# ARMY MANAGEMENT STAFF COLLEGE


# TOOLTIME

# WORKBOOK

# INTRODUCTION

This self-paced workbook is designed to expose you to some of the most commonly used tools and techniques for decision making and problem solving. You will gain a basic understanding of when and how these performance measurement and planning tools can be applied. They are often used in a team environment, as they will be at AMSC.

Following the description of each of the tools, you should think about how you would use them or have used them on a problem or situation in your organization. When you study decision making in the resident portion of AMSC, faculty will ask you to provide an example of how you would use them in your work environment. Furthermore, many sessions in the program will require you to make use of various tools in practical exercises. You will receive more reference material that you can use to get into more detail on these processes. You will not need to know how to illustrate the tools using computer graphics software, although many software programs are available to do this.

You must have a basic understanding of descriptive statistics, such as mean, median, mode, and standard deviation prior to your attendance at the AMSC. These are necessary in order for you to use several of the performance measurement tools. You may want to refresh your memory on these concepts if you do not work with them on a regular basis.

If you have any questions on this workbook, please forward them to

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**Interpreting and Presenting Information**

Professional communication involves interpreting and presenting information of all types to various audiences. The presentation of this information is done orally and visually. The information ranges from qualitative descriptions of concepts to quantitative measurement data. This workbook includes tools that aid in the analysis of information, as well as the effective presentation of the information. Learning to use these tools is an important

step in effectively using information you have gathered and in effectively communicating with your audience.

## Definition of Terms

### Types of Data

Qualitative (also called attribute data) is discrete data and is classified in categories or groups. Examples of qualitative data are colors, yes/no, pass/fail, late/on-time, or male/female. Data may only be placed in one category.

Quantitative data is measured on a continuous scale or by counting (discrete). Examples of continuous data are height, weight. Discrete data are things that are counted, such as errors in a process.

### Measures of Central Tendency

Measures of central tendency provide a view of the most typical value in the data set. If you had to choose only one value to represent the whole set, what would it be? You can use several values, depending on the distribution of the data.

The Mean is the mathematical average of quantitative data. It is obtained by adding the individual values and dividing by the total number of values. Very high and very low values can skew the mean, so it may not be representative of the group.

The Median is the middle value in the sample of data. Half the values fall above the median, and half fall below. If there are an even number of measurements, average the middle two to get the median. Since this is the center of the data set, it may be more representative of the set because it is not affected by extremely high or extremely low values.

The Mode is the measurement that most frequently occurs.

**Measures of Dispersion**

Measures of dispersion indicate how tightly or loosely grouped sets of data are around the center.

The Range is the difference between the highest value and the lowest value. Remember, though, that it may not be very useful to describe the data set if there are extremely high or extremely low values. The range is required in designing charts and graphs.

The Standard Deviation is the most commonly used measure of dispersion. It tells how far the data is dispersed from the mean.

**Using the example of the salaries of the AMSC Softball Team, the following is true:**

| | | | |
|---|---|---|---|
| Pitcher | $5 million | Shortstop | $950,000 |
| 1st Base | $2.5 million | Right Field | $650,000 |
| 2nd Base | $500,000 | Center Field | $800,000 |
| 3rd Base | $1.2 million | Left Field | $1.4 million |
| Catcher | $900,000 | | |

The average (mean salary) is $1,544,444.44.
The median is $950,000
There is no mode.

If you were interested in the salary that is most representative of all the salaries of the team members, you would probably use the median. The average salary of $1.5 million may lead you to believe that all players make a little above that or a little below that, which is not the case. One player makes significantly more than the other players do, and his/her salary pulls up the average. So, if there is one value that is much higher or much lower than all the others, you consider the type of data to determine which measure would be the most appropriate in giving the viewer a sense of what the situation looks like.

## Affinity Diagram

**The affinity diagram** is a creative process that gathers and groups information in order to find the major themes out of a large number of ideas, opinions, or issues.

### Use an affinity diagram to...

Gather and organize large amounts of information that, at first glance, appear to be disorganized, chaotic and unrelated to each other or the problem.

Obtain a breakthrough in traditional concepts and thinking.

### How to build an affinity diagram...

1. Take the issue/problem on which you and your team are focusing and write it into a problem statement agreed to by all team members.

2. Generate and record ideas using brainstorming guidelines. Record each idea on a card (such as a Post-it note) and ensure that it is visible to everyone. (A typical affinity diagram has 40-60 ideas.)

3. Without talking, team members begin to sort the cards into related groupings based on their opinion of how they fit together. Team members take turns passing by and placing the cards until everybody is satisfied with the groupings and indicates this by making no changes. The idea is that each team member will see different connections as he or she tries to understand why others put the cards into different groupings. Even though disagreements will occur, the moving of cards will eventually settle into consensus. Your team should come up with 5 to 10 groupings of ideas.

4. For each grouping, the team decides on a title that describes the central theme of the cards. These are the header cards. Teams have a tendency to rush through this part of the exercise, but it's important to give it more consideration. The header cards provide the workable issues that are part of a larger problem, and they should be as accurate as possible.

## An example of an Affinity Diagram

### Problem Statement: Why do Army employees attend the Army Management Staff College?

**Brainstorm the idea: Why do Army employees attend AMSC?**

- I want to learn more about the Big Picture.
- I need a break from the spouse and kids.
- My boss told me to attend.
- I want to visit Washington, DC
- I need a break from work.
- I want to start a physical fitness program.
- I would like to get promoted.
- I want to stay at Knadle Hall.
- I'd like to learn more about leadership.
- I want to establish networking contacts to help my career.
- I'd like to improve my communication skills.
- I need to get a professional "tune up."

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**Group the Ideas and Develop Header Cards**

**Improve my Leadership Skills**

- I want to learn more about the Big Picture.
- I'd like to learn more about leadership.
- Improve my communication skills.

**Evaluate my life**

- Take a break from work.
- I need a break from the spouse and kids.
- I want to start a physical fitness program.

**Following orders**

- My boss told me to attend.

**See different places**

- Washington, DC is a great place to visit.
- I want to stay at Knadle Hall.

**Improve my career chances**

- I would like to get promoted.
- I need to get a professional "tune up."
- I want to establish networking contacts to help my career.

## Flow Chart

**A flow chart** is the pictorial representation of a process. There are standard symbols to designate certain items or actions in a process, although flow charts can be developed using unique symbols as well.

### Use a flow chart to...

Show the complexity, problems, and redundancies of a process, where simplification may be necessary.

Compare the actual process to the ideal process, and determine where improvements can be made.

Illustrate and examine the individual activities that make up the process.

### How to build a flow chart...

1. Clearly define the beginning (input) and the end (output) of the process.

2. Determine the level of detail that the flow chart should show. The chart can be at the macro level and show enough information to get a general understanding of the process, or it might show a greater level of detail by illustrating each decision point or action.

3. Determine the steps in the process.

4. Write the steps in the process, arranging them in the order in which they are carried out. Write the steps on Post-it notes and place them in the order in which they *actually* occur, rather than how they *should* occur.

5. Draw the flow chart using standard symbols, which indicate the parts of the process.

An oval is used to show materials, information, or action that starts the process (inputs) and the results (outputs) at the finish of the process.

A rectangle is used to show a task or activity performed in the process. There may be several inputs into a task, but there is usually only one output.

A diamond shows a decision point in the process where there is a yes/no question being asked.

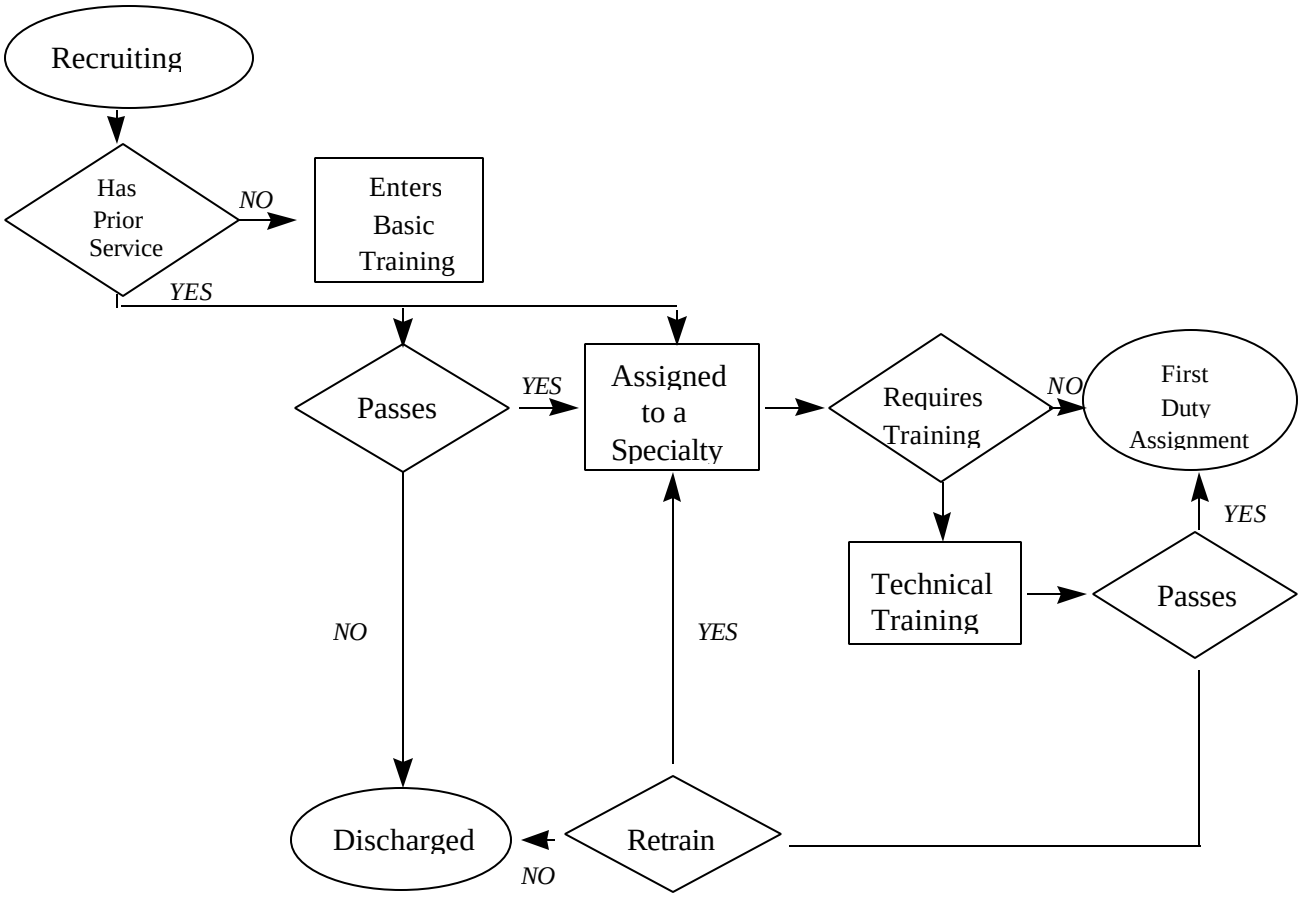
6. Draw arrows to show the direction of the process.

7. Make sure the flow chart is complete and correct. Are the steps of the process stated clearly? Is every feedback loop closed? In other words, does each path take you ahead or back to another step? If there is more than one arrow coming out of an activity box, there may be a need for another decision point (diamond).

8. Analyze the flow chart. Look for complexities and redundancies in the process. Are all outputs being used? Draw a flow chart of the ideal process, and compare it to the current process. Look for differences, and determine how they can be fixed.

## An Example of a Flow Chart

### Enlisted Soldier Accession and Training



## Cause & Effect Diagram

**A cause & effect diagram,** also called a fishbone diagram, shows the relationship between cause and effect. The possible causes of a problem or condition are graphically displayed, in increasing detail, in order to identify the root cause(s).

### Use a cause & effect diagram to...

Aid in finding the root cause of a problem by identifying all the possible causes and symptoms.

Investigate a complex problem where it is not obvious if you are dealing with causes or symptoms of an issue.

### How to build a cause & effect diagram...

1. Generate as many possible causes of the problem as can be determined through brainstorming, or by data collected on a check sheet.

2. Write the problem statement in a box on the right side of the paper, flipchart sheet, or whiteboard.

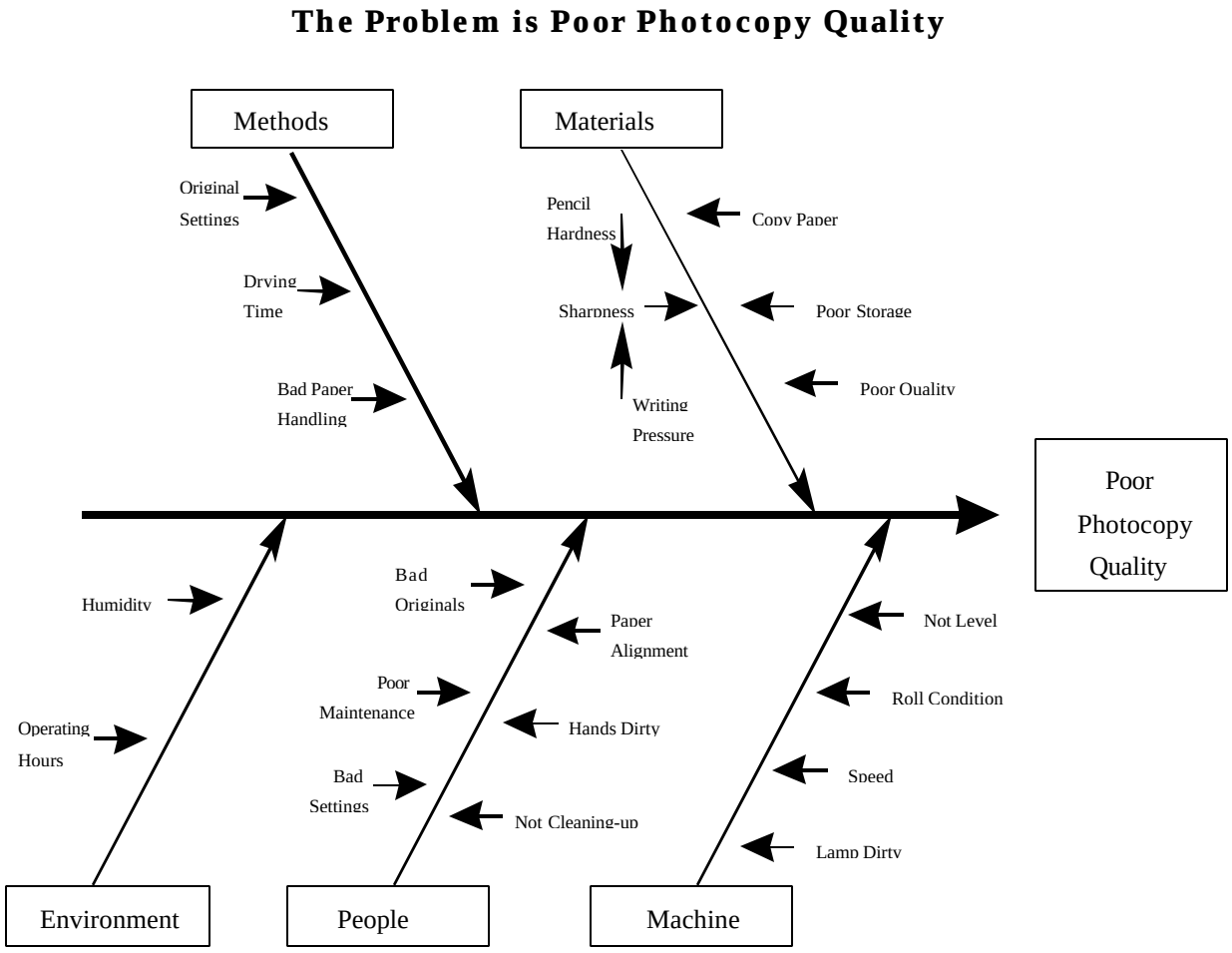
3. Draw the major cause categories or steps in the service or production process as lines off the backbone (main line) of the diagram, and connect them to the backbone. There are traditional categories for a production process (methods, materials, and people) and a service process (policies, procedures, plant, and people). Environment and measurement (calibration and data collection) are often used in both process types. Categories should fit the problem—do not get tied to the same set for different types of problems.

4. For each major cause category or step in the process, ask the question, “what causes this to happen?” Repeat this process for the next level of detail until you run out of causes. Some causes may seem to fit in several categories, although they should best fit in only one. If you cannot decide, put them everywhere they seem to fit, and see how they work out in the end.

5. Test for root cause(s) by one of the following methods:

- Look for causes that appear repeatedly within major cause categories, or across categories.
- Determine the root cause by a consensus process, such a Nominal Group Technique.
- Use a check sheet or some other type of data collection method to gather data on the relative frequencies of the different causes.

**An Example of a Cause & Effect Diagram**




**Your Example:** Using a cause and effect diagram, could you choose a condition or a problem in your organization and identify all of the possible causes as well as the primary, or root cause?

## Check Sheet

**A check sheet** is a chart that shows the systematic collection of data, either through observations or some other method.

### Use a check sheet to...

Show a clear picture of the facts, rather than opinions.

### How to design a check sheet...

1. Come to an agreement with the team, if a team is involved, on the definition of the condition or event that is being observed. Everybody has to be counting the same thing.

2. Decide who will collect the data, over what period, and what the sources of the data will be.

> *Note*. It may be important that the categories of observations be grouped into smaller subgroups, depending on the type of data collected. For example, if you are counting the number of errors in a process, you may want to break the process down into steps and count the errors in each step separately.

*Note*. You should be certain to collect data over a period of time that is a typical cycle for that process.

**Example.**

| TRACKING CUSTOMER COMPLAINTS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Location: Humphrey Hall** | **Dates: 18 May-10 July 1998 First 8 Weeks of Program** | | | | | | | |
| | **Wk 1** | **Wk 2** | **Wk 3** | **Wk 4** | **Wk 5** | **Wk 6** | **Wk 7** | **Wk 8** |
| **Contractor** | **A** | **A** | **A** | **B** | **B** | **B** | **B** | **C** |
| **REASON** | | | | | | | | |
| **Poor Service** | **0** | **0** | **3** | **5** | **8** | **12** | **10** | **2** |
| **Quantity** | **7** | **6** | **4** | **3** | **3** | **1** | **1** | **0** |
| **Taste** | **5** | **5** | **6** | **7** | **4** | **3** | **4** | **3** |
| **Cost** | **0** | **0** | **0** | **3** | **3** | **4** | **2** | **0** |
| **Other** | **1** | **1** | **0** | **0** | **0** | **0** | **0** | **1** |
| **TOTAL (weekly)** | **13** | **12** | **13** | **18** | **18** | **20** | **17** | **6** |

**Your Example:** Could you create a check sheet that shows how a project in your organization requires that certain data be collected or observations to be made?

## Pareto Chart

**A Pareto chart** is a bar graph that displays data in categories from that of the greatest magnitude to that of the least magnitude. It is based on the Pareto principle: 20% of the sources cause 80% of the problem.

### Use a Pareto chart to...

Focus on the problem or category that has the greatest number of occurrences.

Display the relative importance of problems by comparing them to each other in an easy and visually clear format.

### How to build a Pareto chart...

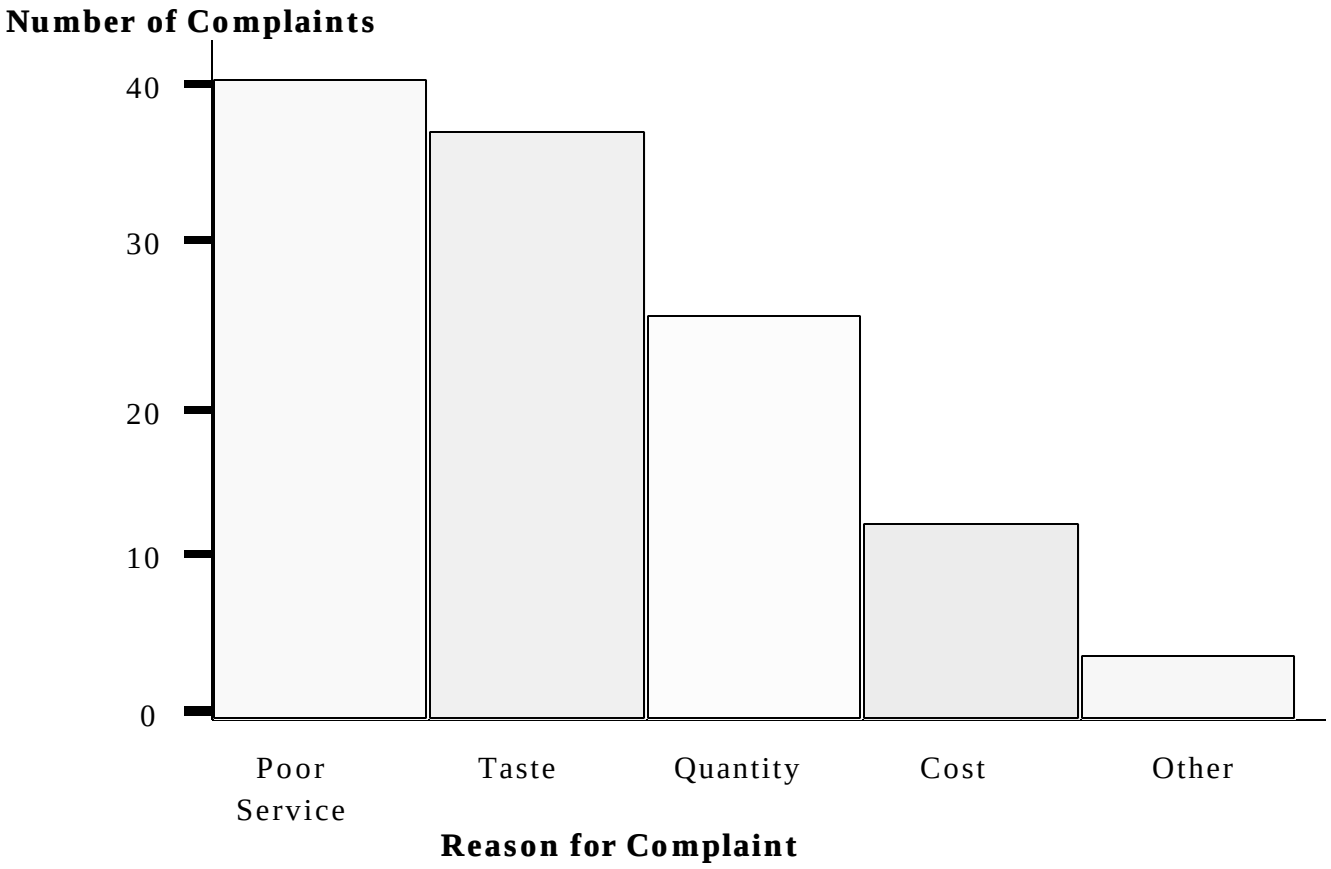
1. Determine the problem.

2. Collect the data on the problem, choosing a meaningful unit of measure such as frequency of occurrence or cost, and decide on a period of time in which the data will be collected. A check sheet is one method of collecting data.

3. List the problem categories on the horizontal (x) axis and the number of occurrences on the vertical (y) axis. All axes should be labeled clearly. Draw the bar for each category up to the frequency point on the vertical axis. The bars should be clearly distinct from each other. As with all graphs, you should be careful not to crowd the graph with too much print, or leave too much white space.

4. Interpret the results, which generally shows the biggest contributors to the problem are the categories that have the most number of occurrences. This is not always the case, though, since the most frequently occurring cause may not be the most important or the most costly. You must know what the impact of each of the categories is on the overall goal of the issue.

**An Example of a Pareto chart.** Customer Complaints on Food Service




**Your Example:** Are you able to design a Pareto chart using the data from the check sheet you would create from the previous tool?

## Run Chart

**A run chart** is a graph that shows plotted points connected by a line.

**Use a run chart to….**

Identify trends in a process, to monitor progress, and to show variation in a process over time.

Focus attention on the important changes in a process.

Track information over time in order to show a trend or make a prediction on future trends based on historical performance.

**How to design a run chart…**

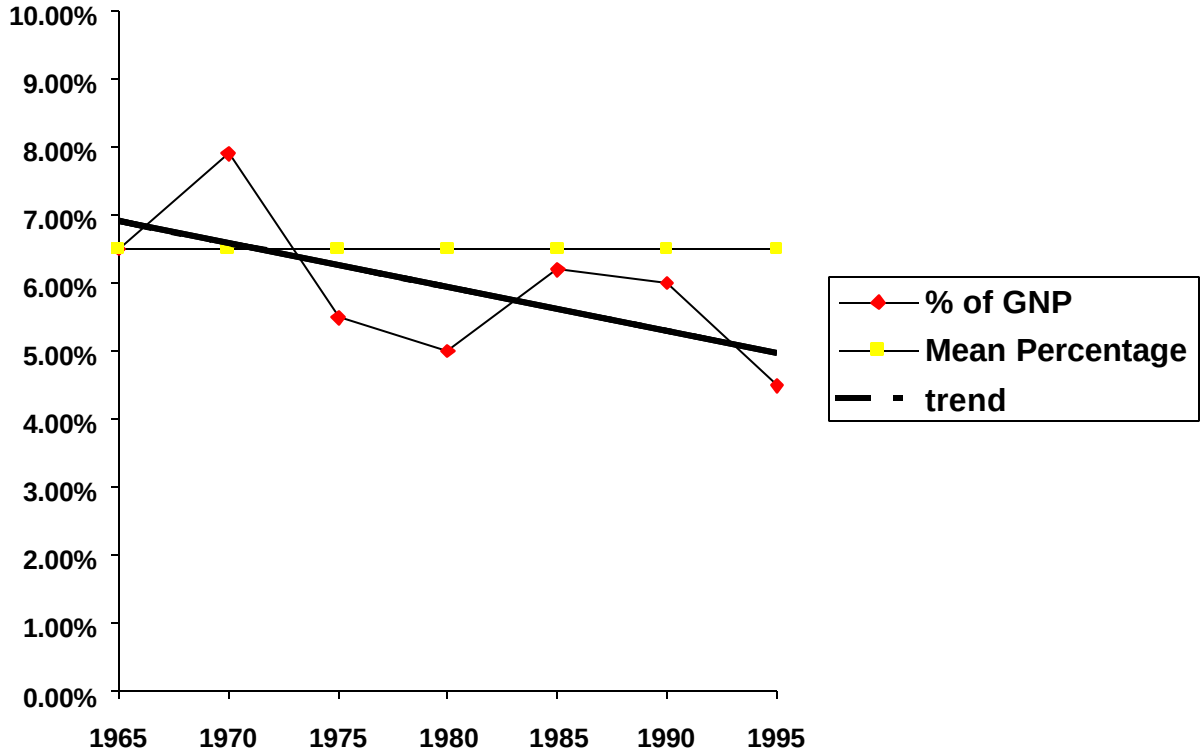
1. Collect data (20-25 data points) to show a meaningful pattern of performance.

2. Create a graph with an x (horizontal) and y (vertical) axis. On the x-axis, draw the time scale. On the y-axis, draw the scale of the variable you are measuring. Be sure to label each axis, and draw the scales proportionately to the amount of data you have collected.

3. Plot the data points (X, Y) = (time, variable). Draw a line from one data point to the next. You may average the variable data and draw a horizontal line at this point to show the average. You may also draw a “line of best fit” between the data points to show the trend line.

4. When interpreting the data shown on the run chart, it is important to not see each variation from the average (mean) as a problem with the process. All processes have some variability. The determination should be made depending how many times the variation occurs and how far from the mean they are. You would have to decide what standards you are trying to meet, and whether or not there is too much variation from those standards.

**Example**. The Department of Defense Budget as a Percentage of the Gross Domestic Product from 1965-1995.




This run chart shows the average (mean) of the variable data (% of GNP) and the trend line—it's gone down over the years from 1965 to 1995.

**Your Example:** Choose a process in your organization that has variable data over time. How would you create a run chart that shows the trend, if there is one, or the variability of the process?

**Histogram (AKA Frequency Chart)**

**The histogram** is a bar graph that summarizes a large amount of data from a process that has been collected over a period.

**Use a histogram to....**

Display the distribution of measured data in an easy-to-read format, rather than in rows and columns in a table.

Show the centering, variation, and shape of the data.

Show if the data is grouped at points to the right or left of the target value, or the average value, if that is what is required.

**How to design a histogram...**

1. Data collected should be variable data; that is, it is measured on a continuous scale. Examples: time, dimensions, scores, weights.

2. Gather the data. If you intend to look for patterns in the distribution of the data, or wish to assess the spread (variation) of the data, you should collect at least 50 to 100 data points.

3. Prepare a frequency table from the data.

**Example.** Here is a listing of test scores:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 33 | 66 | 70 | 75 | 79 | 82 | 88 | 89 | 100 |
| 53 | 66 | 71 | 75 | 79 | 84 | 89 | 90 | |
| 64 | 67 | 72 | 76 | 81 | 84 | 89 | 90 | |
| 65 | 68 | 72 | 77 | 81 | 86 | 89 | 90 | |
| 65 | 70 | 73 | 78 | 82 | 88 | 89 | 91 | |

4. Count the number of data points, n, in the set to get the sample size. The number of data points (test scores) is 41: n = 41.

5. Determine the range (highest point minus the lowest point), R, for the sample. The range of test scores is 67 (100-33=67).

6. Determine the number of class intervals, k, needed. If there are less than 50 data points, you should divide the sample into 5-7 classes. If there are between 50 and 100 points, there should be 6-10 classes. If there are between 100 and 250 data points, there should be 7-12 classes, and if there are over 250 points, there should be 10-20 categories (classes). For this example, with 41 data points, there would be 5-7 categories of data.

> Note: Too many classes of data will produce a spread out, flat pattern, and not enough will produce a high and tight pattern.

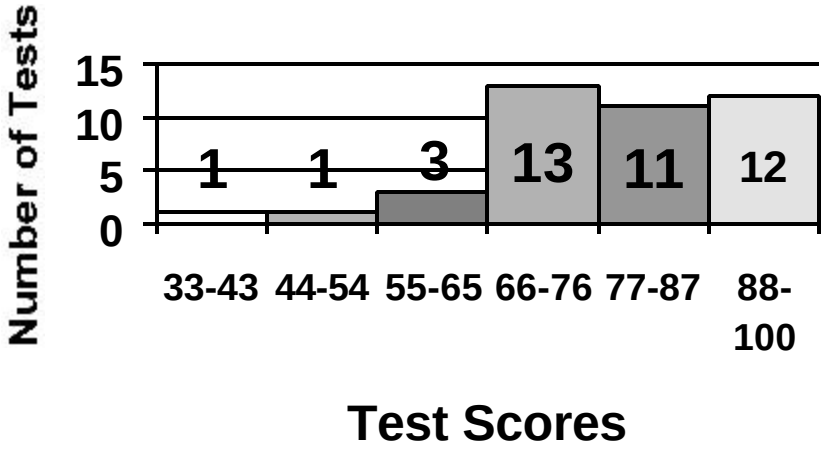
7. Determine the class width, or the size of each category, by dividing the range, R, by the number of classes, k: Category Width: H = R(67) ÷ k(6) = 11.2 rounded down to 11.

8. To make the first class boundaries, the upper and lower points of each class, add 10 to the lowest data point. This is the first class. Consecutively add the class width, H, to the lowest class boundary until all the range of data points are obtained. Since the upper and lower boundaries are counted, this will make each class contain 11 points, except the last class, which will contain 13 points. Note: each class interval must be mutually exclusive, where every data point will fit into only one class interval.

9. Draw a frequency table, showing the number of data points in each class.

| **Class** | **Class Boundaries** | **Frequency** |
|---|---|---|
| 1 | 33-43 | 1 |
| 2 | 44-54 | 1 |
| 3 | 55-65 | 3 |
| 4 | 66-76 | 13 |
| 5 | 77-87 | 11 |
| 6 | 88-100 | 12 |

10. Draw a histogram from the frequency table. On the vertical (y-axis), draw the frequency scale. Make it long enough to cover the highest frequency count. On the horizontal (x-axis), draw the scale that shows the measured data. For each class of data, draw a bar with the height equal to the frequency for that class.



## Brainstorming

**Brainstorming** is used to encourage creative thinking while generating a large number of ideas or issues to work with.

This is usually a group activity designed to generate many ideas in a short period. Individuals may spontaneously call out ideas, or they may take turns, each giving one idea at each turn. Ideas are written down, usually on butcher paper, and no member is allowed to comment on another's idea during the brainstorming session. The recorder may ask for clarification before writing the idea on the butcher paper.

Brainstorming can be structured or unstructured. In structured brainstorming, each team member, in turn, gives an idea. No idea is ever criticized. This continues until each person passes, indicating that they do not have any more ideas to list. Any duplicates are discarded only after the process is complete.

In an unstructured session, ideas are offered randomly, without going around the group in rotation.

Take a moment to clear your mind. Set a timer or note the time on your watch. Make a list of all the ideas that come to you on this topic: In 3 minutes, suggest ways to improve a desk calendar.

How many ideas did you come up with? How many of them would you consider logical? Did you come up with any that seem completely absurd? Did you find yourself making those judgments while you were writing? Did you refrain from writing some down because they seemed ridiculous? In brainstorming, this is not allowed. It is particularly difficult in a group setting to achieve this completely.

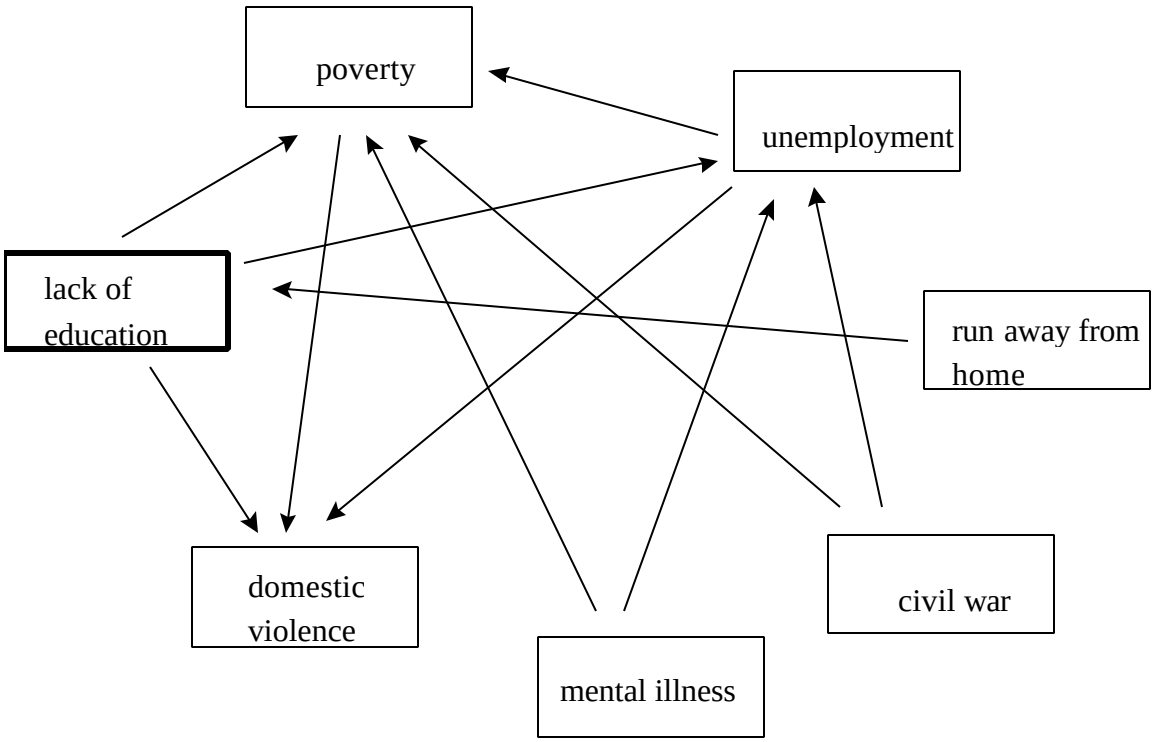
## Interrelationship Digraph

**An interrelationship digraph** illustrates cause and effect relationships among many issues. It is used when there are several causes of variation and you are unsure which cause has the most effect on the others.

This is a tool for a team to use. Once the main causes of a problem or variation are identified, they are written on sticky notes and placed randomly on a large piece of paper. Arrows are drawn between two items that are related from the cause to the effect. The primary cause is the one that has the most arrows coming from it.

**Example.**

What is the primary cause of homelessness?




There are three arrows that come from the "lack of education" box, therefore, this is presumed to be a major **cause** of homelessness, based on this example. "Poverty" has the most arrows coming in to it, so it can be considered a major **effect** of homelessness.

**Matrix Diagram**

There are many types of **matrix diagrams**, depending on the number of items to be compared. The variables are listed down the left column and across the top row. Symbols are used to identify the strength of the relationship between items.

**A matrix can be used to** determine the presence and strength of relationships between items. It can be used to organize work by assigning responsibility to organizations and individuals.

**Example.** This matrix shows the tasks accomplished by members of some of the Army branches. It is obvious to see those tasks that are accomplished by several branches, and those that are unique to certain branches.

Tasks: first aid, personal weapons qualifications, drill, physical training, map reading, radio maintenance, Morse code, radio maintenance, tank maintenance, set up fire control center, read flight instruments

Branch: Signal, Infantry, Armor, Artillery, Aviation, Special Forces

| Branch \ Tasks | Physical Training | first aid | personal weapons qual. | drill | map reading | radio maintenance | morse code | tank maintenance | set up fire control ctr. | read flight instruments |
|---|---|---|---|---|---|---|---|---|---|---|
| Signal | ◆ | ◆ | ◆ | ◆ | ◆ | ◆ | ◆ | | | |
| Infantry | ◆ | ◆ | ◆ | ◆ | ◆ | | | | | |
| Artillery | ◆ | ◆ | ◆ | ◆ | ◆ | | | | ◆ | |
| Armor | ◆ | ◆ | ◆ | ◆ | ◆ | | | ◆ | | |
| Aviation | ◆ | ◆ | ◆ | ◆ | ◆ | | | | | ◆ |

## Decision Matrix

This type of **matrix** evaluates and weighs several alternatives in order to choose the best item or alternative, or to narrow down options to a reasonable number. Each item is compared to others using specific and defined criteria. The type and design of the matrix will depend on the number of alternatives being compared and the type and number of criteria. Raw data criteria may be used to compare alternatives, but it has to be in a uniform scale of measurement, or it will have to be converted to a single scale.

To begin:

List alternatives or courses of actions (set of problem areas or set of potential solutions).

Brainstorm the "selection criteria."

**Example of a Raw Data Matrix.**

This matrix is designed to evaluate the options for a new spreadsheet software program. The selection criteria for evaluation are listed across the top. The companies selling the software program (or courses of action) are listed down the left column.

**Raw Data Matrix**

| | $$ | Megabytes | Consumer Reports Ranking | Days |
|---|---|---|---|---|
| Criteria / COA | **Cost** | **Memory** | **User Friendly** | **Training Required** |
| **ABX, Inc** | 5,000 | 32 Mb | 3 | 15 |
| **ISS** | 9,000 | 128 Mb | 5 | 5 |
| **Software, Inc** | 5,250 | 32 Mb | 1 | 8 |
| **Numbers Are Us** | 7,000 | 64 Mb | 2 | 10 |
| **SoftSpread** | 10,000 | 256 Mb | 4 | 14 |
| | < is better | > is better | > is better | < is better |

You should always have at least three courses of action (COA) and three criteria. At the bottom of the matrix itself, you may place a notation describing the values as “larger is better” or “smaller is better." This is a tool to focus you on remembering when you assign relative values, that the lowest $ cost would be assigned a relative value of “1” while the highest Consumer Reports' ranking would also be assigned a relative value of “1.”

This Raw Data Matrix should be the basis for the development of the three remaining matrices: Relative Value or Prioritization Matrix, Weighted Value Matrix, and the Multiplication Matrix.

**Example of a Relative Value or Prioritization Matrix.**

Each company is ranked (prioritized) according to how it meets each criterion, from 1 (best) to 5 (worst). Thus, within each column, we assign a relative value to each piece of data with the better value being assigned a value of 1. The total for each company is determined, and the lowest number wins.

**Relative Value or Prioritization Matrix**

| | $$ | Megabytes | Consumer Reports Ranking | Days | |
|---|---|---|---|---|---|
| Criteria / COA | **Cost** | **Memory** | **User Friendly** | **Training Required** | **Total Points** |
| **ABX, Inc** | 1 | 4.5 | 3 | 5 | 13.5 |
| **ISS** | 4 | 2 | 1 | 1 | **8** |
| **Software, Inc** | 2 | 4.5 | 5 | 2 | 13.5 |
| **Numbers Are Us** | 3 | 3 | 4 | 3 | 13 |
| **SoftSpread** | 5 | 1 | 2 | 4 | 12 |

In this case the relative values should always add up to 15. If we have four COA the relative value totals should add up to 10, if we have 6 COA the total should be 21, etc.

Note that in the criteria of "memory" we have a tie. In this case we add the relative value (4 plus 5) and average them arriving at a 4.5. Each of the COA would have a relative value of 4.5.

In this case, the lowest number, 8, indicates that ISS wins.

**Example of a Weighted Relative Value Matrix.**

Using your Relative Values Matrix as a basis, you can develop a Weighted Relative Value Matrix.

In the Weighted Relative Value Matrix, you subjectively assign a weight to one of the criterion. In this particular matrix, we determined that memory is more important than the other three and arbitrarily assigned a weighting of 2. We now multiply the weight times the relative value within that column. The next step is to add the relative values across the table and total them. Remembering that **lowest is best**, you would select ISS.

**Weighted Relative Value Matrix**

| Weight | 1 | 2 | 1 | 1 | |
|---|---|---|---|---|---|
| Criteria / COA | **Cost** | **Memory** | **User Friendly** | **Training Required** | **Total Points** |
| **ABX, Inc** | 1 | (4.5 x 2) 9 | 3 | 5 | 18 |
| **ISS** | 4 | (2 x 2) 4 | 1 | 1 | **10** |
| **Software, Inc** | 2 | (4.5 x 2) 9 | 5 | 2 | 18 |
| **Numbers Are Us** | 3 | (3 x 2) 6 | 4 | 3 | 16 |
| **SoftSpread** | 5 | (1 x 2) 2 | 2 | 4 | 13 |

**Example of a Multiplication Matrix**

Using your Raw Data Matrix as a basis, you can develop a Multiplication Matrix.

The multiplication matrix is the most precise of the three matrices. Returning to the Raw Data Matrix, you will multiply the values across using raw data and get a meaningful mathematical total that you can compare. However, all raw data numbers must reflect that the lower number is better. Thus, when you have Megabytes (memory) and *Consumer Reports* ranking (user friendly) having

the higher number as better, you must invert each of those numbers in order to arrive at a meaningful “lower number is better" formula. This "lower number is better" is achieved by placing the raw data number in a 1/raw data number. Next, complete the mathematical computation by multiplying across the table. Again, the **lowest number is the best**, so you should select ISS.

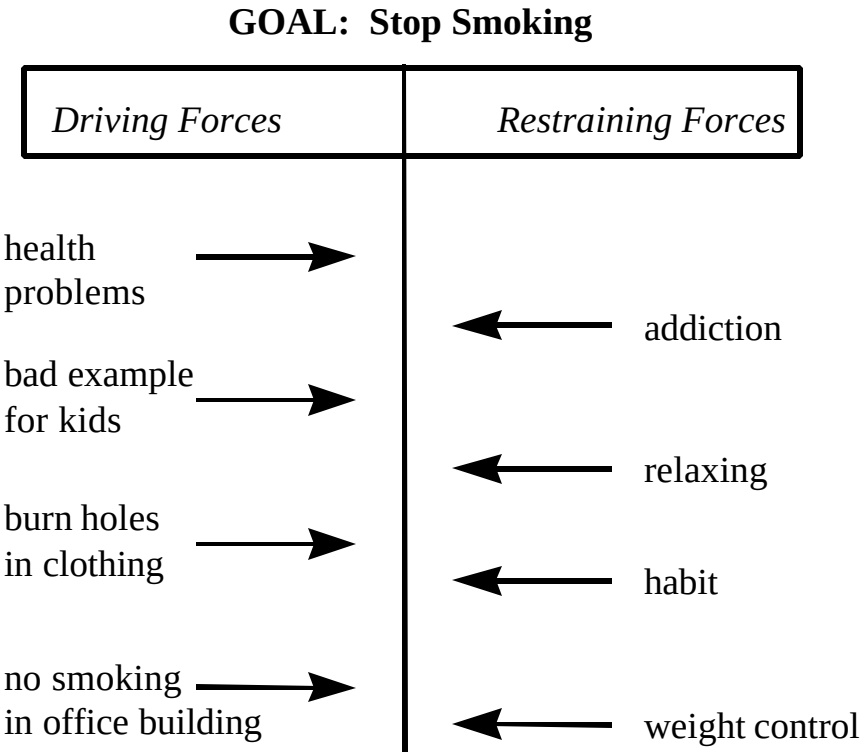
**Multiplication Matrix**

| | $$ | Megabytes | Consumer Reports Ranking | Days | |
|---|---|---|---|---|---|
| Criteria / COA | **Cost** | **Memory** | **User Friendly** | **Training Required** | **Total Points** |
| **ABX, Inc** | 5,000 | 1/32 | 1/3 | 15 | 781.25 |
| **ISS** | 9,000 | 1/128 | 1/5 | 5 | **70.3** |
| **Software, Inc** | 5,250 | 1/32 | 1/1 | 8 | 1312.5 |
| **Numbers Are Us** | 7,000 | 1/64 | 1/2 | 10 | 546.9 |
| **SoftSpread** | 10,000 | 1/256 | 1/4 | 14 | 136.72 |
| | < is better | > is better | > is better | < is better | |

**Force Field Analysis**

**A force field analysis** illustrates the factors or conditions that influence the goal to be achieved or the problem to be solved. It lays out both the forces that drive you towards achieving the goal and those that block the process. If there are conditions that influence the chances of achieving a goal, you should understand what they are and how significant they are. It is usually considered most effective to enhance the driving forces than to eliminate the restraining forces.

**Example....**

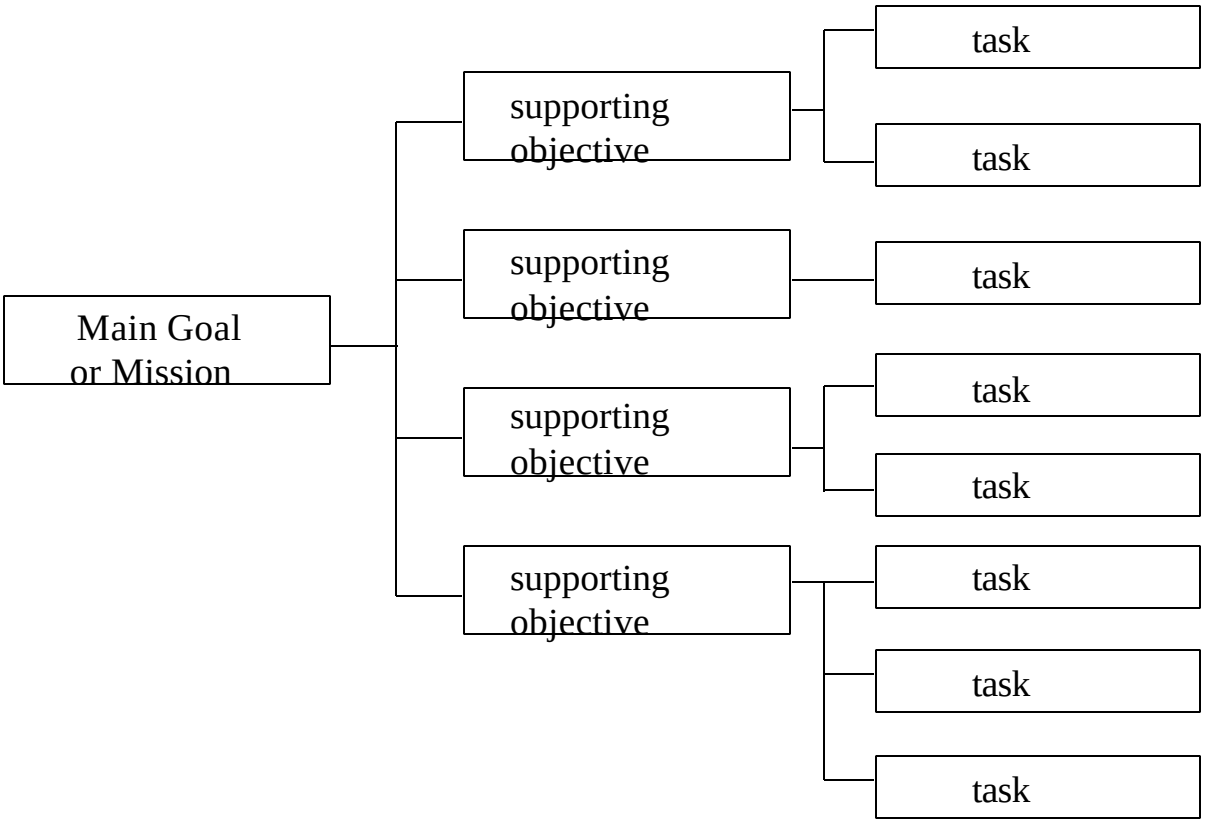


**Tree Diagram**

A tree diagram is useful when you want to break a goal down into major tasks or break down concepts into manageable or understandable components.

This graphic can be illustrated with the main goal or concept on the left, with the breakouts to the right, or with the main goal on the top and the breakouts below. The first breakout takes the main goal and divides it into specific objectives. The second breakout shows the tasks necessary to reach the objectives.

**Example....**



**Gantt Chart**

**A Gantt Chart** is used to show several tasks or events and how they occur over time. It is useful for scheduling various aspects of a project or for monitoring progress. It looks like a sideways bar chart, with the name of the event or task on the left axis, and the passage of time on the bottom axis. It does not show the dependency between tasks, but simply how they lay out over time.

| Summer Leave Schedule for Logistics Branch | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 29 JUN-3 JUL | 6-10 JUL | 13-17 JUL | 20-24 JUL | 27-31 JUL | 3-7 AUG | 10-14 AUG | 17-21 AUG |
| Mary | XXXXX | XXXXX | | | | | | |
| Susan | | XXXXX | XX | | | | | |
| Jeff | | | | XXXXX | X | | | |
| Fred | | XXXXX | | XXXX | XXX | | | |
| Dan | | | | | | XX | X | |
| Jenny | | | | | | XXXXX | XXXX | |
| Joe | | XXXXX | | | | XXXXX | | |
| Sarah | | | XXXXX | | XX | | | XXXXX |

**Your Example.** An ideal process to plan using a Gantt chart is to lay out the timeline that you must follow in order to complete the tasks to get ready to go to AMSC.

Congratulations! You have finished the ToolTime workbook! Remember, if you have any questions, write them down to discuss with you faculty upon arriving at the college, or write to the email address listed in the Introduction. These are samplings of tools and techniques you will use while you are a student, with many more contained in the Memory Jogger II.

## References

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