Quality Control

Project Proposal

Goal

In The Long Term: Reduce waste by reducing number of batches below acceptable purity

Approach

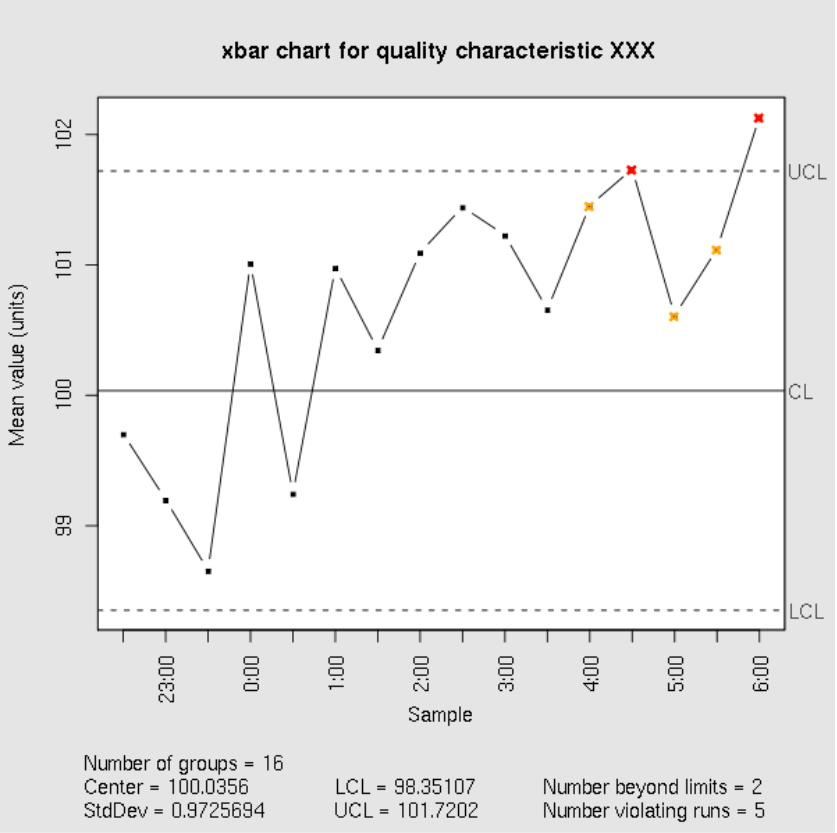
Collect and analyze data – like a scientist!
Adapt according to conclusions drawn

Cost of Project

5 hours per week labor for 50 weeks
$6,000-$7,000/year

Control Charts

- Purpose: To monitor quality of product and help identify sources of unacceptable levels of error
- Quality, for us, relates to ***PURITY***



Control Charts

- Gather points representing mean purity of samples taken from different batches on different days
- Calculate mean purity of all batches
- Draw a center line at the value of the mean of all batch purities
- Calculate the standard error for all samples.
  - Standard Error=standard deviation/sqrt(n)

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

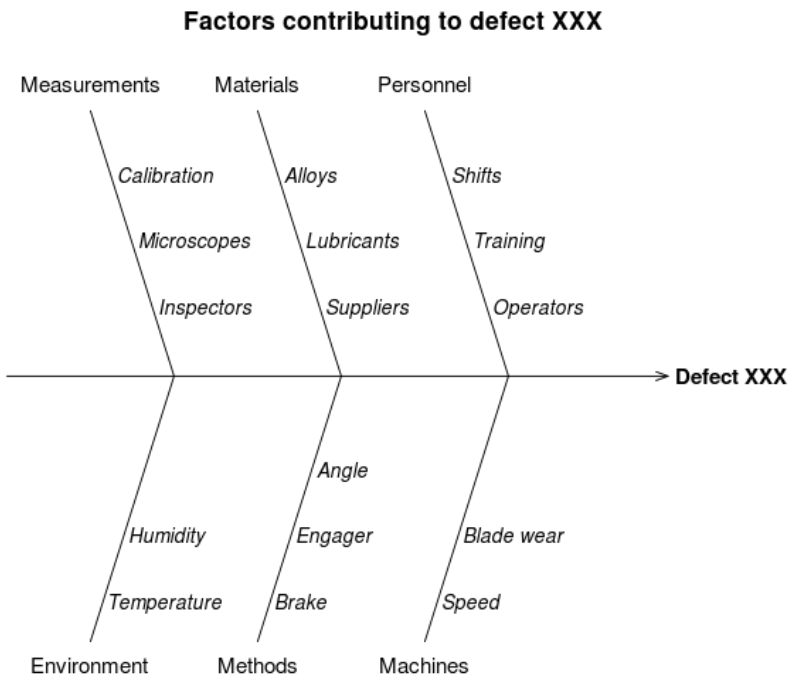
Standard Deviation

- Find upper and lower control limits that indicate the threshold at which the process output is considered highly statistically unlikely (i.e. 3 standard errors below the mean).

Ishikawa Charts (Cause and Effect)

- Purpose: Illustrate potential sources of error accounting for decrease in product quality.

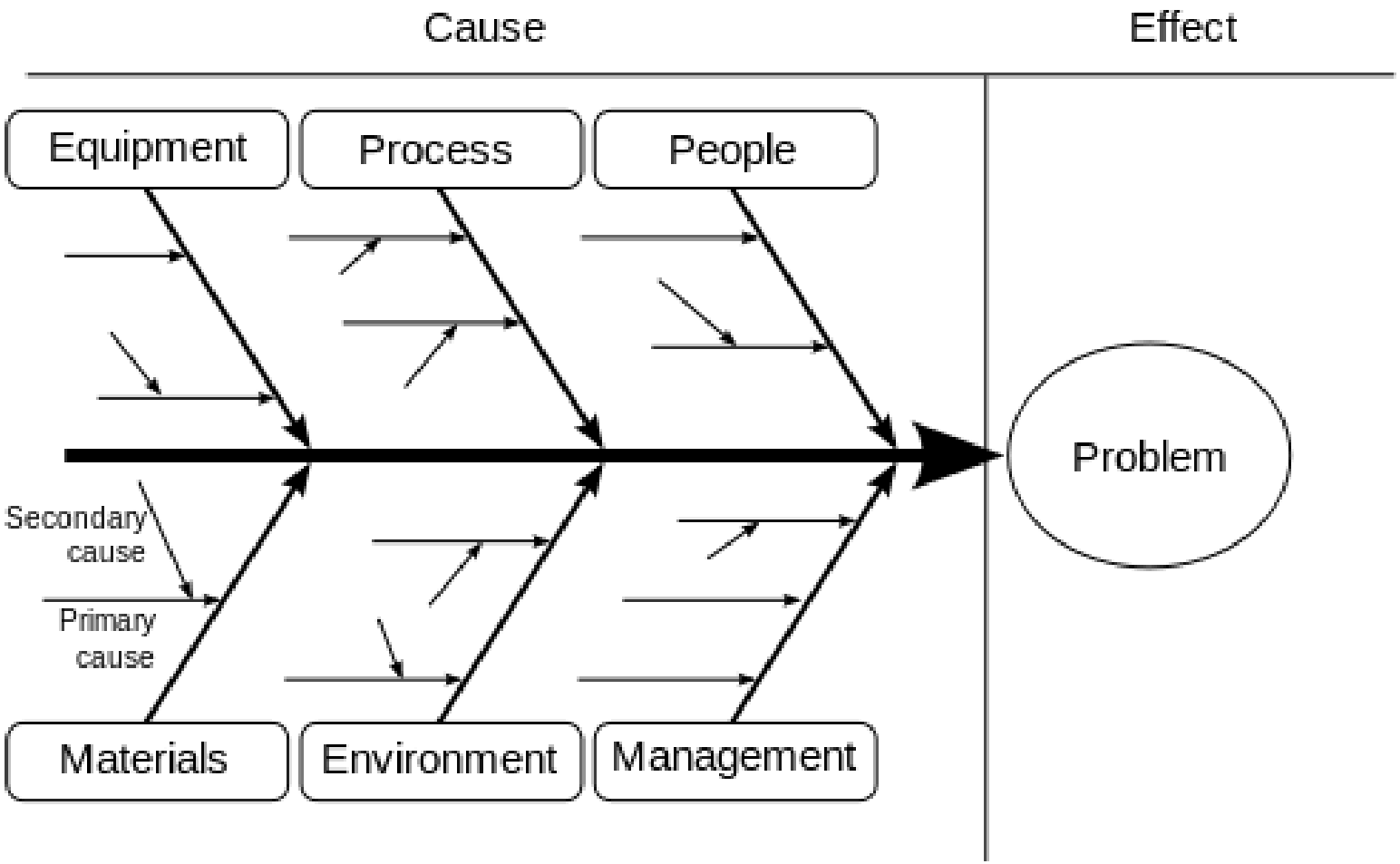
- In our case – this relates to the allowed purity of our chemical batches



Ishikawa Charts (Cause and Effect)

- 6 Major Categories of Possible Sources of Defect in Production
  - Machine (technology)
    - i.e. Faulty equipment, inadequate fume extraction, blade wear
  - Method (process)
    - i.e. Rate of delivery of TFE to sodium hydride/toluene mixture
  - Material
    - i.e. Purity of starting materials, suppliers
  - Man Power
    - i.e. Shifts of workers, training, particular operators
  - Measurement (Inspection)
    - i.e. equipment used, calibration
  - Mother Nature (Environment)
    - i.e. Temperature, humidity

Ishikawa Charts (Cause and Effect)

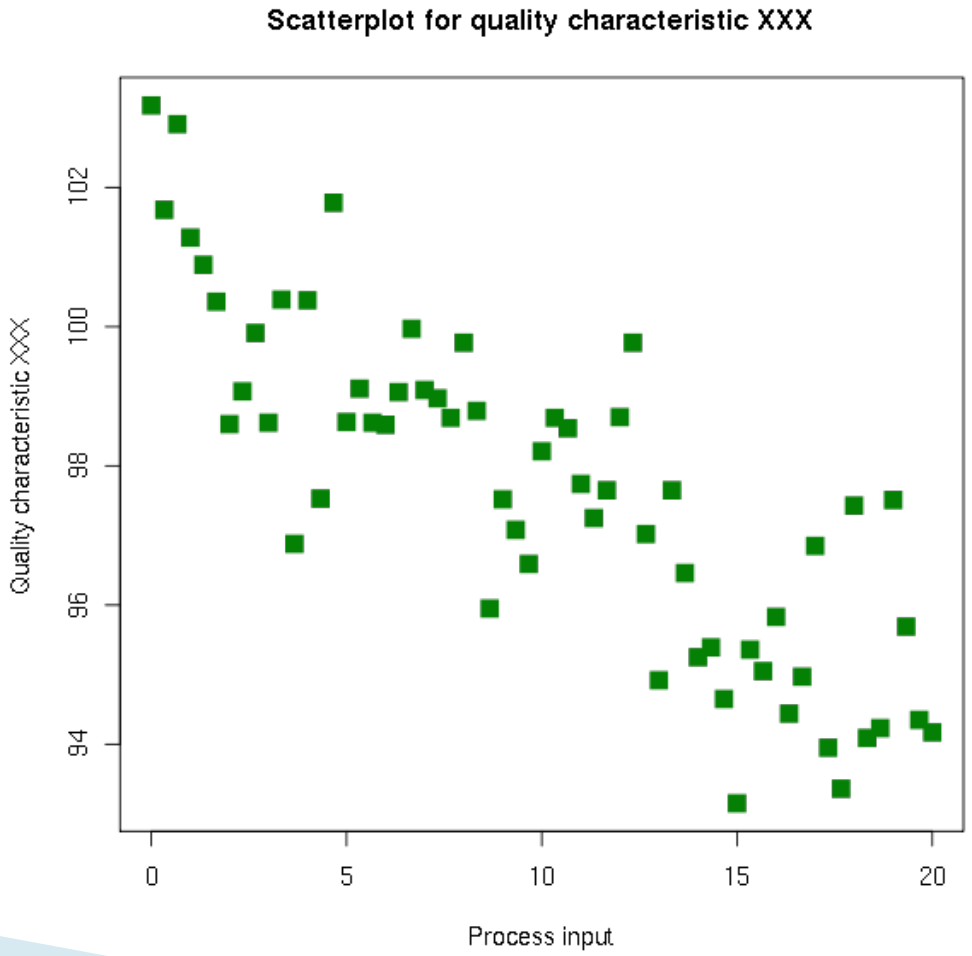


Correlation

- Use when changes are not in the control of the investigator
  - i.e.:

  Time of day vs. sample purity

  - Causality not certain



T-Test's

- T-Test used for when only two groups are being compared
  - *Example*: Increase number of checks performed in between steps of batch production
    - Group 1 (3 necessary checks)
    - Group 2 (6 necessary checks)

- Statistical significance dependent on number of batches tested and ranges of error in each group
- If increase in levels of purity is significant, then consider formally adapting process protocol!

Two-Way ANOVA's (Analysis of Variance)

- Two-Way ANOVA's used for when there are multiple levels of analysis
  - *Example*: Manipulate rate of delivery of trifluoroethanol (TFE) to toluene/sodium hydride mixture
    - Average Purity at Rate 1 vs. Rate 2 vs. Rate 3