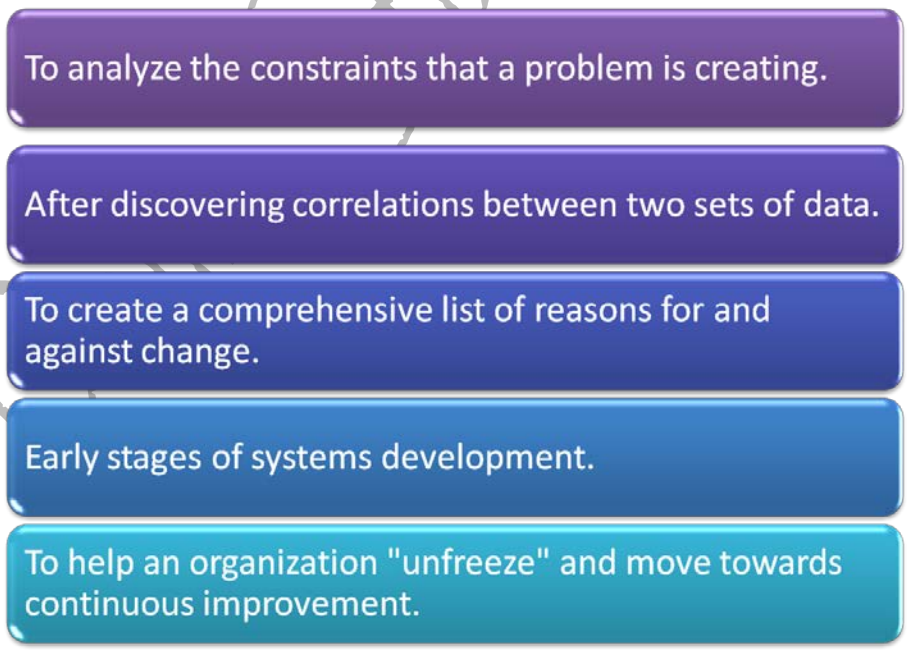
What is Force Field Analysis?

Some of the simplest quality tools generate valuable information for common sense analysis. Force field analysis is one such analytical tool. This tool is based on the work of a German psychologist, Kurt Lewin, who studied the forces that drive people toward, or repel people away from certain behaviors.

Force field analysis enables a team to consider what they are doing well and what may need to be modified in order to create positive change. Force field analysis is a method used to get a holistic view of all the forces, for or against a plan, so that a comprehensive decision can be made. It's a specialized method of weighing pros and cons. Force field analysis is an effective method of getting a picture of all the forces for and against a plan. It helps you to weigh the importance of these factors and assess whether a plan is worth pursuing.

It is based on looking at driving forces. These forces tend to initiate a change and keep it going. In terms of improving productivity in a work group, pressure from a supervisor, incentive earnings, and competition may be examples of driving forces. The corollary of a driving force is a restraining force. Restraining forces are forces that act to sub-optimize the driving forces. Apathy, hostility, and poor maintenance of equipment may be examples of restraining forces against increased production. Equilibrium is obtained when the sum of the driving forces equals the sum of the restraining forces.

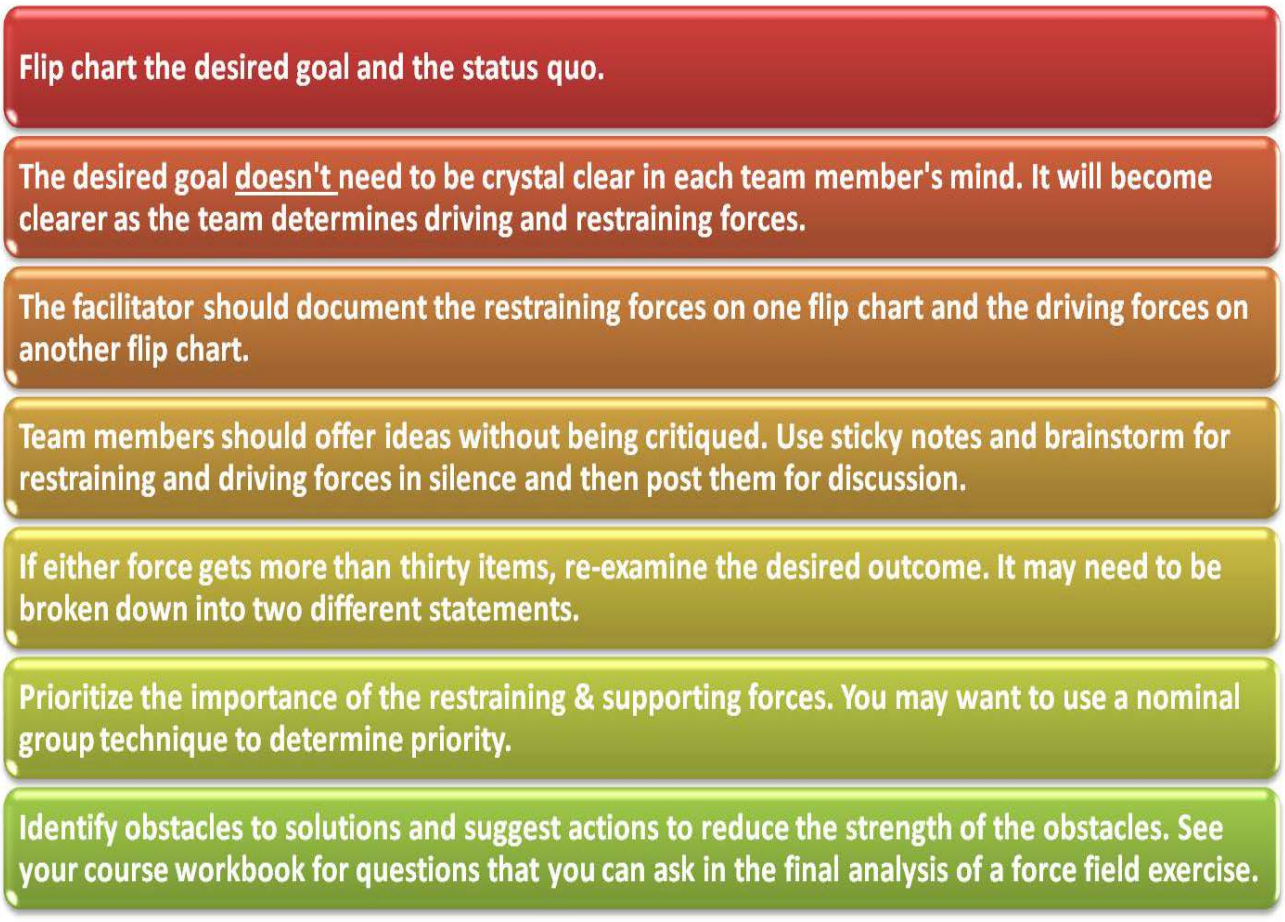
When to Use a Force Field Analysis



How to Conduct a Force Field Analysis

1. *Determine the main theme for the problem being analyzed.*
2. *Identify the current status of the situation, the status quo.*
3. *Define a desired outcome.*
4. *Brainstorm a list of the forces that are driving improvement. And then brainstorm a list of the restraining forces that are keeping the situation static and inhibiting change.*
5. *As a team, review the driving and restraining forces and rate each item on a scale from 1 to 5. The questions that need to be asked is, "How important is this item to helping us reach the needed change?"*
6. *If the total score for the "driving forces" is larger, the decision should be to move forward with the change. If the "restraining forces" is larger, the decision should be to re-evaluate the needed change.*

Guidelines for Using Force Field Analysis



Example of a Force Field Analysis

Main Theme: Communications

Desired Outcome: Improve Communications

Status Quo: Frequent Errors in Billing

Driving Forces		Restraining Forces	
5	Great support from management for changing the system.	System is very decentralized and physical locations not close.	2
2	Available resources to study the current system.	No one wants to take on the job of being a team leader for this project.	5
4	Data that can tell us what is happening and when it's happening.	Nothing is defined on paper, everything is just passed on by word of mouth.	1
Total = 11			Total = 8

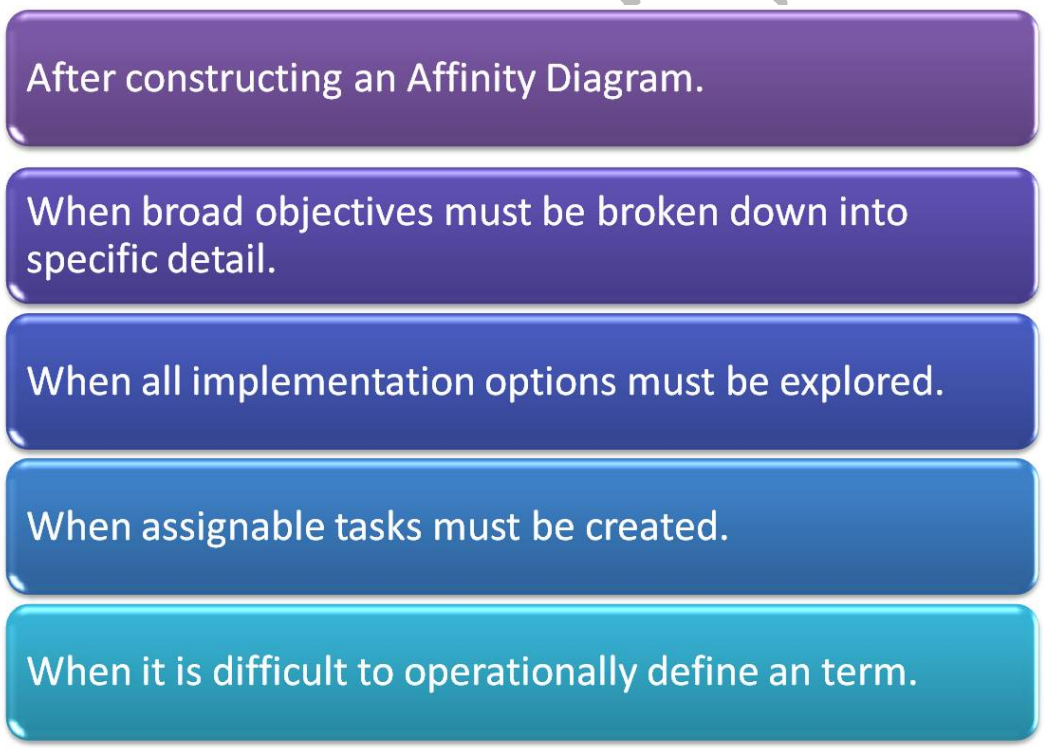
Tree Diagrams

What is a Tree Diagram?

Tree diagrams help the team to define and analyze problems. Using tree diagrams allows a team to discover additional details and map out the full range of possibilities and thinking. Tree diagrams are based on levels of abstraction: primary, secondary and tertiary. The primary data level is typically the initial term or issue to be analyzed. The tertiary level is the lowest level of abstraction.

Tree diagrams take the most generalized information and create a logical linear progression of thinking. They are good for operationally defining terms, as well as documenting tasks. Using tree diagrams in concert with other quality tools gives a team a great way to objectively dissect and define issues. Tree diagrams are typically used with an intact team to capture the team's thinking.

When to Use a Tree Diagram



How to Complete a Tree Diagram

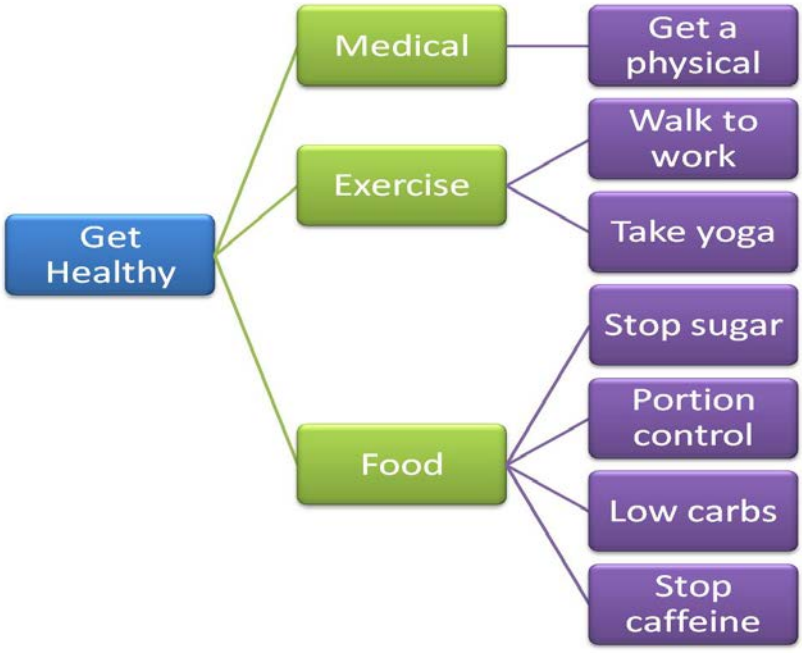
1. *Choose a statement to be analyzed.*
2. *Paraphrase it using only a few words. This will be the primary data*
3. *Tape two to four pieces of flip chart paper together. On the far left hand side of the flip chart paper, write down the paraphrased statement.*
4. *Brainstorm secondary data by asking appropriate questions like, "Why is this happening? or What does this mean?" Ask what, why or how as many times as it takes to exhaust the point.*
5. *For each secondary data point, again identify tertiary data by asking what, why, when, where, or how.*
6. *Study the final results for correlations, logic or sequencing. Also, look for areas that have been duplicated and make appropriate corrections.*

Guidelines for Creating a Tree Diagram

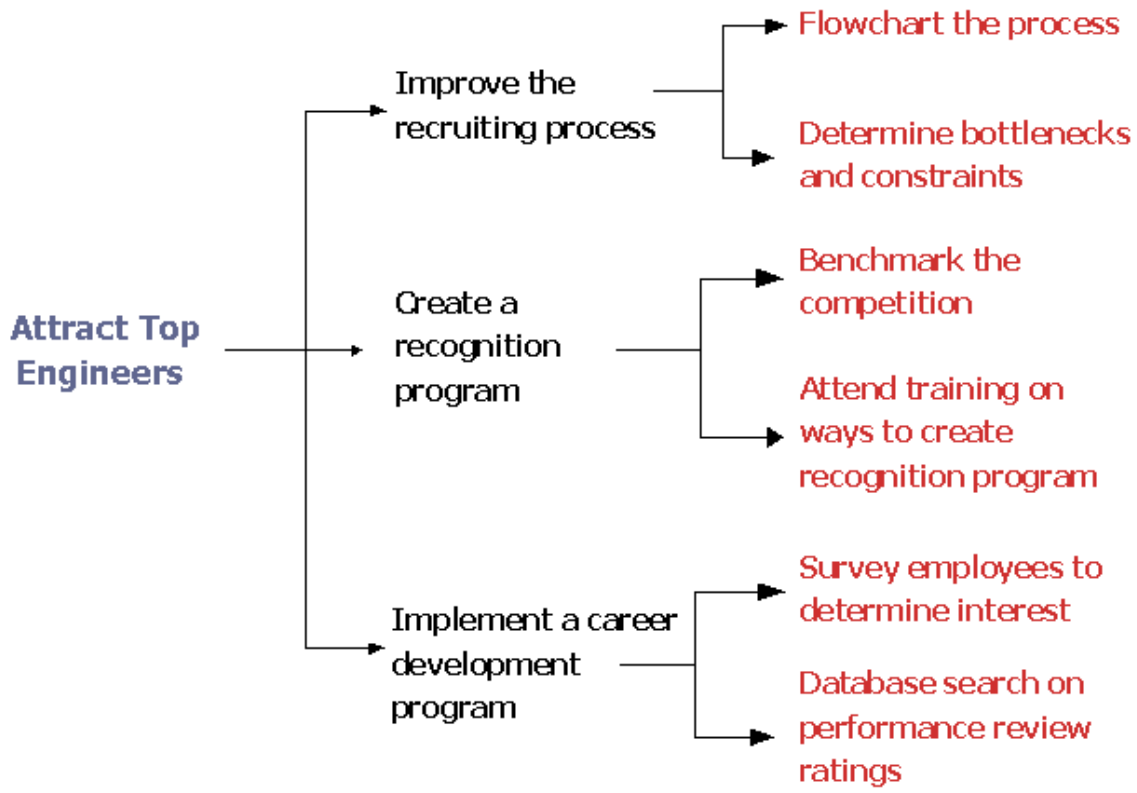
- Document the team's input on a flip chart and tape it to the wall.
- Keep asking the question, "What does X mean?" or "Why does X happen?" or "How does X contribute?" or "What do we need to do to make this happen?"
- Write the documentation from left to right.
- When working through a process improvement phase, keep all the tree diagrams that operationally define terms in plain view.
- Once the team has completed the tree diagram, a follow up tool might be to prioritize the tertiary data using the "Red Dot Nominal Group" technique.
- It shouldn't take more than about forty-five minutes to get a very concise tree diagram.
- One of the real keys to getting good information is to make sure you have the right people in the room.

From This….

To This…



Example of a Tree Diagram



Take a few minutes now and create a tree diagram defining your program for living a better more healthy life. Send it to us at getfreestuff@learnfirm.com and we'll send you a surprise gift. Really…we will!

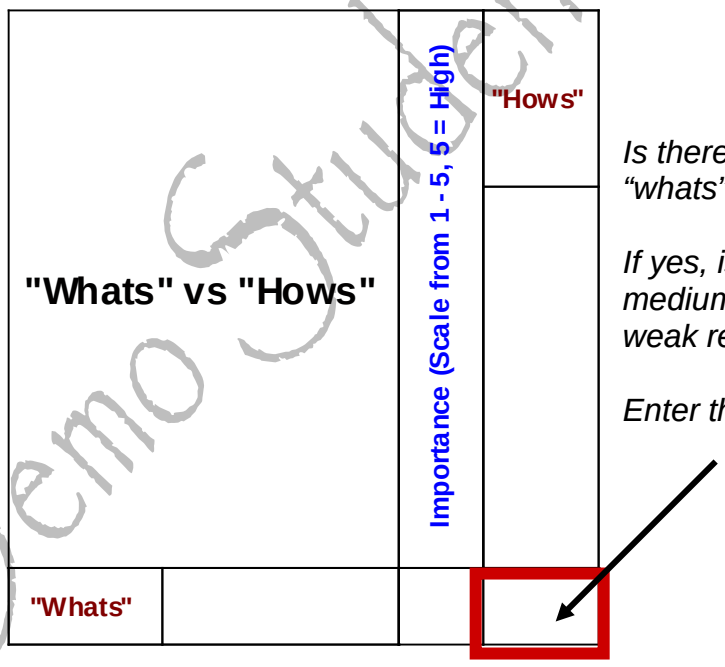
Prioritization Matrices

What is a Prioritization Matrix?

A prioritization matrix provides a way to analyze and prioritize data. The matrix diagram is one of the most versatile tools in a quality professional's tool kit, because of its wide variety of applications.

Matrices are set up to analyze different relational data sets. One set of data goes in the rows and the other data set is documented in the columns. Data sets can consist of different types of data, inputs vs. outputs, needs vs. actions, team objectives vs. measures to benchmark progress, voice of the customer vs. product specifications, etc. The list of different types of data sets is endless.

The data sets that we will be using for our examples are the "whats" vs. the "hows." When looking at these data we will be determining "what" needs to get done and the action required to accomplish the "whats" -- the "hows" -- "whats" vs. the "hows." The "whats" vs. the "hows" is the perfect data to use for planning.



Is there a relationship between the "whats" and the "hows?"

If yes, is it a strong relationship (9), medium strength relationship (3), or a weak relationship (1)?

Enter the relationship strength here.

When to Use a Prioritization Matrix

- Use a prioritization diagram to analyze two different data sets in relation to each other.
- Help you understand where to allocate resources.
- Determines what to work on first.
- Allows you to understand the critical relationships in product/service design, customer needs, parts and processes.
- A great tool to use for strategic planning.

How to Create a Prioritization Matrix

1. *Write a brief description of the objective. Is it to reduce cost, improve communications, or improve customer satisfaction?*
2. *Using sticky notes brainstorm a list of the "whats" that need to take place to meet your objective. Each "what" goes in a row on the matrix.*
3. *Give each "what" an importance rating. A rating of 5 = great importance, and a rating of 1 = not that important. Document that information in the rows of your matrix.*
4. *For each "what," brainstorm at least two "hows" needed to meet the objective. Place this data in the columns in the matrix.*
5. *Working inside the center of the matrix for each intersection between a "what" and a "how" ask the question, "If we deployed this action, the "how," would that support the "what." If so, what is the strength of the relationship? Indicate the strength of the relationship using; 0 = none, 1 = weak, 3 = moderate, and 9 = strong.*
6. *Document the value for each cell in the center of the matrix.*
7. *Working down the columns, total the values in each cell. Now each "how" has an importance rating. You have just prioritized what you need to work on first!*

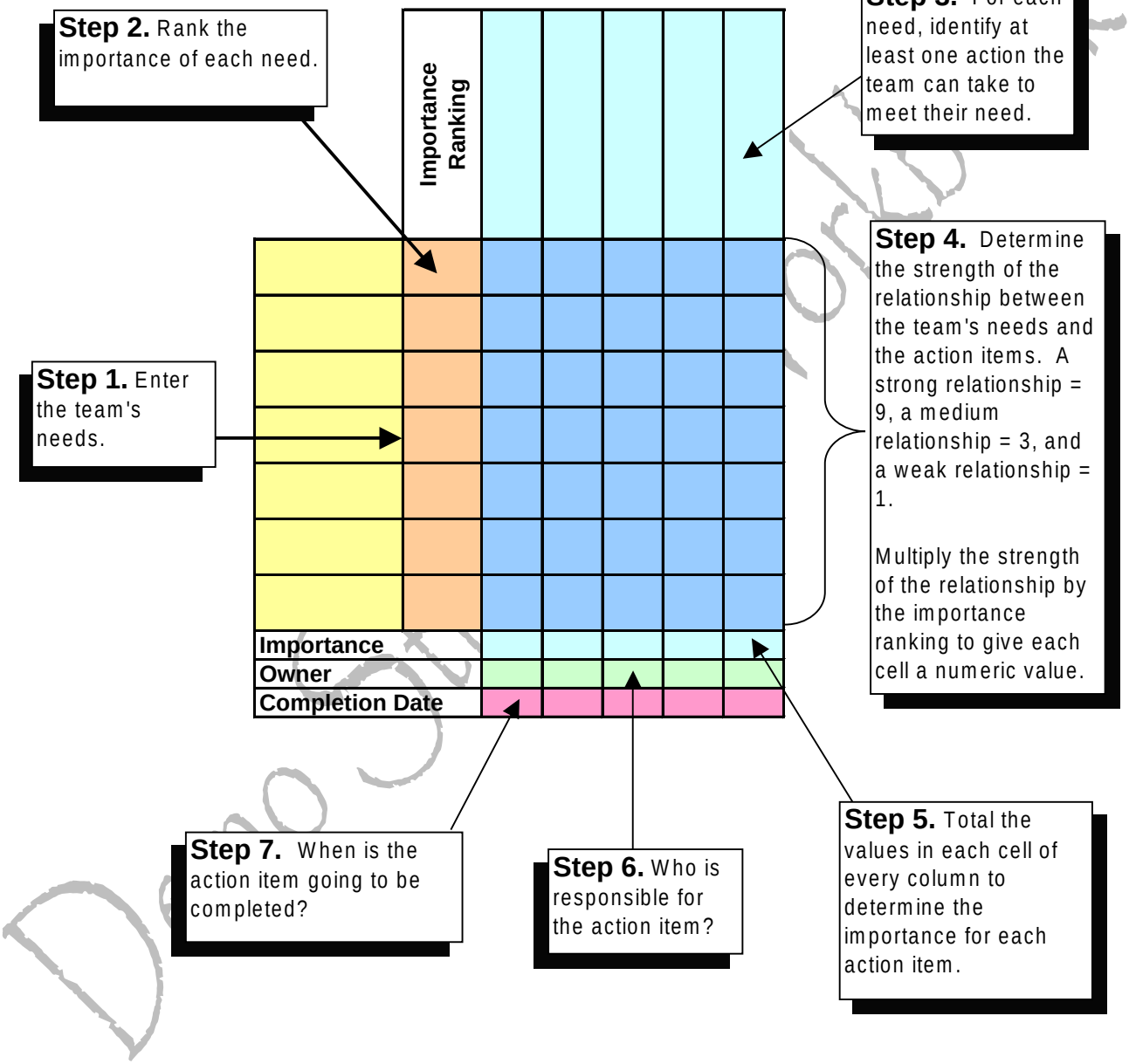
Guidelines for Creating a Prioritization Matrix

- Use an Excel spread sheet to do your analysis.
- Make sure the importance rating for any of the data found in the left hand side of the matrix is done correctly. The importance rating drives the entire matrix.
- Think about using some sort of normalizing technique to add robustness to the priority of data found in the rows.
- Work to create meaningful data sets that can easily be updated and reviewed.
- Use a facilitator who will be operating the software application while the team thinks about relationships between data.
- Make sure the right people are on the team when working through relationship area.

Example 1 - Prioritization Matrix

Priortization Matrix		Importance	How are we going to meet our goals?					
			Flow chart manufacuturing process	Create team to study "lean concepts"	Record customer complaints	Train customer service reps	Review all job descriptions	Analyse key customer needs
What do we have to do to reduce costs?	Decrease work in process	4	◉	◉	△		△	
	Improve customer service	2	○	△	◉	◉		◉
	Re-allocate resources	5	△	△			◉	○
Importance			47	43	22	18	49	33

Example 2 - Prioritization Matrix



Example 3- Operations Plan

	Operations	Weight	Processes/Systems (Hows)										Measurement	Target	Actual
			Provide, Enable and Develo People	Provide and Maintain Suppl Line	Bring new prod to Manufacturability	Provide/Maint Quality Mgmt Sys	Plan, Supply and Distrib Products	Plan/ Analysis of Finances	Mechanical Assy	Manuf Engr	Electronic Assy	Service Center			
Objectives (Whats)	Optimize Total Cost	5.0	△	◉	◉	○	◉	◉	◉	○	◉	○	GP as % of Sales	50%	40%
	Ensure Quality	4.0	○	◉	◉	◉	○	△	◉	◉	◉	◉	FPY/Prod Returns	90%	78%
	Develop Integrated Planning System	2.0	△	△		△	◉	△	◉			△	Index	100 on Index	29
	Improve On-Time Delivery	2.0	△	◉	○	△	◉	△	◉	○	◉	◉	OTD to Cust Req	90%	79
	Op Effectiveness in New Product	4.0	◉	◉	◉	○	◉	△	○	◉	○	○	Index		
	Improve Inventory Management	1.0	△	◉	○	△	◉	○	○	△	○	○	ITO	12	8
	Weighted Importance		**58.0**	**146.0**	**126.0**	**68.0**	**138.0**	**60.0**	**132.0**	**94.0**	**114.0**	**86.0**			

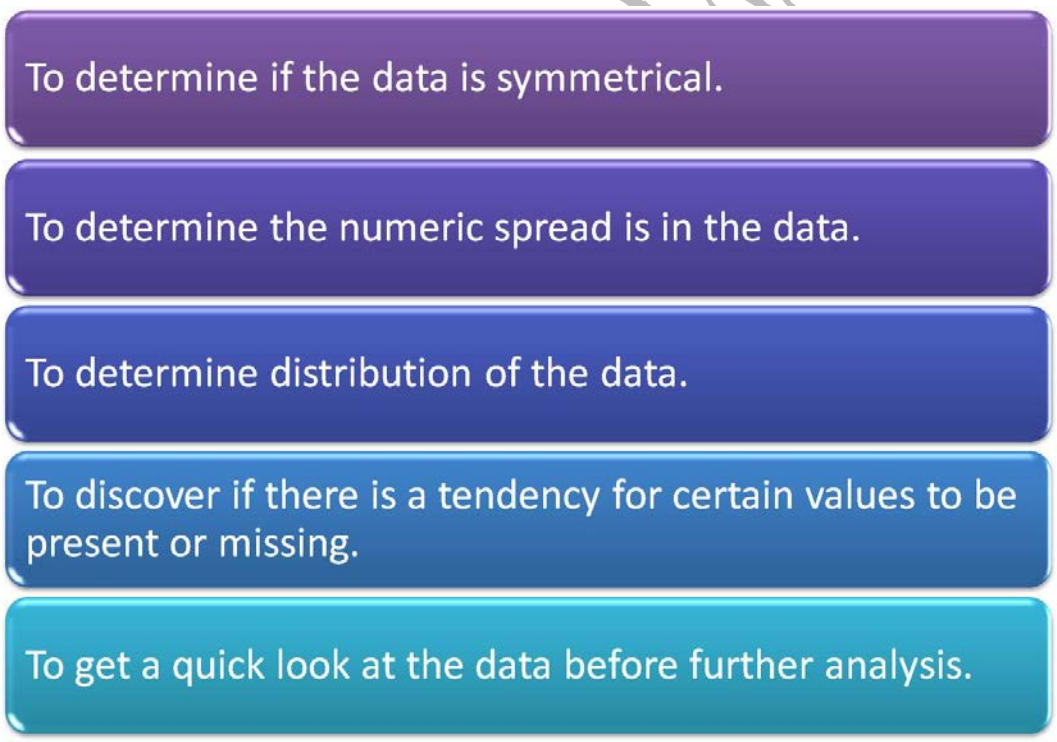
Dot Plots

What is a Dot Plot?

A dot plot graphically represents observations for a variable as points on a number line and how much spread there is in data. They are a quick and easy method to understand the variation and spread in just about any type of data. Dot plots also help determine the most common and isolated values in the data.

These simple plots do a good job of displaying the shape, location and spread of the distribution, as well as showing evidence of clusters, granularity and outliners. For smallish data sets, a dot plot is easy to construct, so the dot plot is a particularly valuable tool for teams who may not have access to sophisticated software analysis.

When to Use a Dot Plot



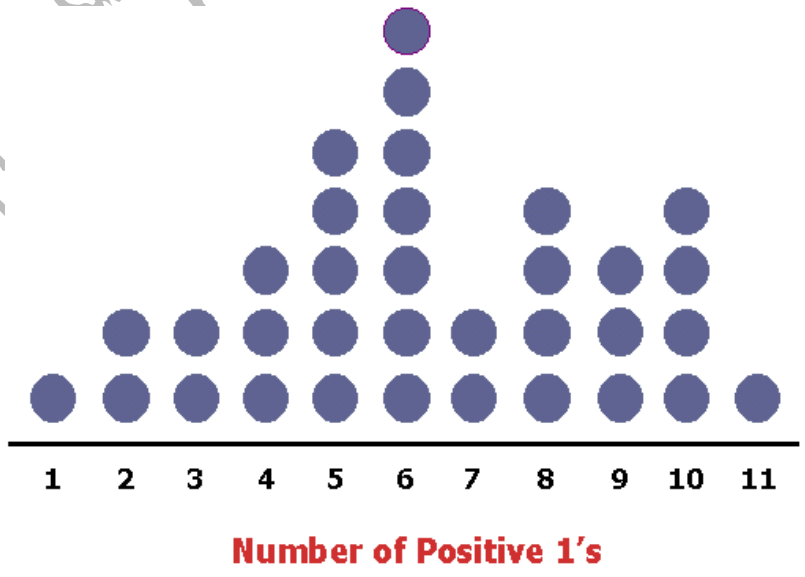
How to Complete a Dot Plot

1. *Operationally define the data you will be collecting.*
2. *Collect the data and get ready to create your chart.*
3. *Start with a straight line marked off in intervals corresponding to the units of measurement.*
4. *Determine the range of the data, smallest to biggest..*
5. *Arrange the units of measurement on the Y axis in ascending order. This is considered to be the interval data.*
6. *Place a dot over a value each time that value appears in the data.*

Guidelines for Creating a Dot Plot

- Data is collected outside a team meeting and then analyzed by team members.
- At least thirty data points should be collected to give a representative sample.
- The important thing to look for are surprises in the distribution that are not normal.
- Look for "twin peaks" to understand if the data is coming from more than one source.
- Make special notes of data that is "skewed" towards one end of the graph.
- Dot plots work best where values are repeated.

Example of a Dot Plot



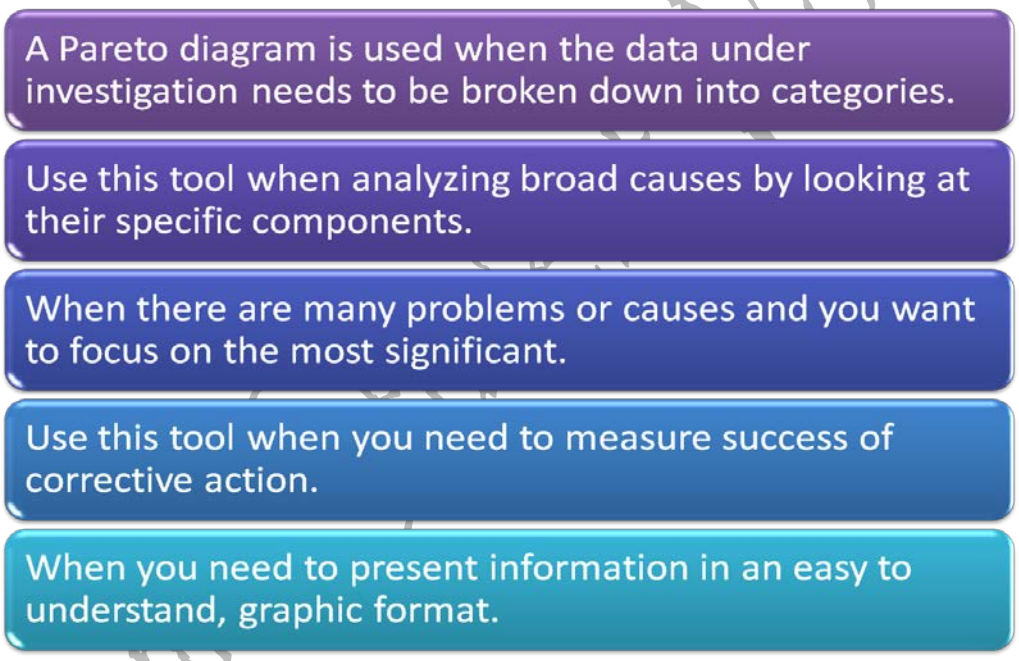
Pareto Charts

What is a Pareto Chart?

The term Pareto Principle was coined by Joseph Juran in the late 1930's. The name came from the work of Vilfredo Pareto (1848-1923). He found that 80% of the wealth was concentrated in about 20% of the population. Thus, the other name given to the principle is the 80/20 rule.

Pareto charts help in deciding which problem to work on first. It is a powerful communication tool to show management which are the top concerns. By doing a diagram before and after an improvement activity occurs, it can also be determined if the change effort was successful.

When to Use a Pareto Chart



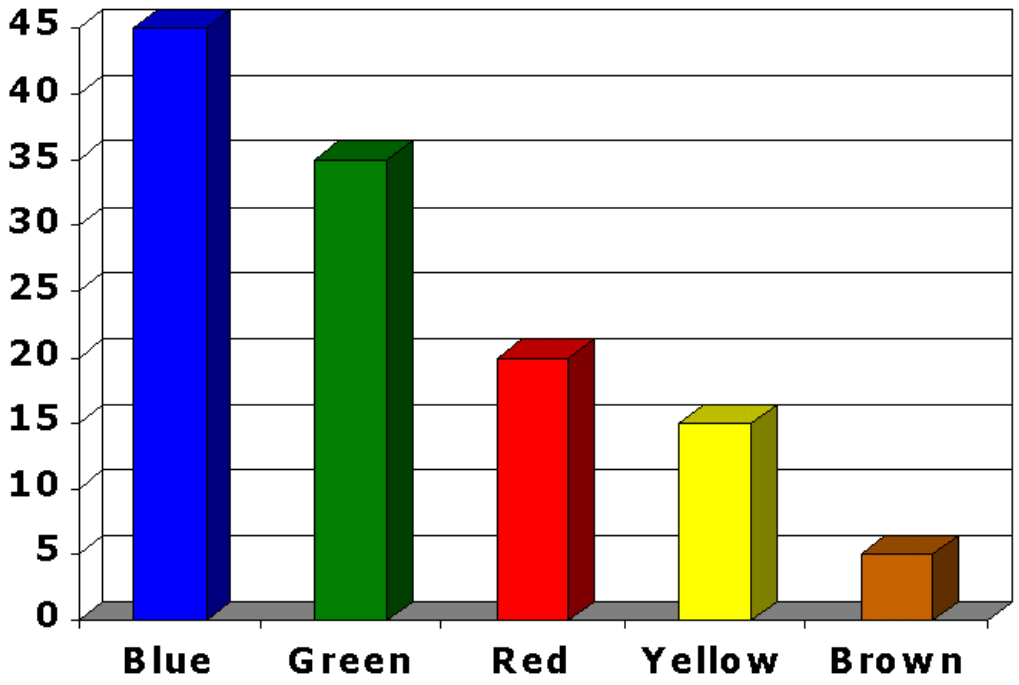
How to Complete a Pareto Chart

1. *Define categories for the data.*
2. *Devise a check sheet that collects the occurrences of the data.*
3. *Once enough data has been collected (at least thirty occurrences), sum up the rows of the check sheet and look for the most frequently occurring classification.*
4. *Using spreadsheet software, like Excel or Lotus, create a bar chart. You can also do this by hand by simply drawing the bars on a sheet of paper. However, if you're going to keep track of this data over an extended period of time you may want to consider computerizing the information.*
5. *Across the horizontal axis, list the different categories.*
6. *Indicate the most frequent occurrence (the largest bar) as the first bar closest to the vertical axis.*

Guidelines for Creating a Pareto Chart

- If there is no clear distinction between the categories (if all bars are roughly the same height) consider organizing the data in a different manner.
- Create before and after comparisons of Pareto diagram to show impact of improvement efforts.
- Construct the Pareto diagram using different measurement scales, frequency, cost or time on the vertical axis.
- Use objective data to perform Pareto analysis rather than team member's opinions.
- Pareto diagrams open the door for further examination of an issue or challenge.

Example of a Pareto Diagram



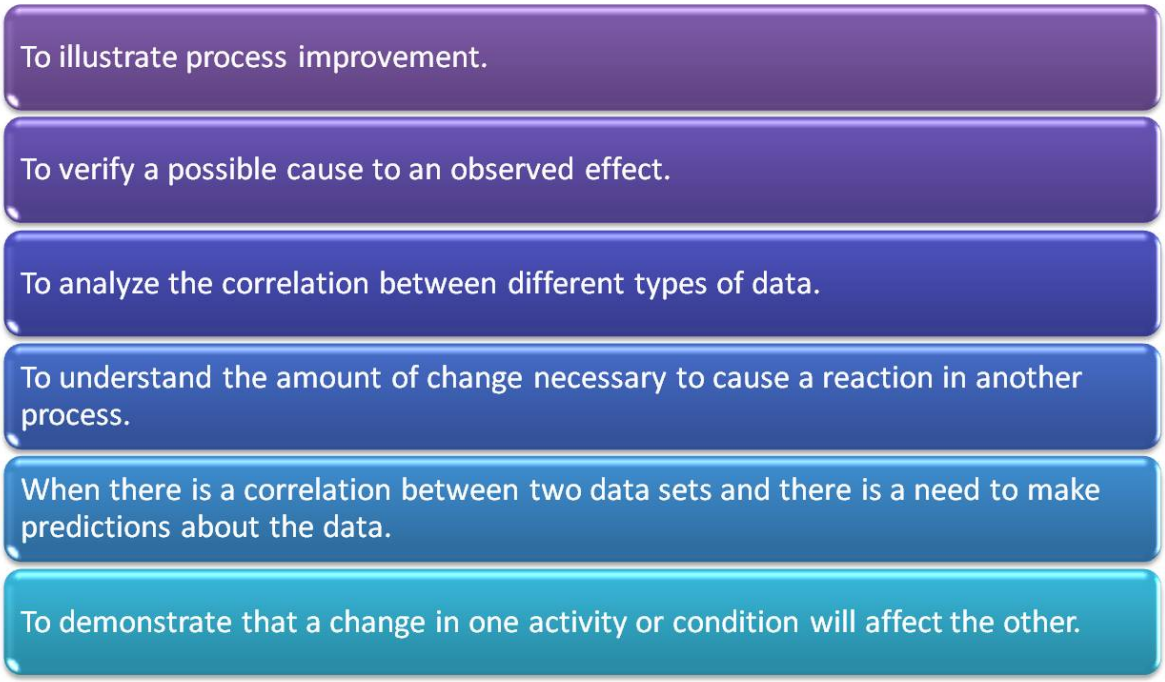
Scatter Diagrams

What is a Scatter Diagram?

Scatter diagrams are used to examine the relationship between two different sets of data and their characteristics. If the results from a scatter diagram suggest a relationship between two characteristics, it may imply a cause and effect relationship.

Scatter diagrams help the team to understand the relationships between data. They are also a good beginning to understanding basic correlations. Positive correlations are indicated by data points moving in a tight pattern upward, from left to right. A negative correlation is depicted by data points moving in a downward pattern, from left to right.

When to Use a Scatter Diagram



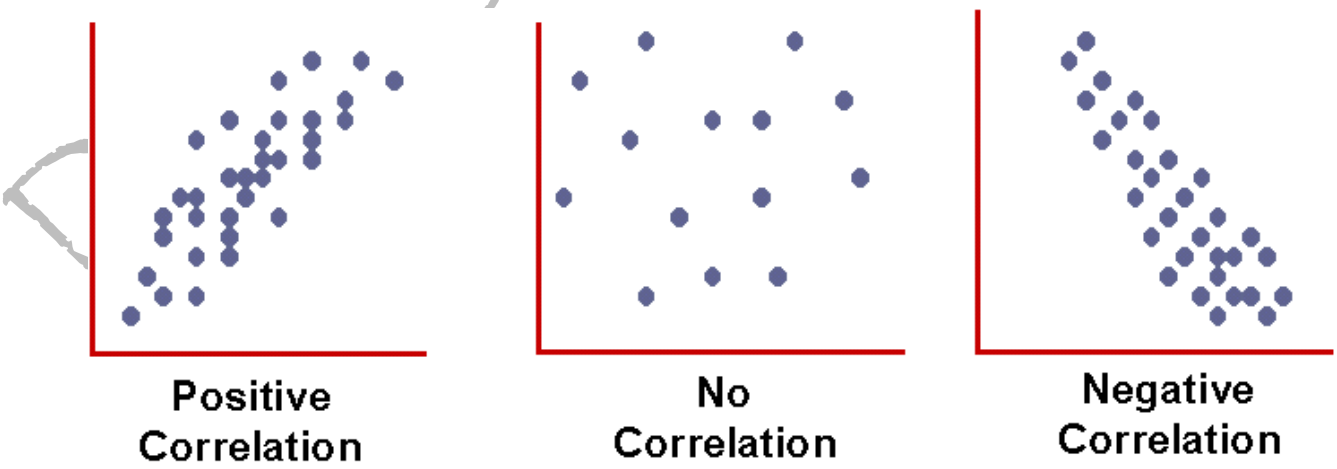
How to Complete a Scatter Diagram

1. *Determine the paired data and measure both variables during the same time period.*
2. *Collect 50 to 100 paired samples.*
3. *Label both the "X" and "Y" axis.*
4. *Create intervals along both axes so that the lowest value is closest to the apex of both axes.*
5. *Plot the points corresponding to the pairings found in the data.*
6. *Look for positive correlations, no correlations, or negative correlations.*

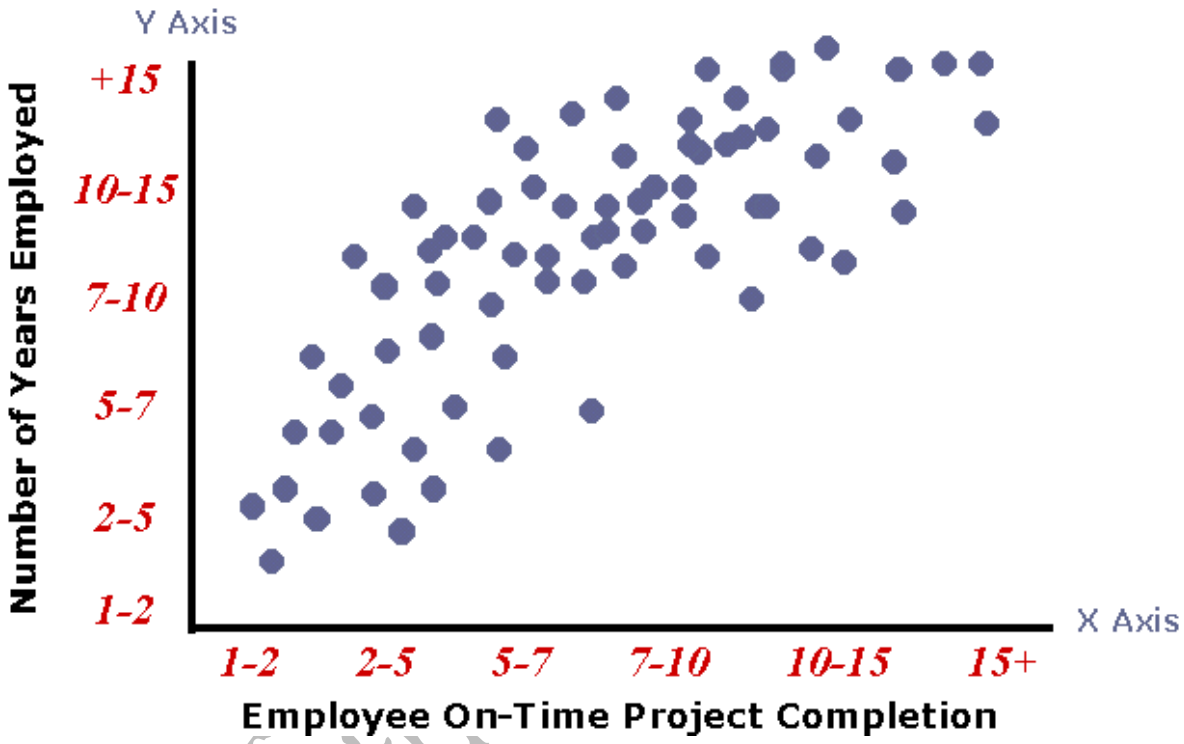
Guidelines for Creating a Scatter Diagram

- Pay attention to the closeness of the pattern of data.
- If data is coming from different sources use different symbols for the different sources.
- The more the data resembles a straight line, the stronger the correlation is between the variables.
- Data for this tool is collected over a period of time
- Negative correlations go down from the left to right and positive correlations go up from the left to the right.
- Time is usually a good constant variable to place on the "X" axis.
- A correlation does not necessarily mean a cause and effect relationship exists.

Depending on the direction that the data falls, an indication of correlation is defined.



Example of a Scatter Diagram



Nominal Group Techniques

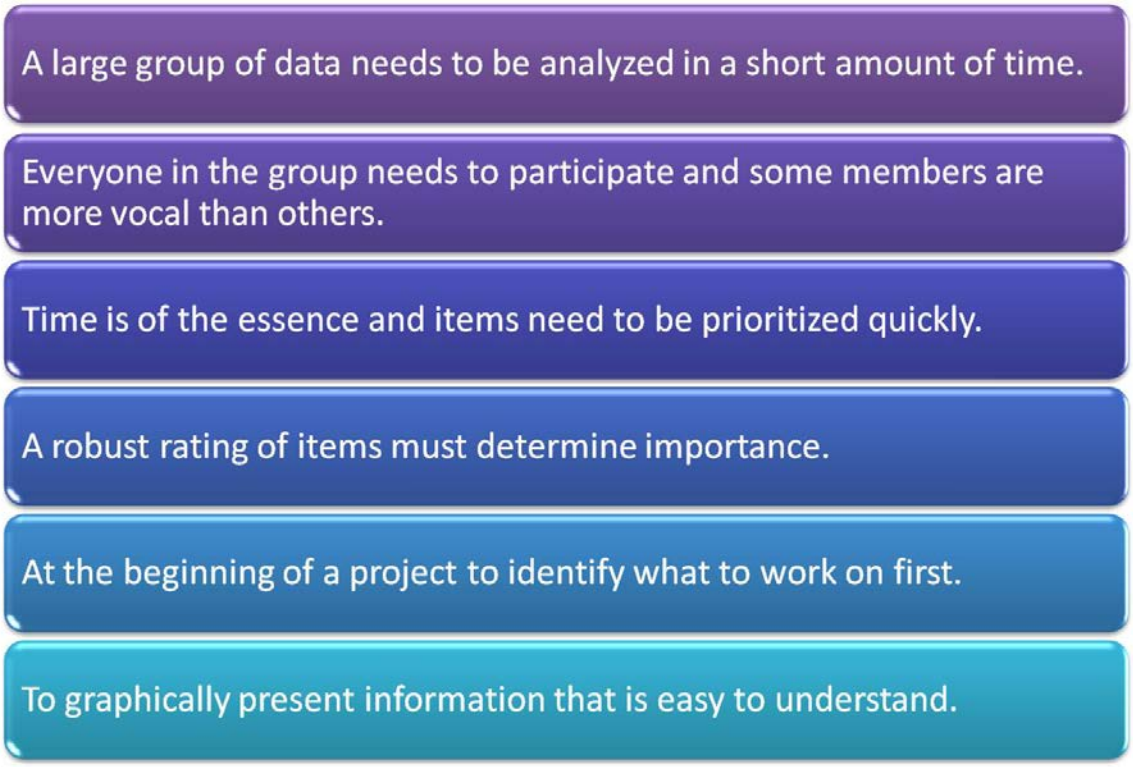
What are Nominal Group Techniques (NGT)?

Nominal group techniques help groups prioritize information quickly and without too much subjective interference. There are several different types of these techniques that can be very simple to very complex. The one big advantage to using a nominal group technique is that everyone on the team gets to give their input. Most activities are conducted silently initially, to give team members who may not be the first to speak up a chance to communicate their ideas. The team can then discuss rationale for decisions made by individual team members.

The criteria for choosing the importance of data may differ. Questions might be, "Which is most important?" or "Which task involves the most risk?" or "Which item costs the most?" to "Which activity would create positive change the quickest?" There are numerous other questions the team may be asking themselves during a nominal group session, it really depends on the situation.

Nominal group techniques range from multi-voting where everyone picks their top five items then prioritizes and ranks them, to analytical hierarchy processes involving an eighteen-point ratio scale comparison. Sometimes the simplest activity can provide powerful results and, for that reason, the example on the following page is a simple and clean way to gather a group's input.

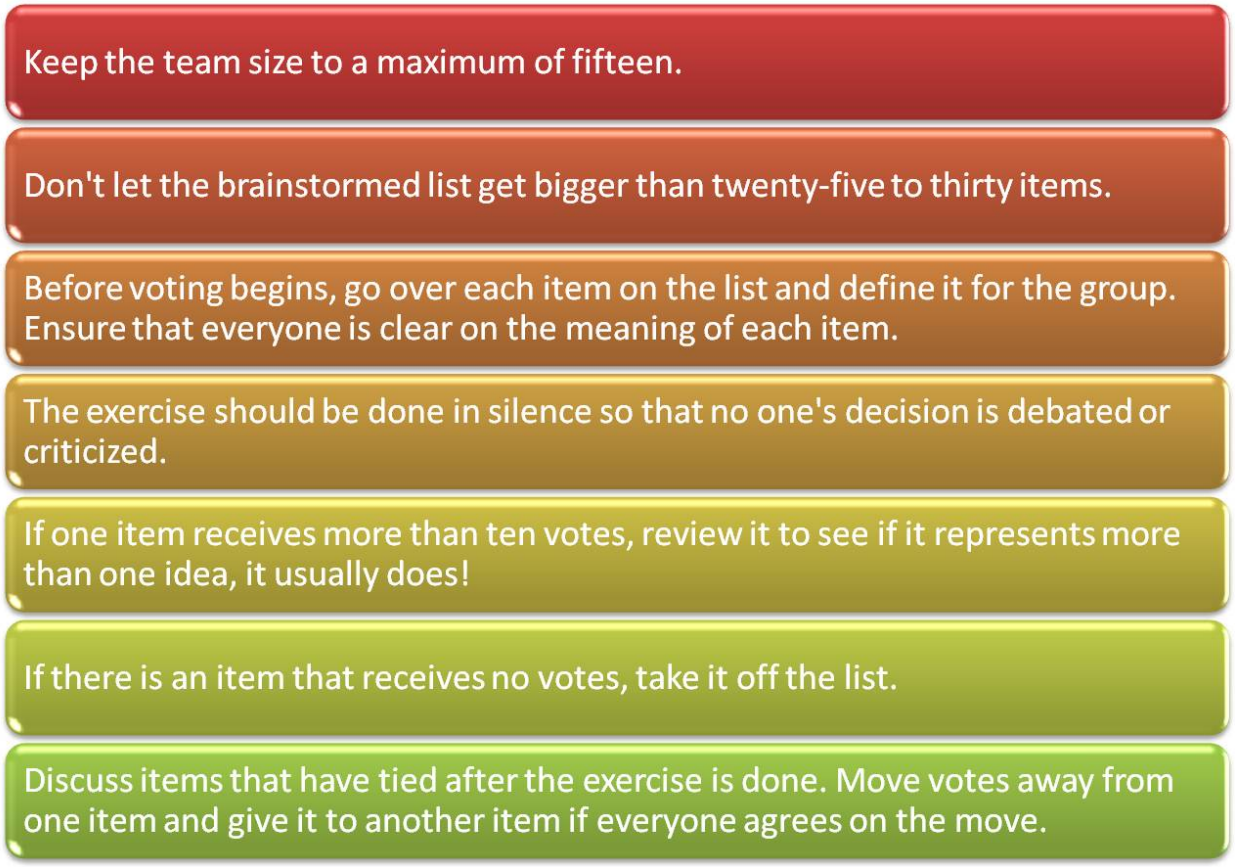
When to Use a NGT



How to Conduct a NGT Activity

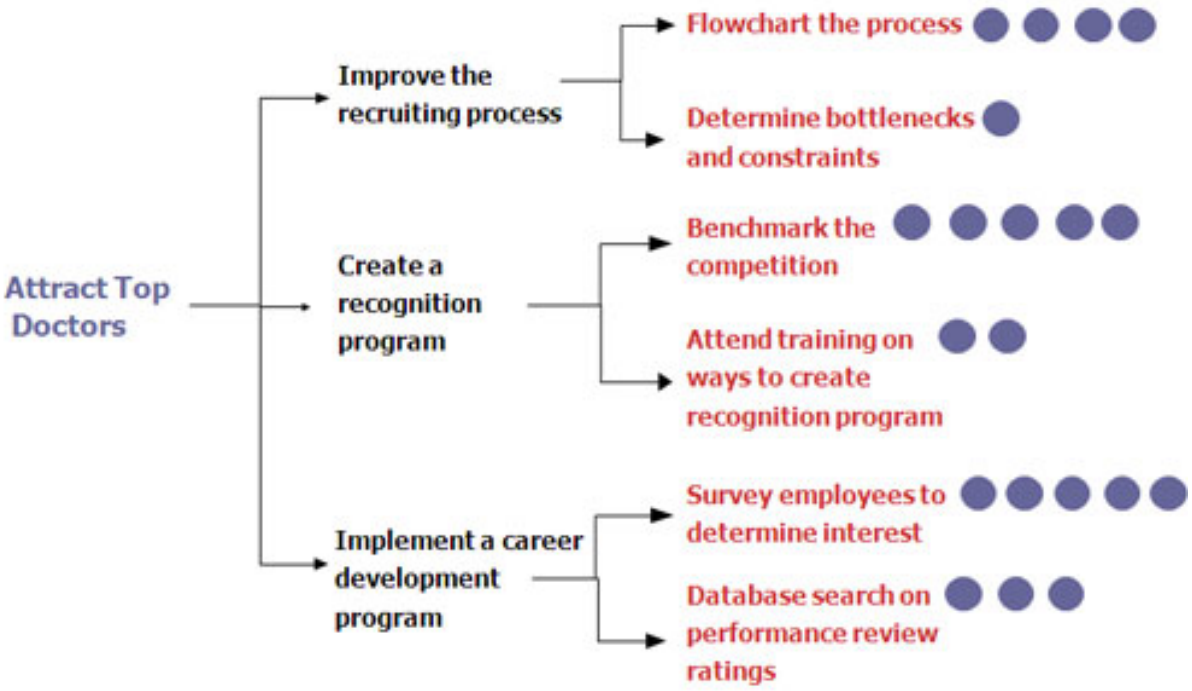
1. *The team's leader/facilitator discusses with the group an objective for the session.*
2. *Based on the objective, the team brainstorms a list of items and the facilitator posts them on a flip chart. You need to have at least 20 to 25 brainstormed items.*
3. *The facilitator starts by taking 100 red "sticker" dots and distributing them between the team.*
4. *Based on the number of people participating in the exercise, the team leader divides the one hundred red dots equally.*
5. *Team members are instructed to identify the things they feel are most important by placing a red dot next to the item. They aren't allowed to place all of their dots next to one item. They must divide their dots between three items - - at least!*
6. *Team members are given ten minutes to walk up to the flip chart and place their red dots.*
7. *Add up the number of red dots for each item. The item that receives the largest value is placed at the top of a list indicating priority order.*
8. *Discuss any items that are tied or have received more than 10 votes.*

Guidelines for Using NGT



Example of a NGT

Below is an example of how a team has prioritized the information in red. After the team defined the tasks involved in attracting top engineers, they used a simple nominal group technique to determine which task was most important. The most important activities are to benchmark the competition with respect to a recognition program and to survey employees to determine if there is an interest in a career development program. Team members picked the most important by using purple dots to indicate their votes.



About Your Instructor

Biography of Karen Roberts

Karen Roberts has worked in the field of organization development, quality, communications, and training for the past 20 years. She has set up and facilitated product development teams, and customer to support large-scale quality systems implementation, and strategic plans to support change. She has been instrumental in helping employees at all levels move towards continuous improvement and innovation.

Her consulting practice concentrates on training and consulting to business on ways to increase organizational effectiveness by improving individual interpersonal skills, team development, leadership, and quality measurement concepts. Before starting a private practice, she was employed for six and a half years with a high tech manufacturing division of Emerson Electric Company as their manager of training and organization development. Before that she spent thirteen years at AT&T. While at AT&T, she wrote and conducted seminars on team dynamics and communications.

She is a faculty member at Regis University, teaching courses on measuring human performance and effectiveness. She has a master's degree in Organizational Communications from the University of New Mexico and a master's degree in Business Administration. Her undergraduate studies were in the fields of Psychology and Communication.

Ms. Roberts has been a frequent speaker at the American Society for Quality: Rocky Mountain Quality Conference. She has also been a featured presenter for two years at the United States Office of Personnel Management's Annual Conference on Total Quality Management. She has presented her ideas on quality and organization development at the national conference for the American Society for Training and Development and Fairleigh Dickinson University: Corporate Communication Conference.

In addition she is a lead auditor in the International Quality Rating System designed by Det Norske Veritas and teaches courses in quality systems auditing. She conducts training in Quality Function Deployment and facilitates high profile product development teams for clients like Emerson Electric Company and Johnson & Johnson Medical. Other clients include Nasa, McDonnell Douglas, the Department of Transportation, the Department of the Interior and Roche Chemicals.

She is a long time member of the American Society for Training and Development and the American Society for Quality. Karen is a charter member of the Quality Function Deployment Institute and has studied advanced QFD techniques with the co-creator of QFD, Dr. Yoji Akao.