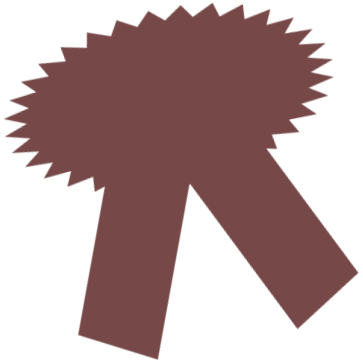
CONTROL PHASE

OBJECTIVE



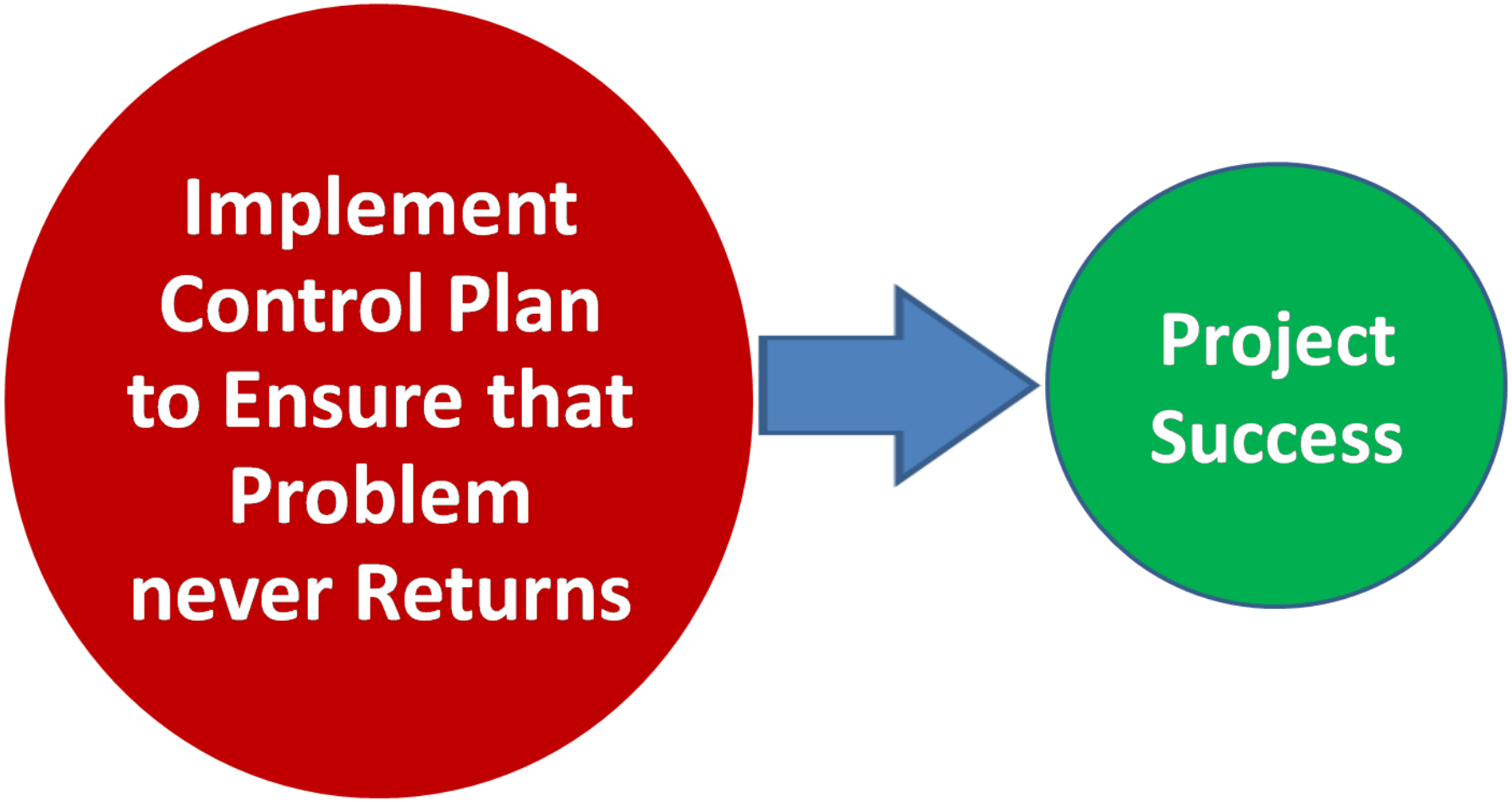
Main objective of control phase:

- **Final solution**
- **Maintaining guaranteed process improvements**
- **Ensuring that new process problems are identified and quickly corrected**
- **Disseminating lessons learned and to identify replication**
- **Standardization of opportunities.**

CONTROL OVERVIEW

- Develop- To develop the process control plan
- Monitor- To monitor the performance of ongoing process
- Prepare-Prepare the response Plan
- Success-Having a success Meet

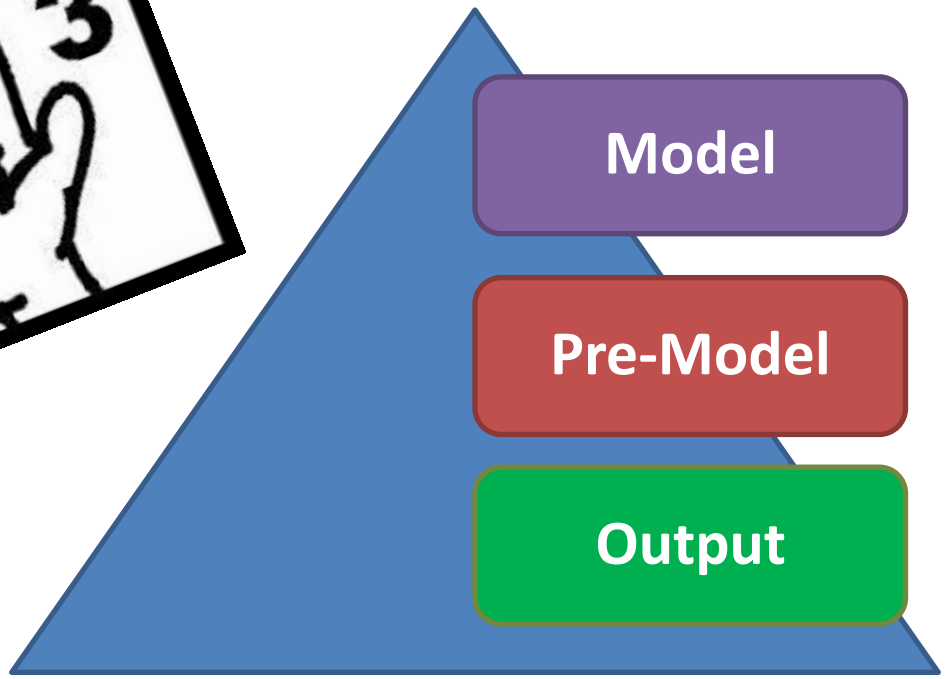
WHAT IT MEANS



Developing a process Control plan

- ✓Control plan notifies the vital quality features, the X's or Y's of the process elements .
- ✓The control plan substitutes detailed instructions of working or basic functional operations.
- ✓All process parts constitutes corresponding control Plan and similar ones are grouped

Types of control Plans



- Model
- Pre-Model
- Output

MODEL

Definition

It lists the controls for the following:

- dimensional measurements
- types of materials
- required performance tests.

KAIZEN

Definition:

- Kaizen refers to a philosophy or practices that focus on continuous improvement of processes in
  - Manufacturing
  - Engineering and
  - Business Management
  - Kaizen means 'change' or the 'action to correct'.
  - Zen means 'good'.

HISTORY OF KAIZEN

- **Masaaki Imai** is known as the developer of Kaizen.
- Toyota production system is the primary base for kaizen.

Characteristics Of KAIZEN

- **Applicability**

Can be used in both manufacturing and non-manufacturing environments

- **Highly effective & results oriented**

Kaizen events will generate

- Quick results
- Measurable results
- Establish the baseline and
- Measure the change.

Characteristics Of KAIZEN

- **A Learning Experience**

Every member of a Kaizen Team will walk away from the event learning something new.

- **Team based & cross functional**

Team members can be from various functions of the business.

Kaizen Result Sheet

Kaizen Results

Department Name	Mac-30 Line				Date	26-Feb-02	
Clutch Type	102-20-177				Takt Time	126	
Station Identification							
		Goal	Before Kaizen	After Kaizen	Total Change		
	Space (Sqare Feet)	-50%	323	208	-36%		
	Inventory at Line	-75%	91,635	16,000	-83%		
	Leadtime To Pull Job For Line	-75%	1 Hour	5 min	-92%		
	Crew Size	-25%	4	2	-50%		
	Scope Changeover (mins)	-50%	40	20	-50%		
	Press / Drill Changeover (mins)	-50%	35	10	-71%		
	One good piece - Throughput	-50%	4050 sec	78 sec	-98%		
	Line Flow	One Piece	Batch -50 per	One Piece	n/a		
Remarks							

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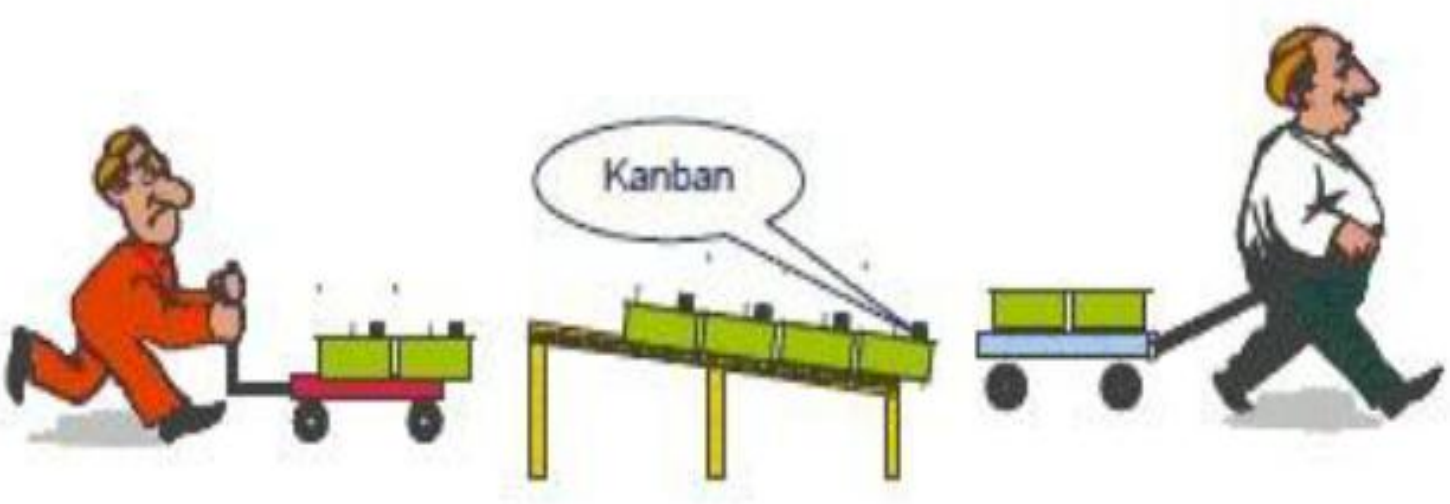
Tools

- Flow Charts
- Cause And Effect Diagrams
- Check Sheets
- Histograms
- Pareto Charts
- Scatter Diagrams
- Control Charts

Kaizen Events

- ✓5s
- ✓Value stream mapping
- ✓Standardizing work

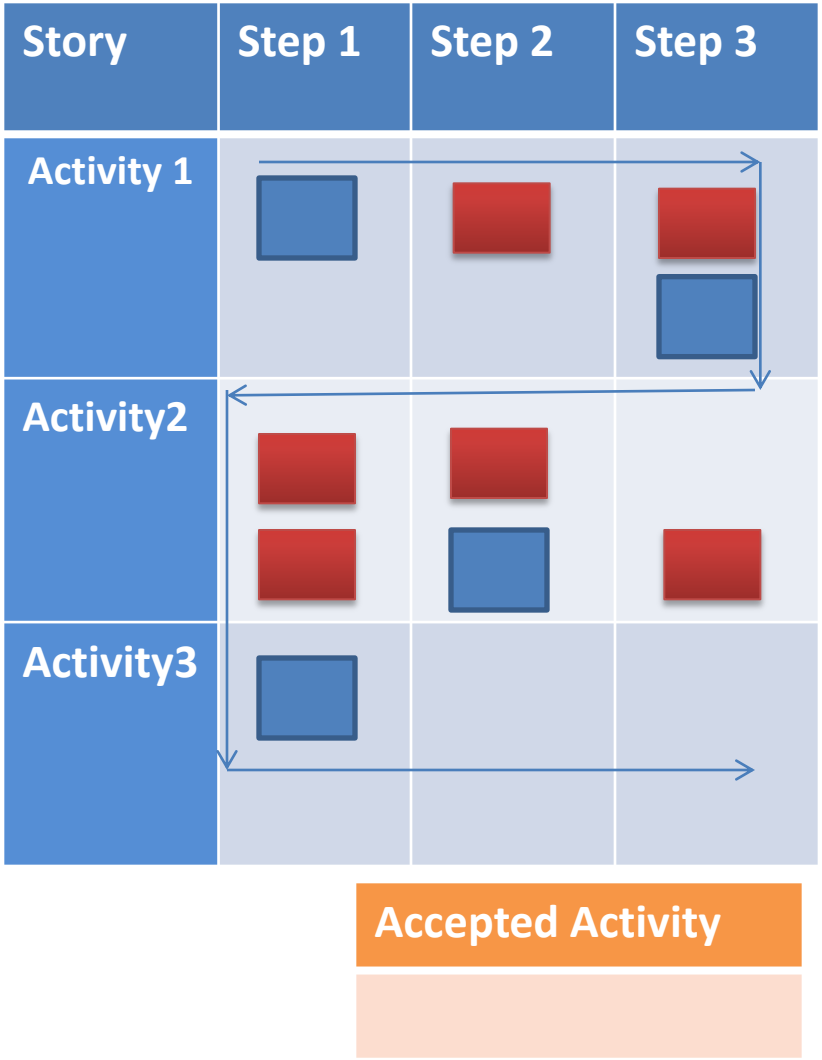
Kanban



What Kanban Is

- Kanban is a Japanese term which means designated place
- It is a method of just-in-time (JIT) production that uses precise instrumentation or sizing with a visual attachments
- It is used in manufacturing which tells the time to get or make more of something(visual card, sign board or billboard)

Which is clear?



Advantages of Kanban

- Reduced inventory as inventory is replenished only when it is consumed
- Less waste
- Flexibility in production
- Reduced cost due to reduced inventory

Determining Kanban Material

$$k = Tt = tS/nP$$

Where

Tt = Takt Time

nP = Average number of Parts shipped

tS = Average time between

$$\mathbf{K} = (DL + SS)/CS$$

Where

- **K** = Kanban size
- **DL =** Average Demand during Lead time
- **SS =** Safety Stock
- **CS =** Container Size

Size of kanban

$$K = \frac{P}{U} * T$$

Where

K = Kanban size

p = Units transported per month

u = Number of minutes for a month of production

T = Process active (time)

$$Tt = nP/SLt$$

Where

Tt = Takt time

nP = Number of Raw Parts that can be made in determined shipping window time

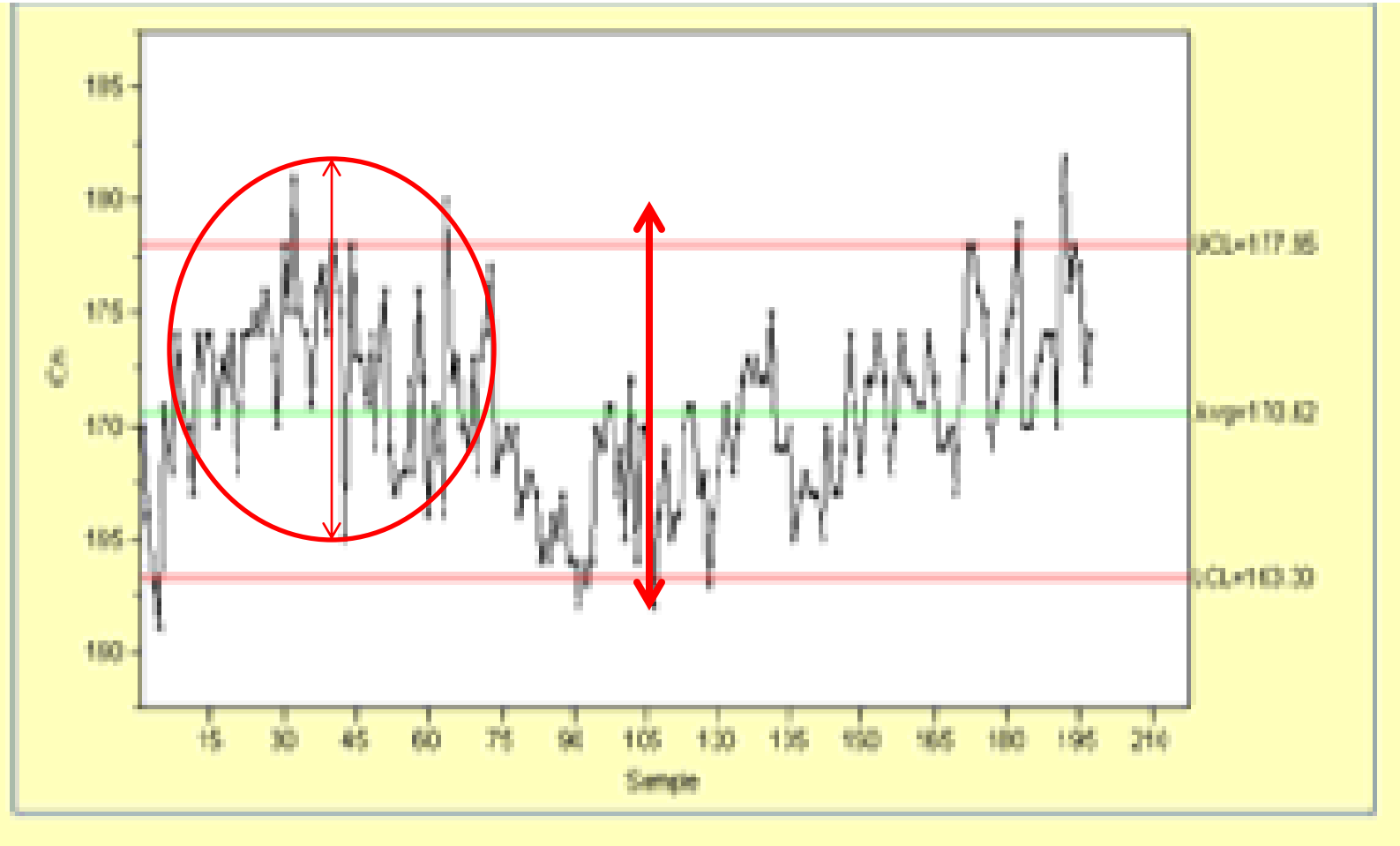
SLt = Standard Lead time

Control Plan

Standardizing work:

- A Standardized work is organized and order of work items that itaccomplishes are
  - Less Variation
  - Standardized work is demanded by visual factory Framework

Variation


185
180
175
170
165
160
15
30
45
60
75
90
105
120
135
150
165
180
195
210
Sample

Key Deliverables

Developing Process Control	• Control Charts
Monitoring Plan	• Dashboard • Response Plan • Project
Documentation	• Process
Procedures	• Replication
Opportunities	• Solution Transfer Plan

Purpose

- Maintains the changes that were made in the X's in order to sustain the improvements in the X's
- The team must develop a control plan, which consists of five basic parts

✓ training plan

✓ documentation plan

✓ monitoring plan

✓ response plan and

✓ institutionnalisation plan

Training Plan

The Training Plan gives

- ✓ Instructions for reading and interpreting control charts
- ✓ Guidance in understanding and using all the documentation on the improved process
- ✓ Knowing the contingency response plan and a way to implement it

Documentation Plan

The Documentation Plan ensures whether

- The improvements are institutionalized
- The new process steps, standards, and documentation are integrated into normal operations
- Systems,procedures,policies,instructions and budgets are modified to sustain the gains that have been achieved.

Monitoring Plan

The Monitoring Plan

- Documents and monitors the process using the metrics defined in DMAIC
- Evaluates the solution
- Assesses the capability of the process over time
- Establishes control systems to ensure that the solutions work for the long term

Response Plan

The Response Plan

- ✓ Establishes and checks the points that will signal out-of-control conditions
- ✓ Defines the actions to be taken.

Institutionalization Plan

The Institutionalization Plan

- Aligns systems and structures in order to ensure that the changes will continue
- Develops standards,procedures documents and communicates them to all stakeholders particularly to the owners and operators of the process

Lean Controls

Step	Japanese Word	Direct Meaning	English
Step 1	Seri	Clearing Up	Sorting
Step 2	Seiton	Organizing	Straightening
Step 3	Seiso	Cleaning	Shining
Step 4	Seketsu	Standardizing	Standardizing
Step 5	Shitsuke	Training & Discipline	Sustaining

Explanation

Seiri = Sorting
Eliminate everything not required for the current work, keeping only the bare essentials.

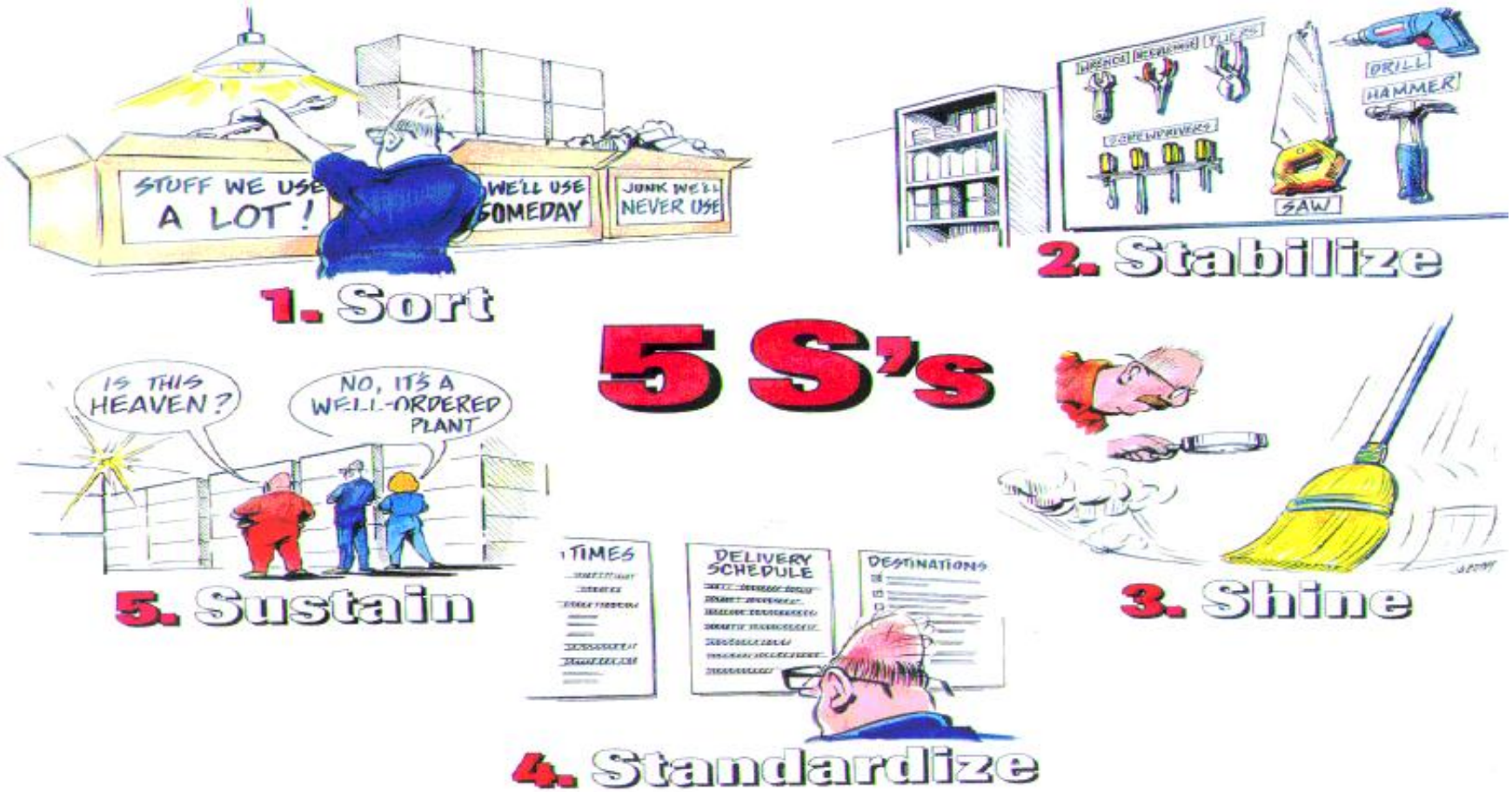
Seiton = Straightening
Arrange items in a way that they are easily visible and accessible.

Seiso = Shining
Clean everything and find ways to keep it clean. Make cleaning a part of your everyday work.

Seketsu = Standardizing
Create rules by which the first three S's are maintained.

Shitsuke = Sustaining
Keep 5S activities from unraveling

Understanding



Sort

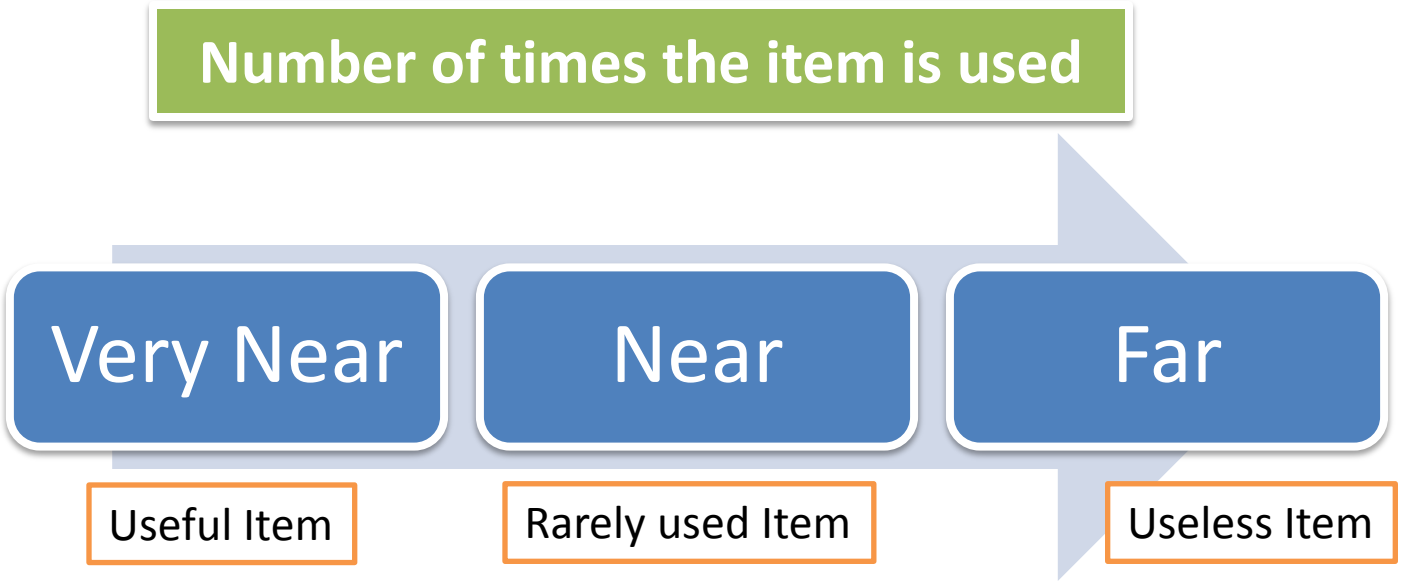
- Sorting always helps in removing waste
- Creates safer work area
- Gains space
- Easier to visualize the process.

Un Sorted Garments

Sorted Garments

Technique of Sorting.

Sorting things are based on the number of times an item is used and the more times it is used the more accessible it should be.



Straightening

Definition

Arranging all necessary items in a designated place that gives easy access and thus save access time.

Shining

- Keep everything clean.
- A clean work place is a symbol of quality production process and gives an ease to identify problems.

Standardizing

- ✓ We must keep the work place neat enough for visual identifiers to be effective in uncovering hidden problems.
- ✓ Continuous assessment always gives a scope to improve and makes problems visible

Sustaining

- Defined as a process of continuous improvement and sustaining the previous S's using self-discipline.
- Each individual has to commit to the process, stick to the rules, and maintain motivation.

Everyone Should meet the Requirements

Results of 5s's

- ✓Neat & clean workplace
- ✓Smooth working
- ✓No obstruction
- ✓Safety increases
- ✓Productivity improves
- ✓Quality improves
- ✓Wastage decrease
- ✓Machine maintenance
- ✓Visual control system
- ✓Employees motivated
- ✓Workstations become spacious

Red Tag Techniques

The Red Tag Techniques does the following:

- Gives Red Labels to the staff
- Ask Staff to go through every item in the work area
- Store in the red tag area
- Place the suspected items in the red tag area once a week
- Allows the staff to reevaluate the needed items

Statistical Process Control

- In Production process there are always errors due to which the outputs cannot become deterministic and perfect.
- In erroneous production the manufactured parts become non-identical which lead to variation growth in some features of the product.
- To correct these problems we need robust statistical techniques and probabilistic models to study such processes.

Statistical Process Control(SPC)

- SPC is a methodology that monitors processes and identifies cause of variance which in turn signals the need to take necessary actions
- When a cause is present, the system is said to be statistically out of control
- If the variance is due to usual errors, then process is said to be in statistical control

SPC: Drill

Concepts:

- Mean
- Standard Deviation
- Sampling
- Central Limit Theorem
- Control Charts for Attributes: p Charts
- Control Charts for Variables: x and R

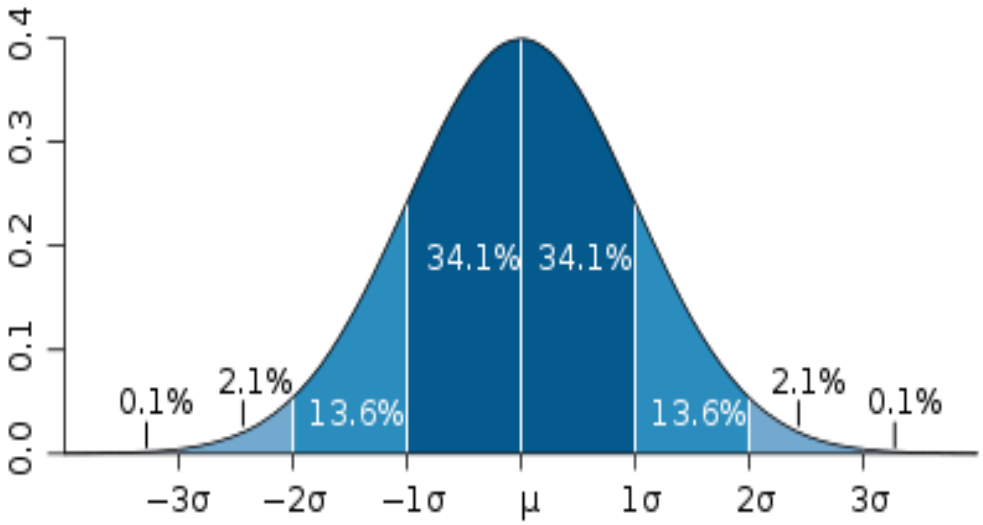
Mean

Mean is defines as the average of data values in a group.

$$\frac{M + E + A + N}{4}$$

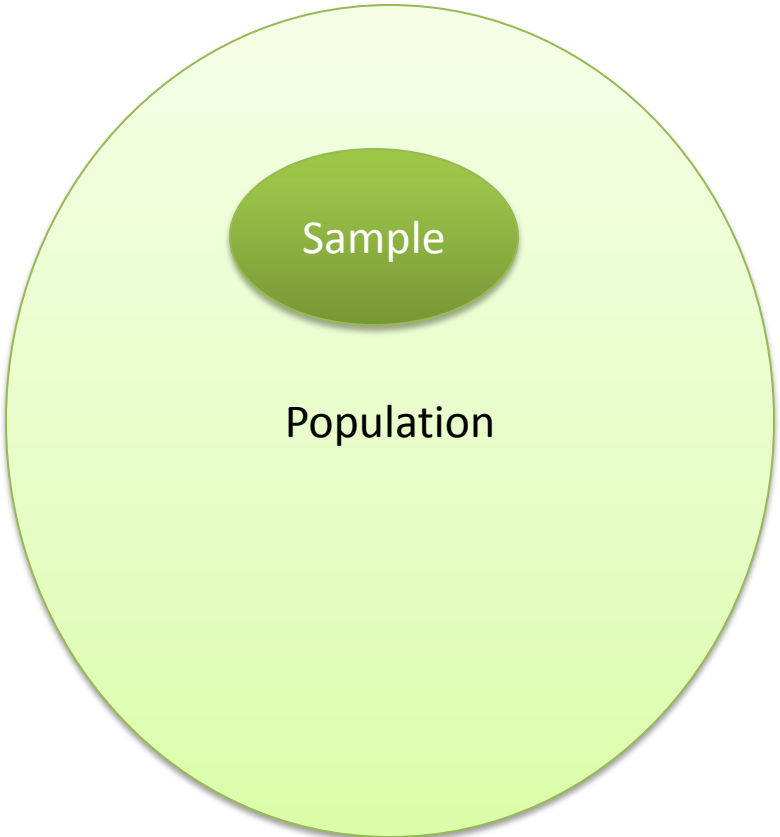
Standard Deviation

SD shows how much variation or "dispersion" exists from the average



Sampling

Sampling is to select at random from a population and use it to test hypotheses about the population

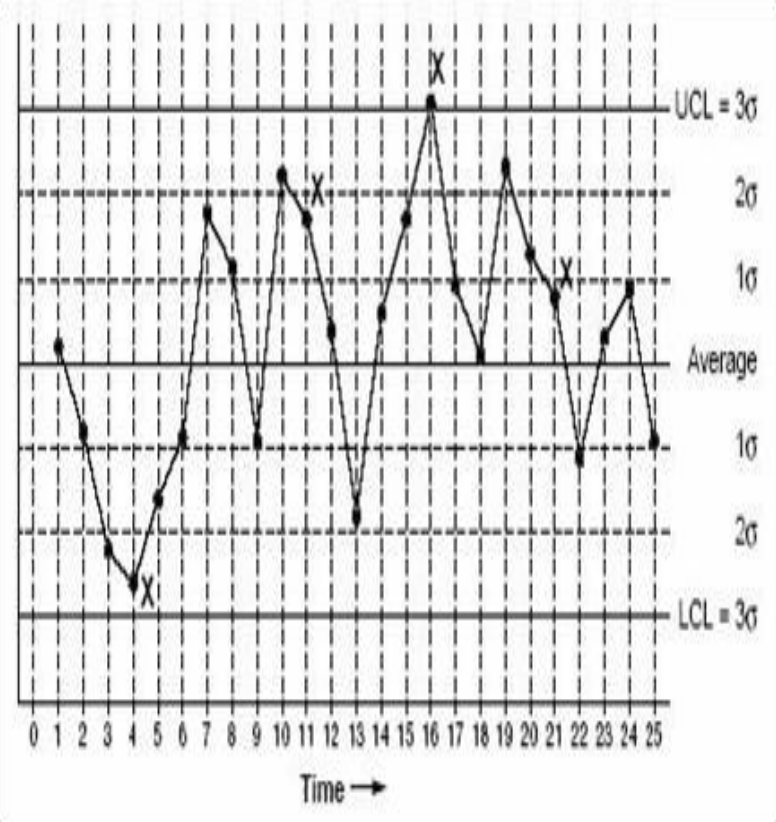


CONTROL CHARTS

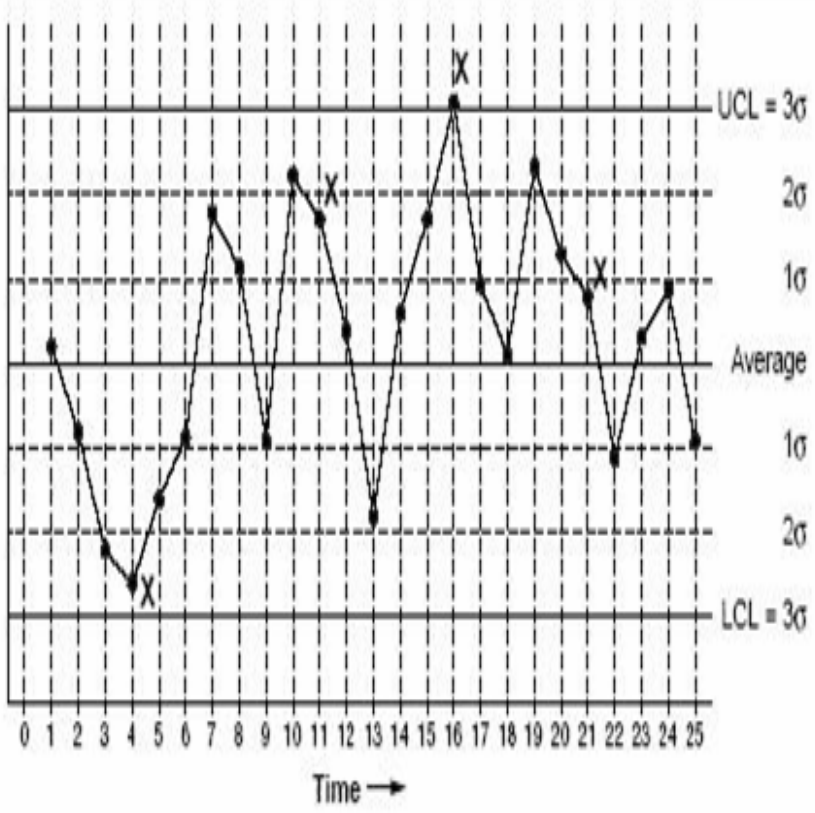
- ✓ It is a graph that represents measurements of process performance.
- ✓ It contains the target values of the attribute that is being measured
  - Upper control limit (UCL)
  - Lower control limit (LCL)
- ✓ Types of control charts
  - X bar chart
  - R chart
  - P chart

EXAMPLE OF CONTROL CHARTS

Average $\bar{X}$



Range R



Calculating the control limits

Avg($\bar{x}$)and Range (R)

$\bar{X}$ chart: $UCL_{\bar{X}} = \bar{\bar{X}} + A_2 \bar{R}$

$LCL_{\bar{X}} = \bar{\bar{X}} - A_2 \bar{R}$

R chart: $UCL_R = D_4 \bar{R}$

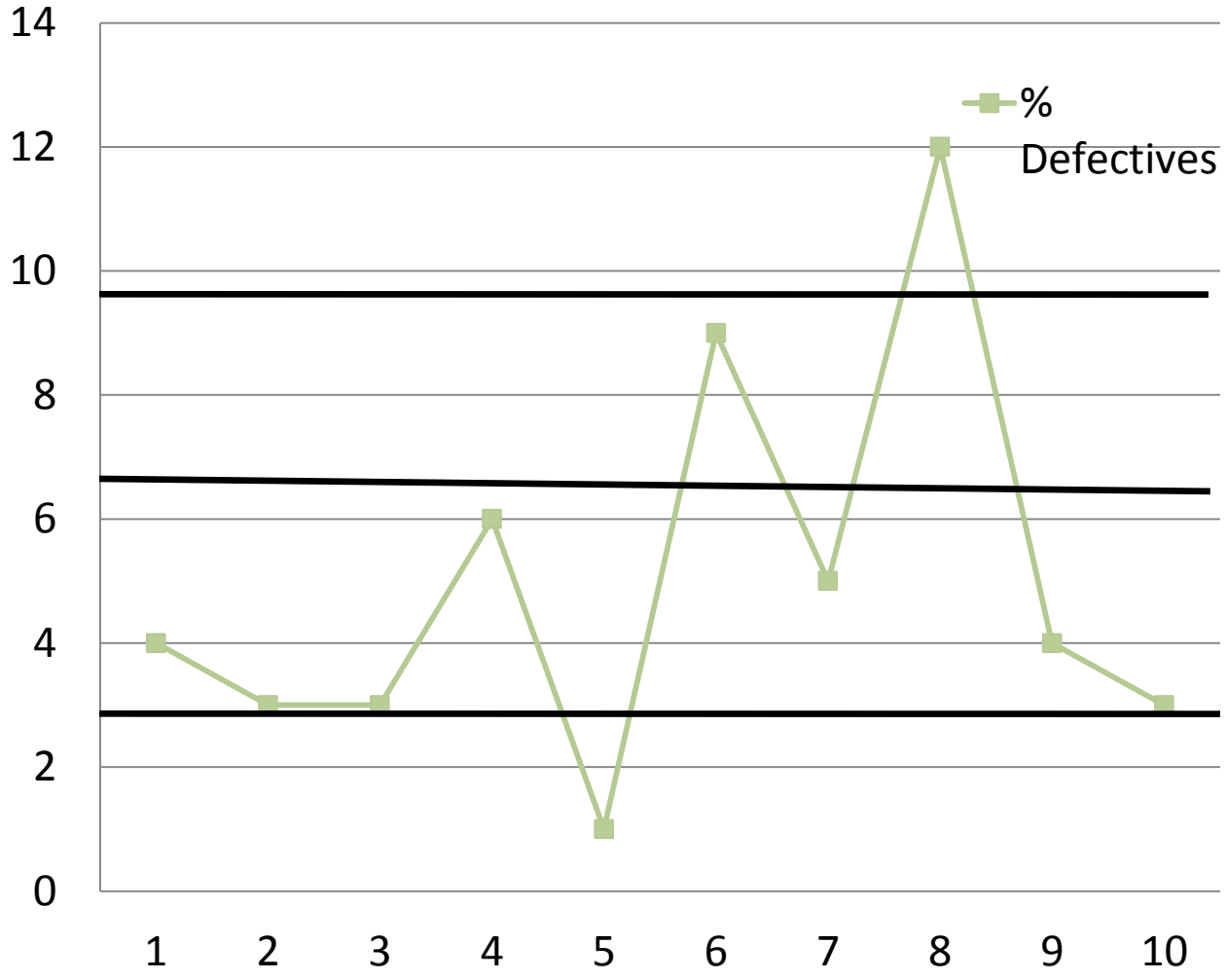
$LCL_R = D_3 \bar{R}$

- $\bar{\bar{X}}$ - Average of the $\bar{X}$ values
- $UCL_{\bar{X}}$: Upper ControlLimit on Avg chart
- Lower limit on Avg chart
- $LCL_{\bar{X}}$: Upper control on R chart
- UCL_R: Lower control limit on R chart
- LCL_R : Sample Size
- : Avg of all reading in sample
- $\bar{X}$: Data Reading
- D_i : Varying constants

CONTROL CONCEPTS

- Lean Control Plan
- Standardize Process
- Total Productive Maintenance (TPM)
- Audit and Documentation

P-Charts



P-charts are used where Subgroup Size Varies on the following:

P-CHARTS

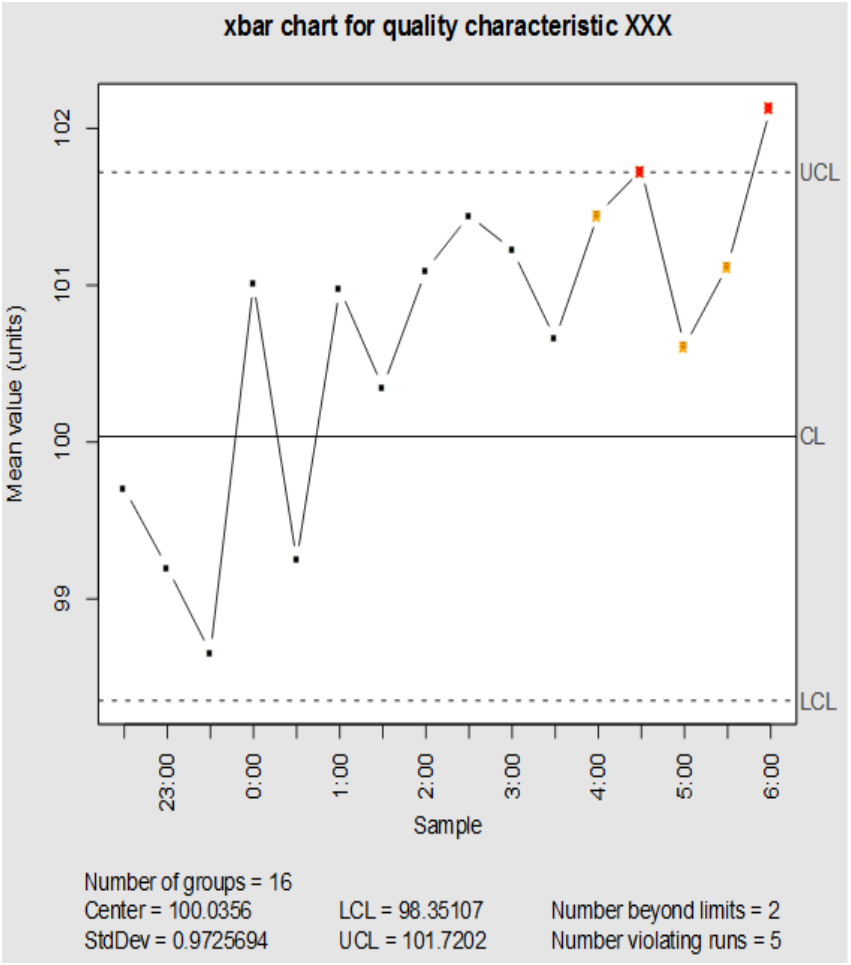
- Proportion of Late Deliveries
- Closing Books on Time
- Defectives by Production Runs
- Inventory Cycle Count Accuracy
- Percent of Claims Rejected
- Batch Proportion Defective

X charts

X bar R "Classic" is the most common chart for manufacturing

Uses

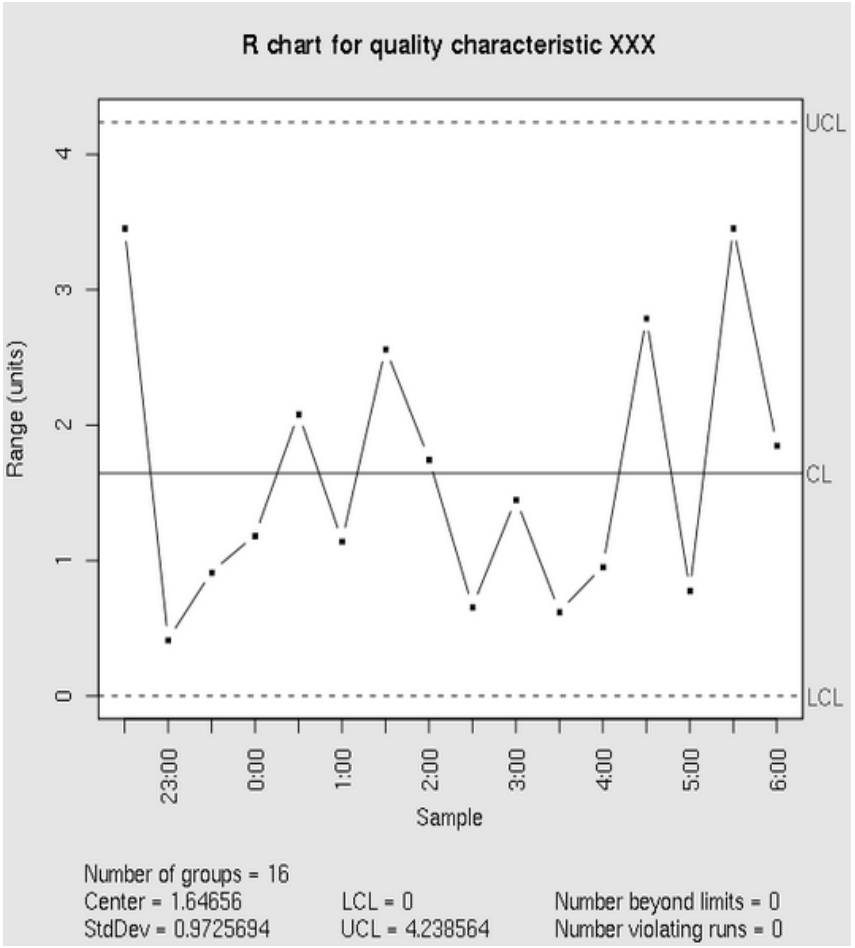
An x bar chart is used to monitor the average value, or mean, of a process over time .



R chart

- An "R" Chart is a control chart that is used to monitor process variation when the variable of interest is a quantitative measure.

- $R = x_{max} - x_{min}$



End of the Control Phase

- The controller calculates, verifies, and documents the financial gains of the project
- The black belt and the champion close the control Phase and formally end the project with the final phase-gate review, handing over the process to the process owners

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