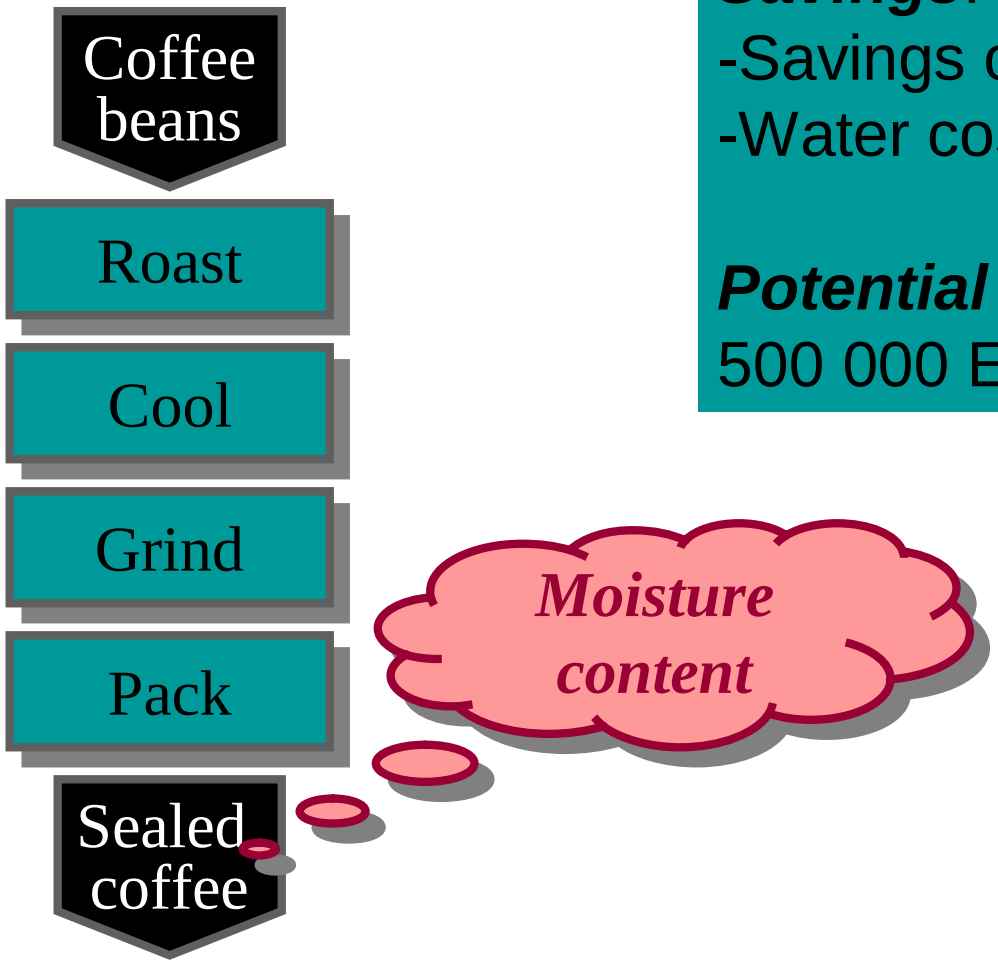
Project Name : Low Moisture content in coffee beans

Charter

project selection



Savings:
-Savings on rework and scrap
-Water costs less than coffee

Potential savings:
500 000 Euros

Measure

1. Select the Critical to Quality (CTQ) characteristic
2. Define performance standards
3. Validate measurement system

Measure

DMAIC 6σ

1. CTQ

Moisture contents of roasted coffee

2. Standards

- Unit: one batch
- Defect: Moisture% > 12.6%

3. Measurement reliability

Gauge R&R study

Measurement system too unreliable!

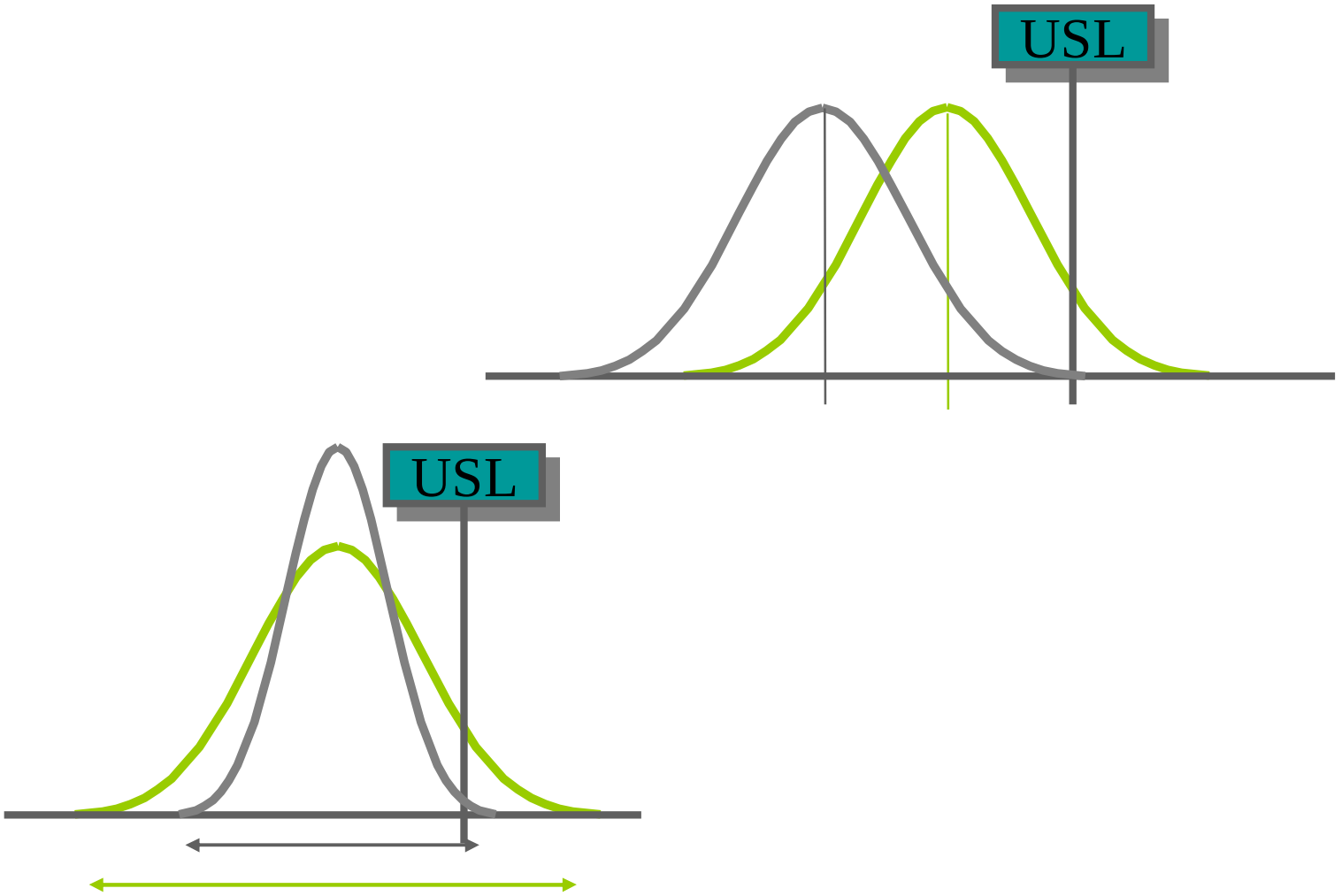
So fix it!!

Analyze

Analyse
4. Establish product capability
5. Define performance objectives
6. Identify influence factors

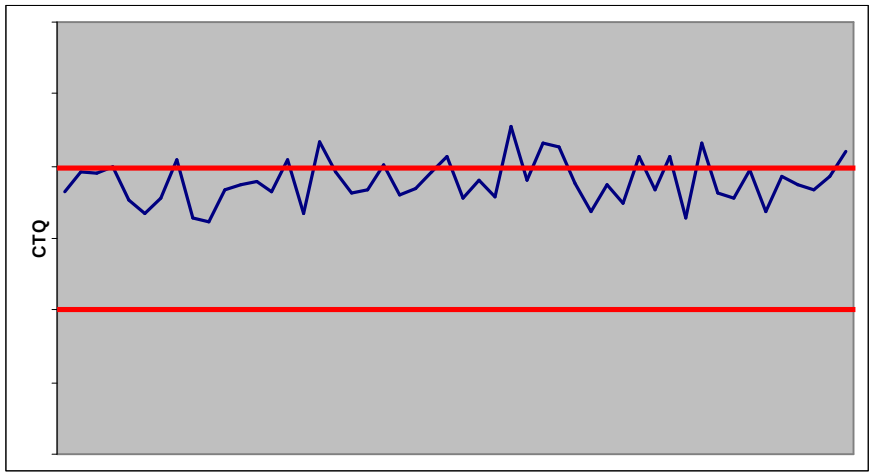
Analyze

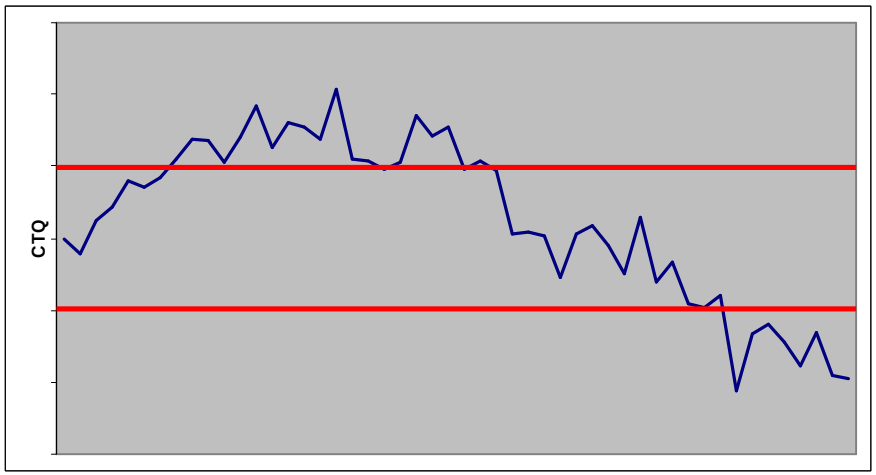
Improvement opportunities

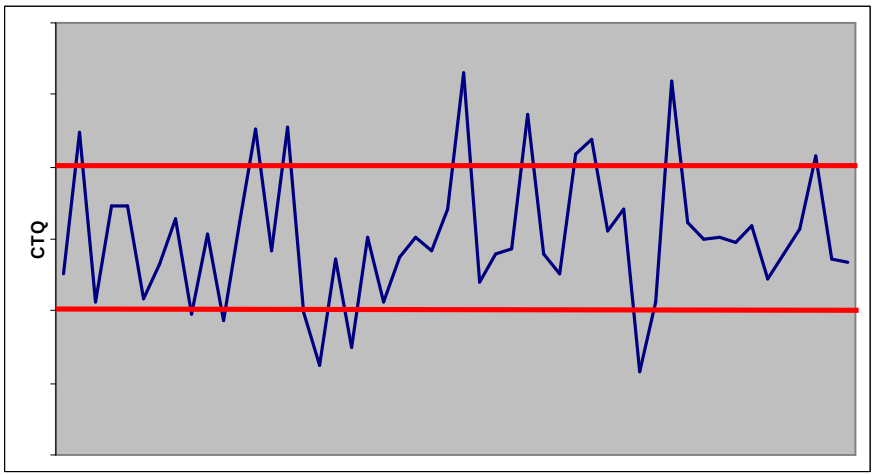


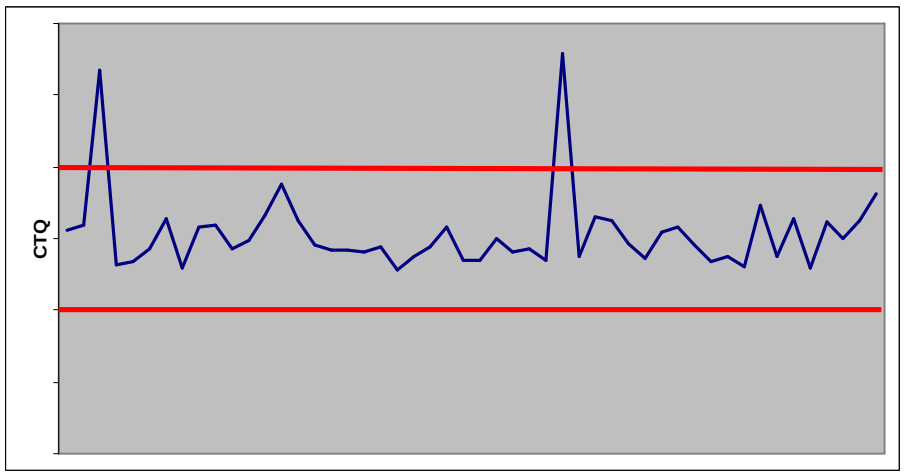
Analyze

Diagnosis of problem



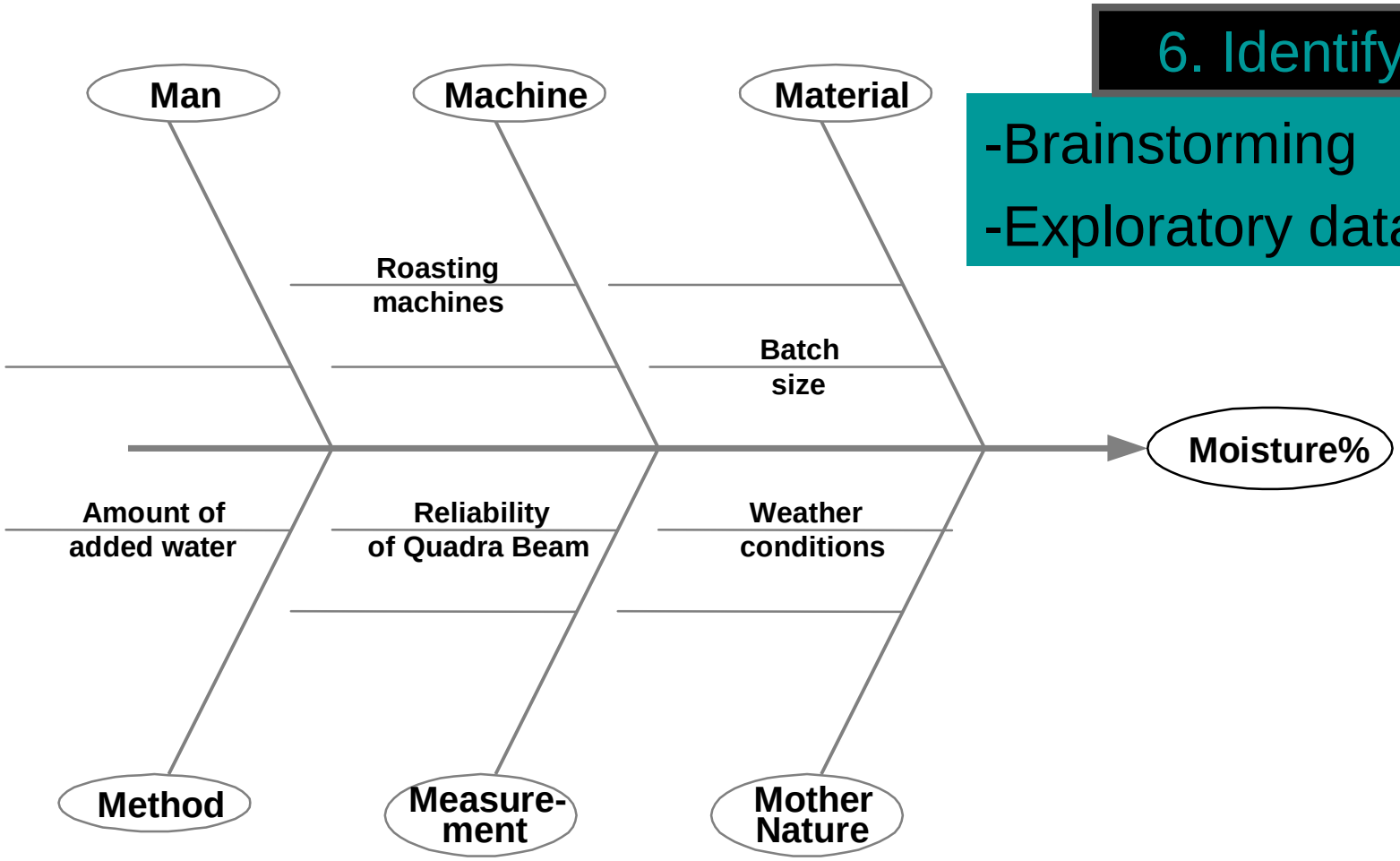






Analyze

Discovery of causes



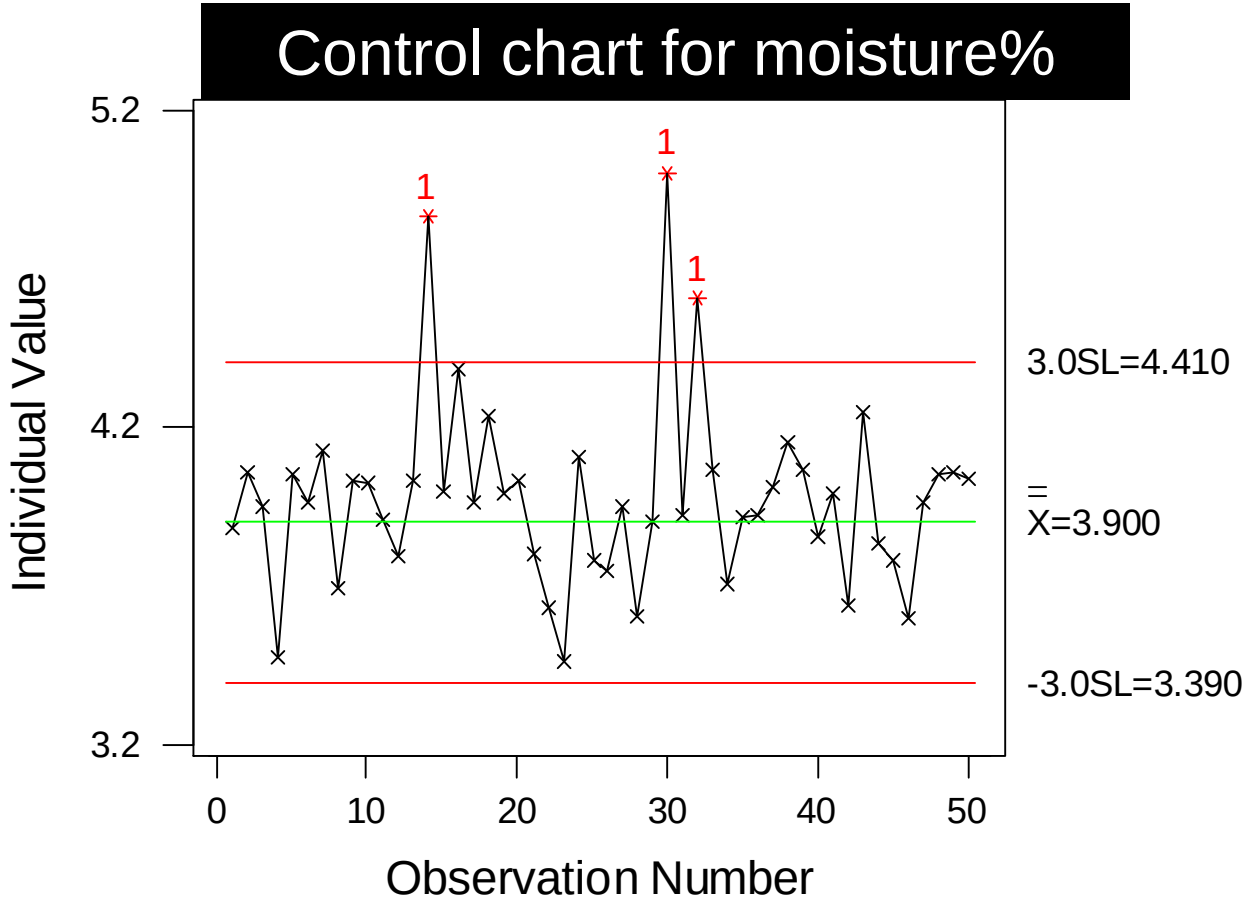
6. Identify factors

-Brainstorming

-Exploratory data analysis

Analyze

Discovery of causes



Analyze

Potential influence factors

- Roasting machines (Nuisance variable)
- Weather conditions (Nuisance variable)
- Stagnations in the transport system (Disturbance)
- Batch size (Nuisance variable)
- Amount of added water (Control variable)

Improve

Improve
7. Screen potential causes
8. Discover variable relationships
9. Establish operating tolerances

Improve

7. Screen potential causes

- Relation between *humidity* and *moisture%* not established
- Effect of stagnations confirmed
- Machine differences confirmed

8. Discover variable relationships

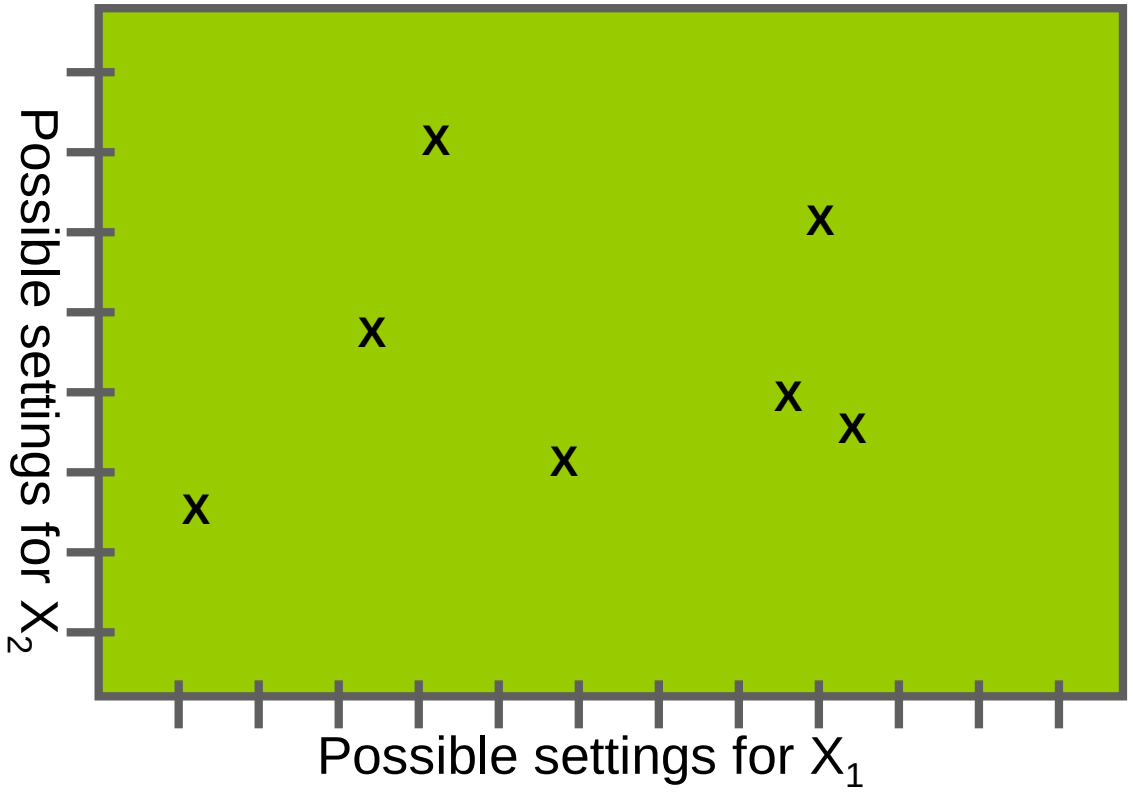
Design of Experiments (DoE)

Improve

Experimentation

How do we often conduct experiments?

Experiments are run based on: Intuition
Knowledge
Experience
Power
Emotions



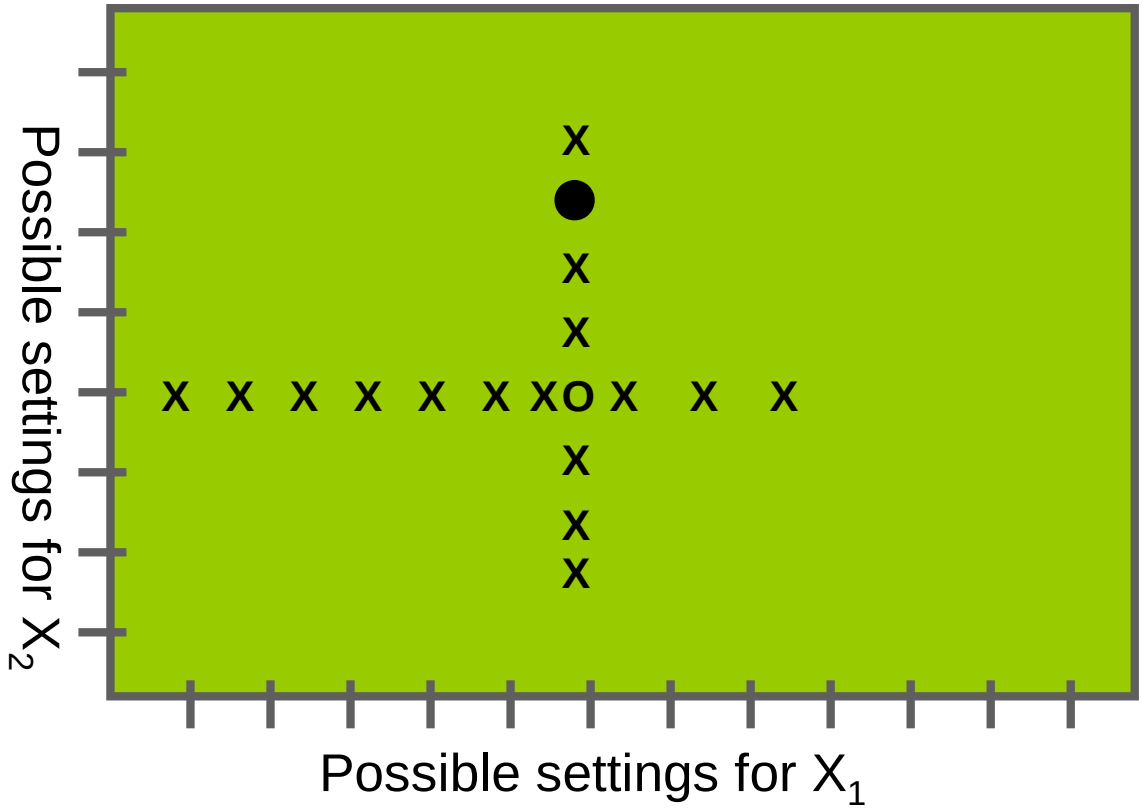
X: Settings with which an experiment is run.

Actually:
- we're just trying
- unsystematical
- no design/plan

Improve

Experimentation

A systematical experiment: Organized / discipline
One factor at a time
Other factors kept constant



Procedure:

X: First vary X_1; X_2 is kept constant

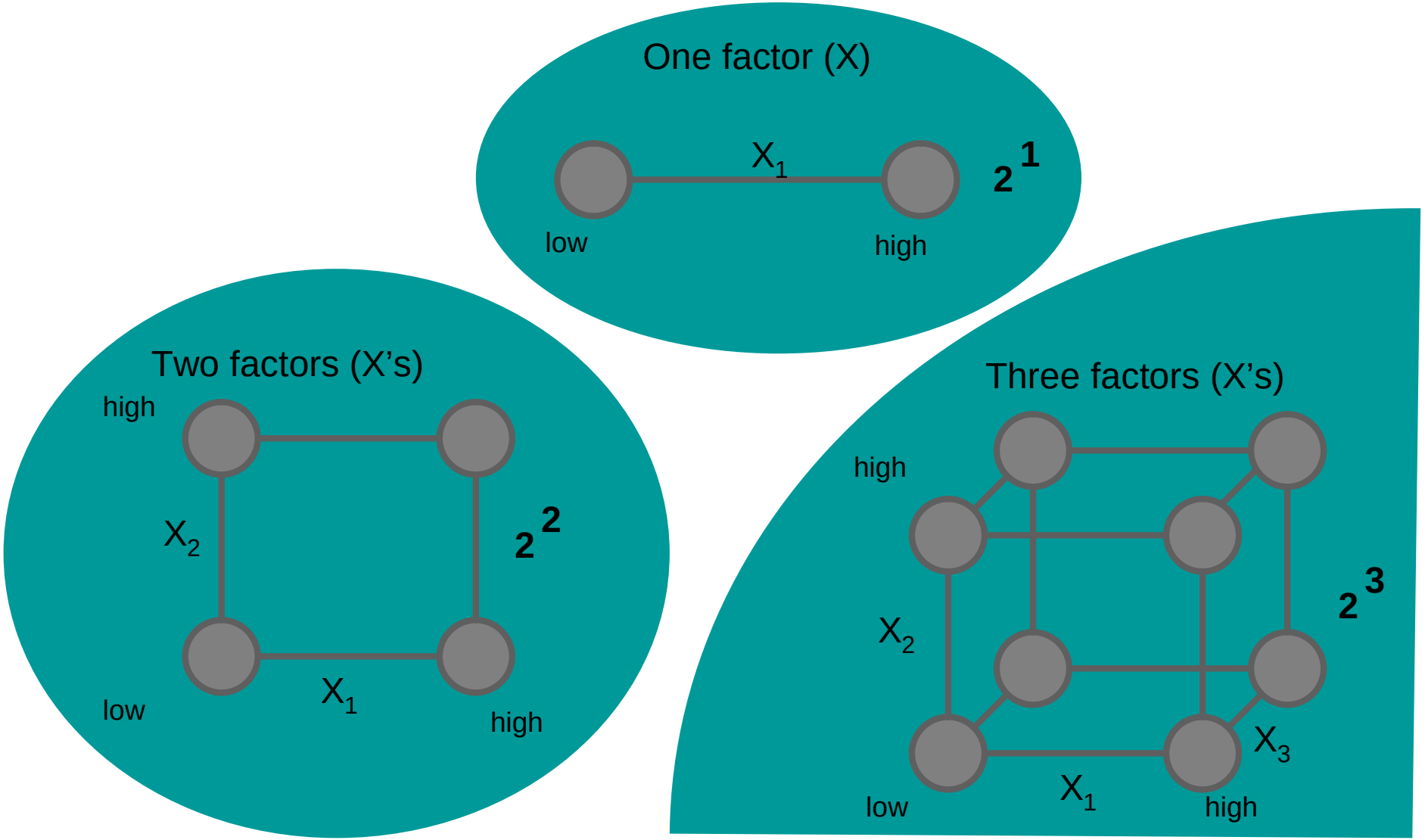
O: Optimal value for X_1.

X: Vary X_2; X_1 is kept constant.

●: Optimal value (???)

Improve

Design of Experiments (DoE)

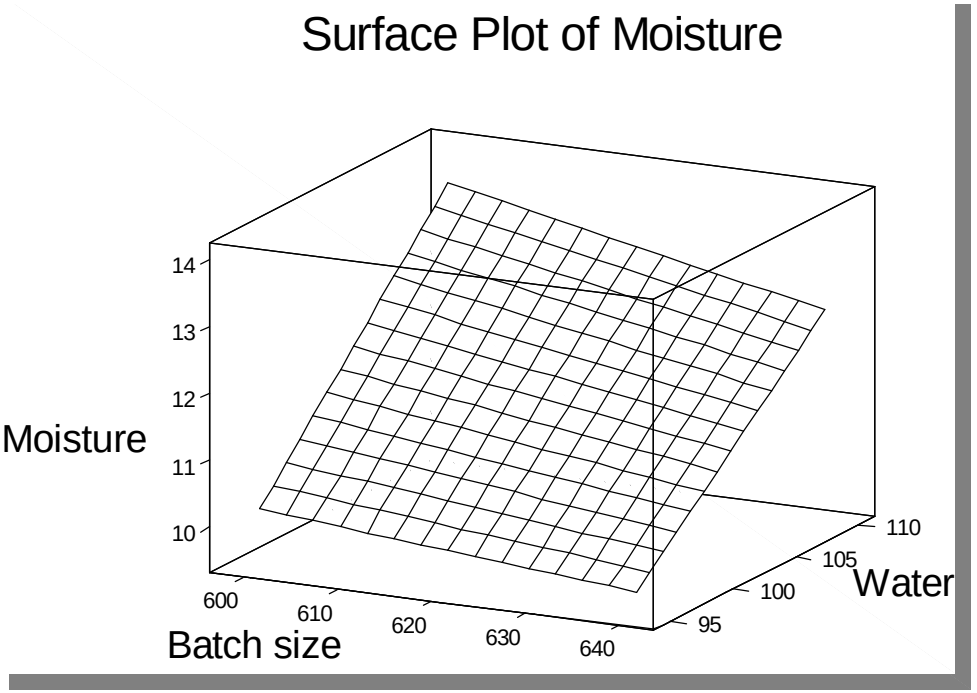


Improve

Experiment:

Y: moisture%

X_1: Water (liters)
X_2: Batch size (kg)

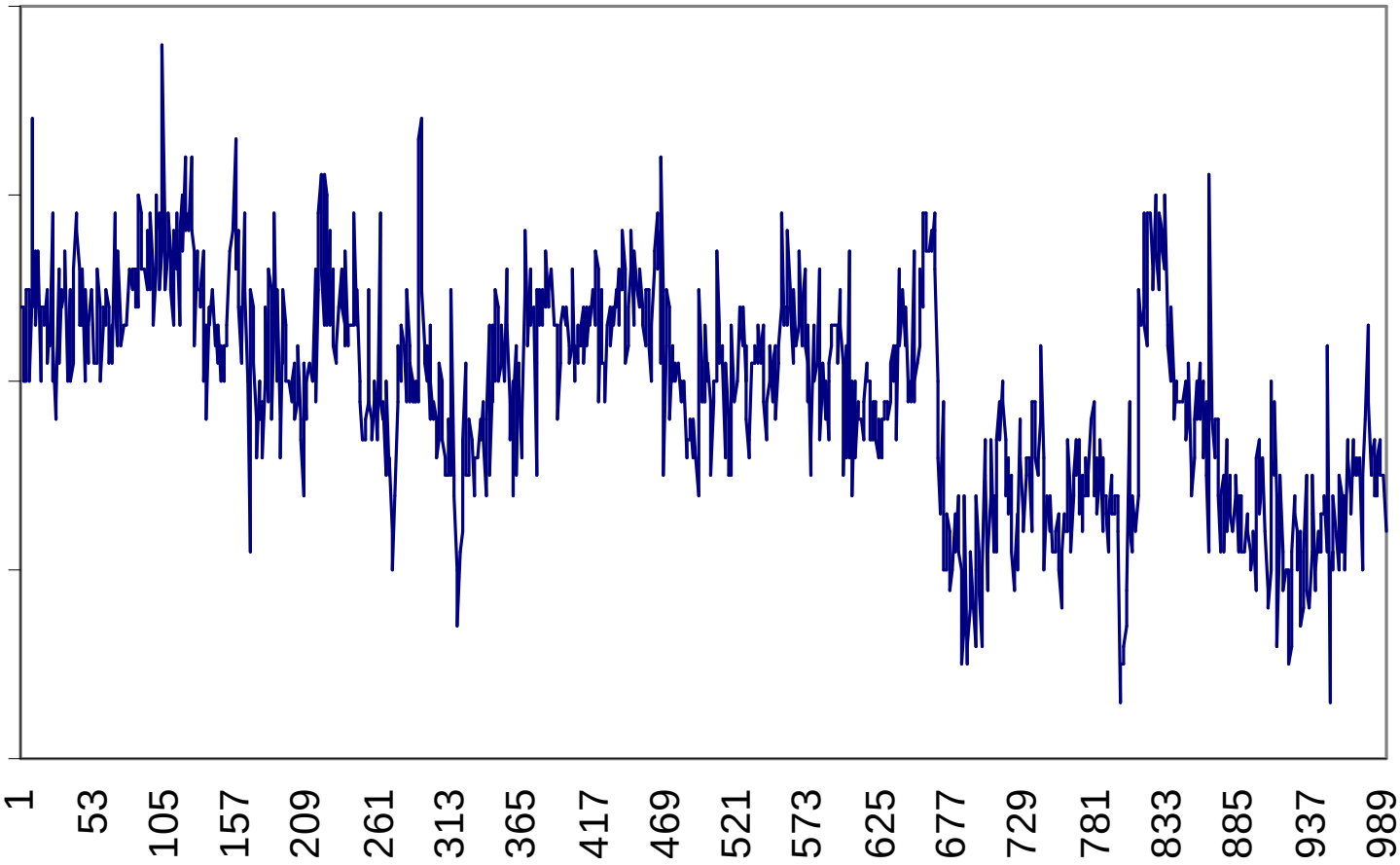


Improve

9. Establish operating tolerances

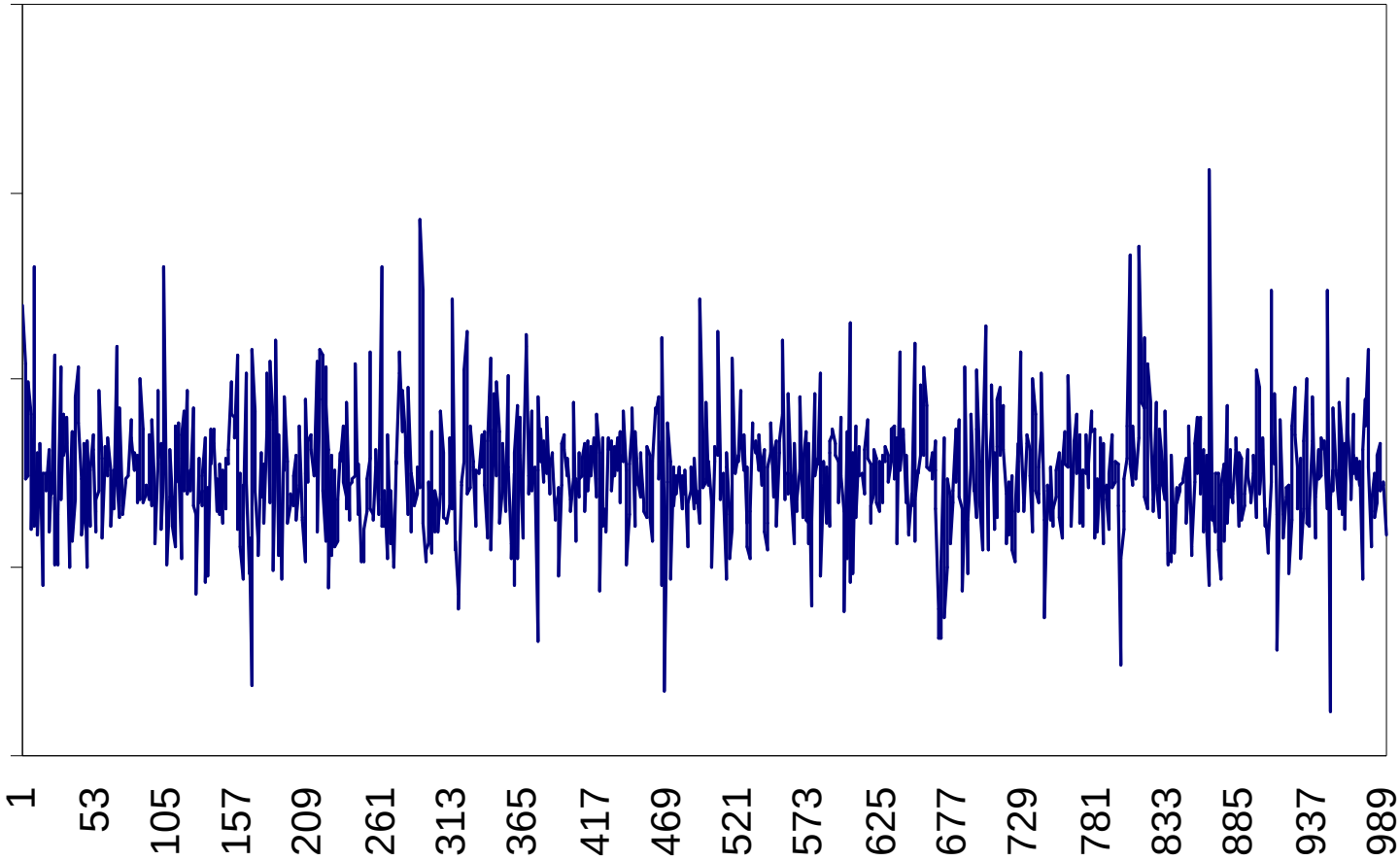
Feedback adjustments for influence of weather conditions

Improve



Moisture% without adjustments

Improve



Moisture% with adjustments

Control

Control
10. Validate measurement system (X's)
11. Determine process capability
12. Implement process controls

Control

Before

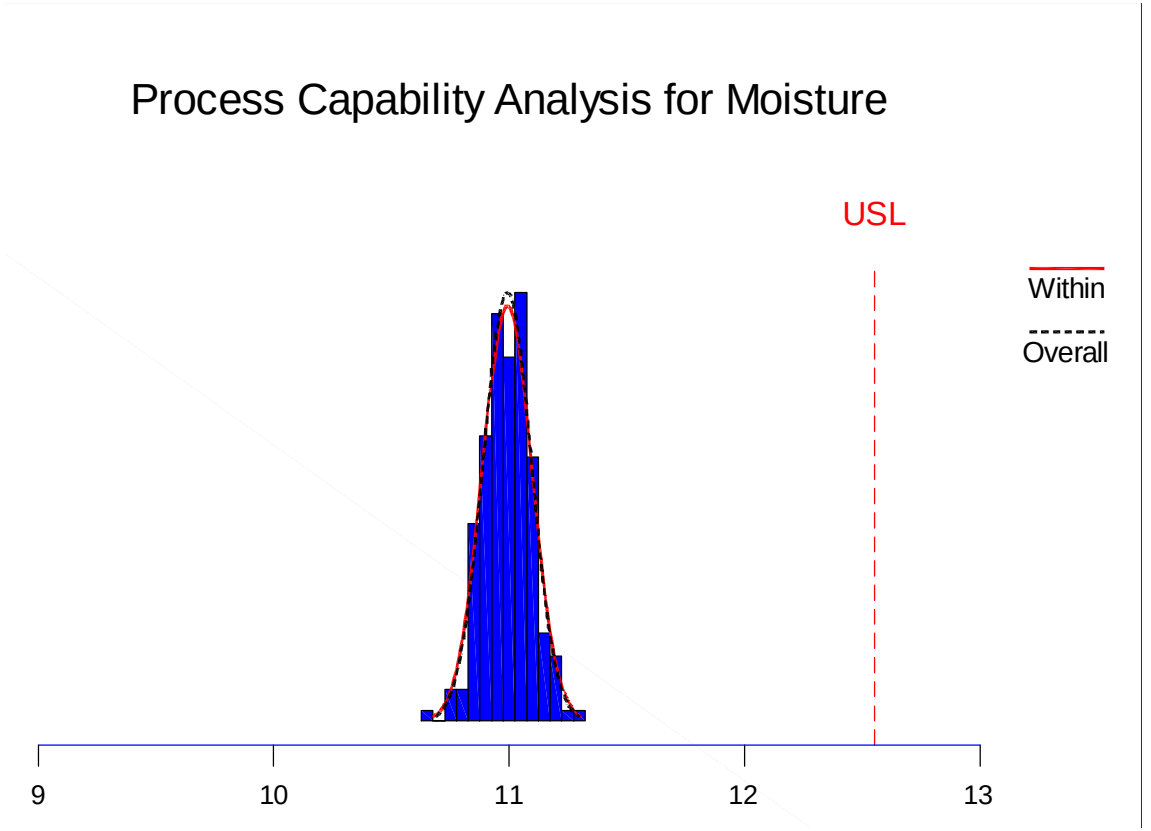
$\sigma_{long\text{-}term} = 0.532$

Objective

$\sigma_{long\text{-}term} < 0.280$

Result

$\sigma_{long\text{-}term} < 0.100$



Control

Benefits of this project

$\sigma_{long\text{-}term} < 0.100$
$P_{pk} = 1.5$
This enables us to increase the mean to 12.1%

Per 0.1% coffee: 100 000 Euros saving

Benefits of this project:

1 100 000 Euros per year

Approved by controller

Control

12. Implement process controls

- SPC control loop
- Mistake proofing
- Control plan
- Audit schedule

Project closure

- Documentation of the results and data.
- Results are reported to involved persons.
- The follow-up is determined

Control

Approach to this project

- Step-by-step approach.
- Constant testing and double checking.
- No problem fixing, but: explanation $\rightarrow$ control.
- Interaction of technical knowledge and experimentation methodology.
- Good research enables intelligent decision making.
- Knowing the financial impact made it easy to find priority for this project.

Re-cap

- Structured approach – roadmap
- Systematic project-based improvement
- Plan for “quick wins”
  - *Find good initial projects - fast wins*
- Publicise success
  - *Often and continually - blow that trumpet*
- Use modern tools and methods
- Empirical evidence based improvement

Thank You