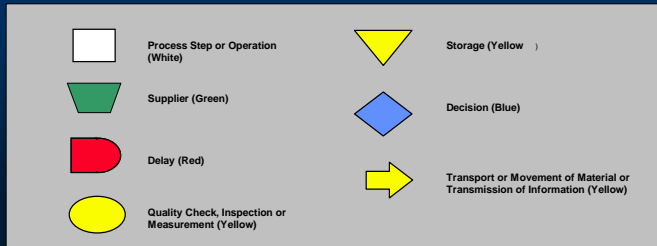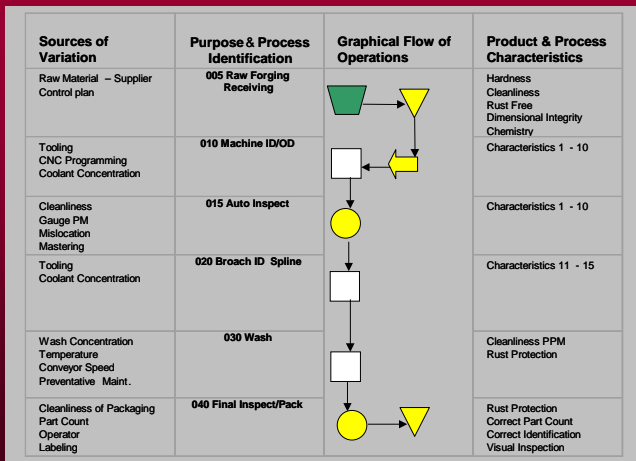# Basic Tools

Flow Chart

Use:
A pictorial representation of the steps of a process, it is used to identify the actual and ideal path that a process follows and to identify deviations. Further, it shows how steps are related to each other, it can uncover potential sources of trouble, and it provides a common language. Easily recognizable symbols represent the type of processing performed

- Process Step or Operation (White)
- Supplier (Green)
- Delay (Red)
- Quality Check, Inspection or Measurement (Yellow)
- Storage (Yellow)
- Decision (Blue)
- Transport or Movement of Material or Transmission of Information (Yellow)

Process:
- **Gather a group of people who represent the various parts of the process**
- **Decide where the process begins and ends**
- **Brainstorm the main activities and decision points in the process**
- **Arrange these activities and decision points in their proper order, using arrows to show direction of flow**
- **As needed, break down the activities to show their complexity**
- **Review the flow chart to assure that it represents the intended process**

Sources of Variation	Purpose & Process Identification	Graphical Flow of Operations	Product & Process Characteristics
Raw Material – Supplier Control plan	005 Raw Forging Receiving		Hardness Cleanliness Rust Free Dimensional Integrity Chemistry
Tooling CNC Programming Coolant Concentration	010 Machine ID/OD		Characteristics 1 - 10
Cleanliness Gauge PM Mislocation Mastering	015 Auto Inspect		Characteristics 1 - 10
Tooling Coolant Concentration	020 Broach ID Spline		Characteristics 11 - 15
Wash Concentration Temperature Conveyor Speed Preventative Maint.	030 Wash		Cleanliness PPM Rust Protection
Cleanliness of Packaging Part Count Operator Labeling	040 Final Inspect/Pack		Rust Protection Correct Part Count Correct Identification Visual Inspection

Check Sheet

Use:
An easy to understand form that is used to answer the question of how often certain events are happening. It starts the process of translating "opinions" to "facts". It is used to gather data based on sample observations where you can begin to detect patterns. It helps to categorize as well as collect data.
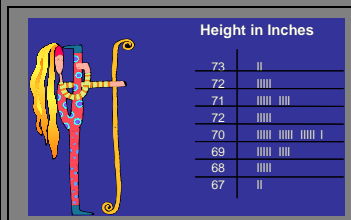
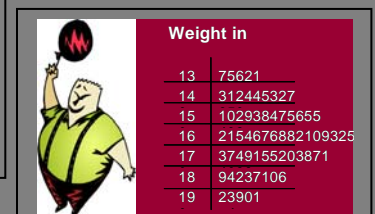| Defect	Week2/24	Week 3/2	Week 3/9	Total
Missing Label	IIIII I	IIIII II	IIIII III	21
Missing Ops	II	III	II	7
Wrong Packaging	IIII	II	III	9
Wrong Dimension	IIIII IIIII II	IIIII IIII	IIIII IIIII III	34
Missing Parts	I	II	III	6
Total	25	23	29	77

Process:
- **Agree as to exactly what event is being observed, then determine the appropriate categories**
- **Decide on the time period during which data will be collected**
- **Design a form that is clear and easy to use**
- **Use tick marks to record the occurrences**
- **Collect the data consistently and honestly**
- **Make sure that observations/samples are as random as possible**
- **Make sampling process is efficient so people have time to do it**
- **Population being sampled must be homogeneous. If not, it must be first stratified (grouped) with each grouping sampled individually**

Other Types of Check Sheets:

Variable

Stem and Leaf

Height in Inches

73	II
72	IIIII
71	IIIII IIII
72	IIIII
70	IIIII IIIII IIIII I
69	IIIII IIII
68	IIIII
67	II

Weight in

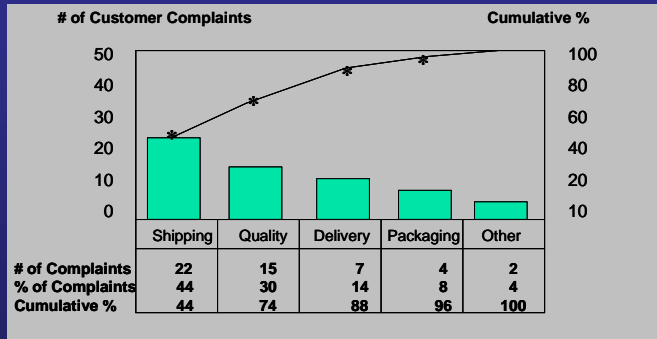| 13	75621
14	312445327
15	102938475655
16	2154676882109325
17	3749155203871
18	94237106
19	23901

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Pareto Diagram

Use:
Used to display the relative importance of all of the problems or conditions. It is a special form of vertical bar chart used to help decide which problems to solve first. The chart is based on the work of Vilfredo Pareto, an Italian economist who studied distribution of wealth. Pareto developed an 80/20 rule that stated that 20 percent of the people owned 80 percent of the land. He later found this percentage to hold true for many other things too.

# of Customer Complaints	Shipping	Quality	Delivery	Packaging	Other
# of Complaints	22	15	7	4	2
% of Complaints	44	30	14	8	4
Cumulative %	44	74	88	96	100

Process:
- Select the categories to be compared and ranked
- Select the unit of measurement
- Select time period to be studied
- Gather data for each category
- Compare frequency/cost of each category to others
- List categories in order of decreasing cost/frequency
- Draw a rectangle that represents the frequency/cost for each category

Cause and Effect Diagram

Use:
Used to explore and display all of the possible causes of a specific problem or condition. Also known as Fishbone Diagram or Ishikawa Diagram.

Process:
- Effect or problem is stated on the right side, major influences or causes on the left
- Common major cause categories:
  - People • Machines • Methods • Materials
  - Environment • Measurement
- Find minor causes, ask 5 W's and 3 H's
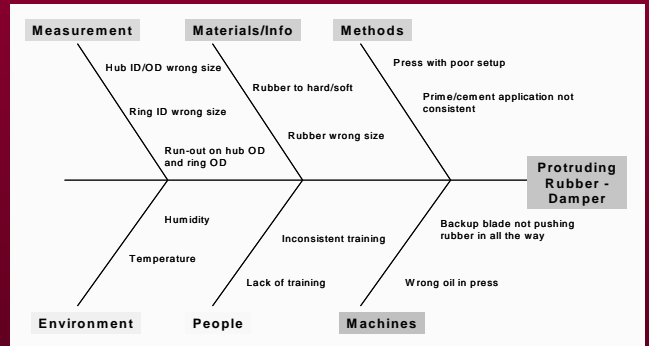
- Agree on one statement that describes the problem(s)
- Generate the causes
- Construct actual diagram
- Find the most basic causes of the problem
- Don't go beyond the area of control
- If a particular group of causes dominate the diagram, place them in their own diagram
- Useful variation is to make the cause and effect diagram public

Selection Matrix

Use:
A tool for narrowing a list of items to one or to the few that are most important. Helps make objective decisions through the use of discrete selection criteria. Issues are weighed against predetermined criteria and rated against how well they meet criteria.

PORPOSED PROJECT/ CHANGE DESCRIPTION	F	I	U	Total	Rank
Material Shortage	4	5	5	14	3
Absteeism High	5	5	5	15	1
Line Conyevor Stopping	4	3	2	9	6
High Incidence of Sub-Assembly Defects	4	5	5	14	2
Press # 3 Over Heating	5	3	1	9	5
#6 Packing Machine Often Down	5	1	2	8	7
Downtime is High	4	5	3	12	4

Process:
- Determine Feasibility (F): Can it be done?
- Does team have authority? Will they be met with a lot of resistance? Do they have or can they get the essential resources and skills?
- Determine Impact (I): If factors have major impact, then they must be considered in definition of impact
- Determine Urgency (U): Is immediate resolution necessary to reduce significant impact or is there only a minor/no increase if resolution is delayed?
- List the issues
- List the rating criteria
- Rate each item for feasibility, impact, and urgency: • 5 high • 4 moderately high
  - • 3 moderate • 2 moderately low • 1 low
- Numerically rank items based on combined criteria ratings of each
- If management judgment challenges the appropriateness of giving action priority to the highest ranked issue, clarify the criteria used by the group. Rank the items again.
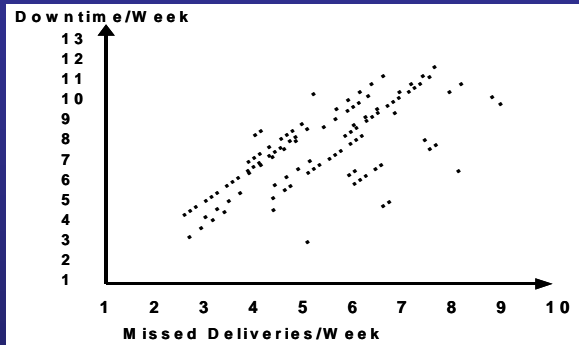
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Scatter Diagram

Use:
To display the relationship between one variable and another.

Process:
- Collect paired samples of data that may be related
- Draw a horizontal and vertical axis. Values get higher as you move up and right on each axis
- Plot the data and circle repeated values

Interpretation:

Negative Relationship | No Relationship | Possible Positive Relationship | Possible Negative Relationship | Positive Relationship

- **The shape of plotted points indicates if two variables are related**
- **Points randomly scattered indicates variables are unrelated**
- **When points approach a straight line, there is a stronger relationship**
- **It may be the case that two strongly related variables can have a nonlinear relationship**
- **No measure of relationship is appropriate when the scatter diagram breaks into 2 or more clusters**
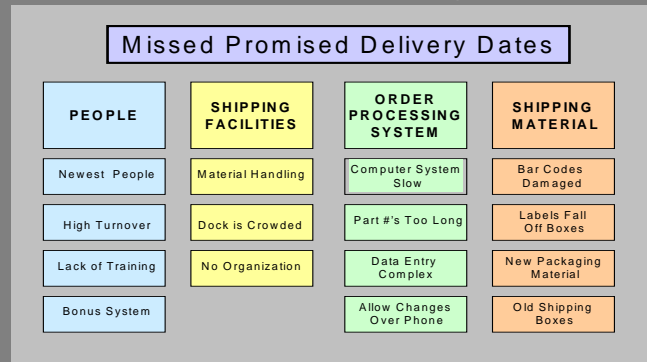
Affinity Diagram

Use:
To find major themes from many ideas, opinions, or issues; to group ideas and identify one concept that ties them together. Creative, rather than logical, consensus by sorting. Useful when chaos exists or breakthrough thinking is required.

Process:
- **Assemble the right team**
- **Determine topic**
- **Generate and record ideas**
- **Randomly lay out completed cards**
- **Sort the cards into related groupings**
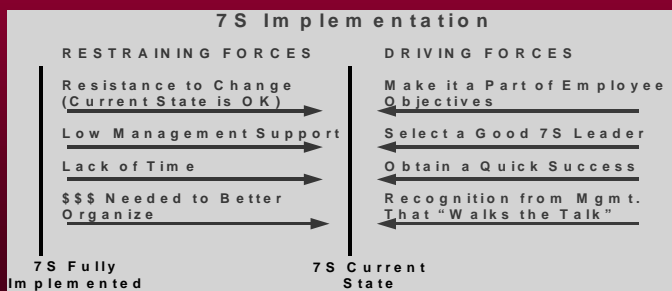- **Create the header cards**
- **Draw the finished Affinity Diagram**

Missed Promised Delivery Dates

PEOPLE	SHIPPING FACILITIES	ORDER PROCESSING SYSTEM	SHIPPING MATERIAL
Newest People	Material Handling	Computer System Slow	Bar Codes Damaged
High Turnover	Dock is Crowded	Part #'s Too Long	Labels Fall Off Boxes
Lack of Training	No Organization	Data Entry Complex	New Packaging Material
Bonus System		Allow Changes Over Phone	Old Shipping Boxes

- **Keep the team small**
- **Don't agonize over sorting**
- **Ideas are clarified, not criticized**
- **Avoid one-word cards**
- **When possible, statements have a noun and verb**
- **Silence during sorting, discuss during creation of headers**
- **Look within grouping for appro. header card**
- **If grouping is overwhelmingly large, divide it**
- **Keep the process moving**

Force-Field Analysis

Use:
Focuses group on high impact activities, identifies sources of help, may help uncover obstacles, and helps group anticipate special factors.

7S Implementation

RESTRAINING FORCES	DRIVING FORCES
Resistance to Change (Current State is OK)	Make it a Part of Employee Objectives
Low Management Support	Select a Good 7S Leader
Lack of Time	Obtain a Quick Success
$$$ Needed to Better Organize	Recognition from Mgmt. That "Walks the Talk"

7S Fully Implemented   7S Current State

Process:
- **Draw a Force-Field Chart**
- **Place current situation at bottom of rightmost line**
- **Place desired situation at bottom of leftmost line**
- **Brainstorm:**
  - **Restraining forces, left side of the chart**
  - **Driving forces, right side of the chart**
- **Determine which factors could be altered to increase success**
- **Prioritize the factors in order of impact restraining or driving**
- **Brainstorm ways of altering high-priority factors**
- **Determine viable solutions.**

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Histogram

Use:

Used to discover and display the distribution of data by bar graphing. For measurement data, displays several characteristics of one variable.

Shows:
- Shape characteristics
- Location of the average
- Variation among values
- Measurement information for one variable
- Does not show time – snapshot

Process:
- Collect the data and determine number of points
- Determine range (subtract smallest point from largest)
- Determine the number of data bars:

Under 50	5-7 bars
50-100	6-10 bars
100-250	7-12 bars
over 250	10-20 bars

- Determine width of each data bar
- Class intervals on the horizontal axis
- Frequency on the vertical axis
- Sort data points into class intervals
- Draw height of each bar to represent number or frequency of class interval

Machine Center #3
Diameter (mm)

Short Run

Mean

Samples: 80
Mean: 1.2625
Std Dev: 3.2482
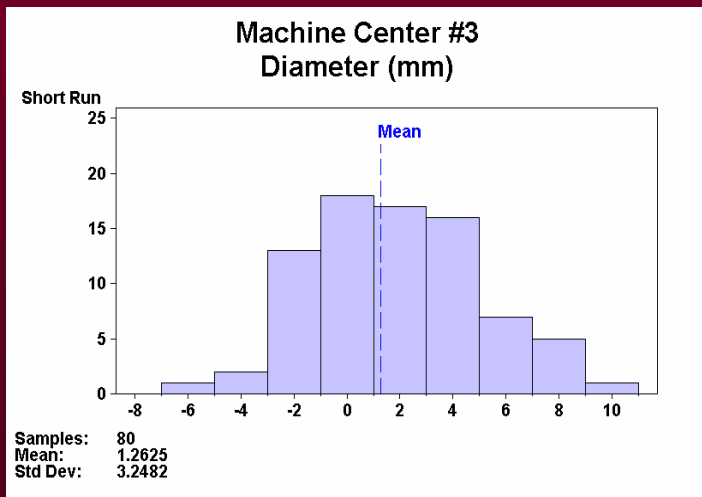
Interpreting:
- Some variables are naturally skewed
- Be suspicious of data that suddenly stops
- at one point
- Look for twin peaks

Bar Chart

A Histogram, but displays attribute data, one characteristic for two or more variables:

Units Produced

Machine A   Machine B
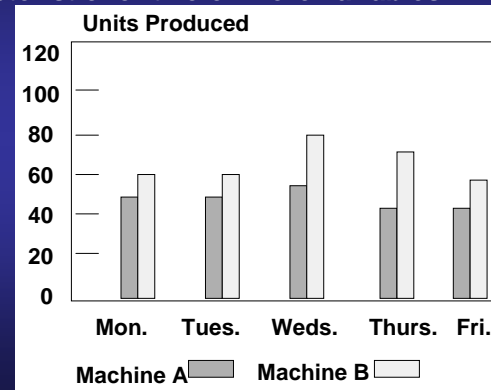
Run Chart

Use:

The simplest possible display of trends within data points over a specified time. Tracks a characteristic over time, sequence of data points is critical.

Process:
- Y Axis – Vertical
- X Axis – Horizontal
- Marked point, the quantity observed or sampled at one point in time
- Data points are connected for easy interpretation
- Time period covered, unit of measurement and creator are clearly marked on the chart
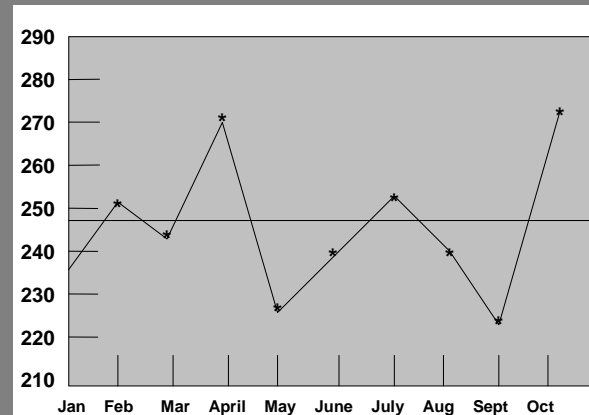
Interpreting:
- Avoid tendency to see every variation in the data as being important
- Points should fall randomly above or below the average
- Shifts: 7 or more points above or below the average
- Trends: 7 or more points constantly increasing or decreasing

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