

Process Variation

**Data Science for Quality Management:
Understanding Process Variation**
with **Wendy Martin**

Learning objective:

Define a process in terms of sources of variation

What is a Process?

All personnel, equipment, materials, methods, procedures, and environmental characteristics that interact to produce an output.

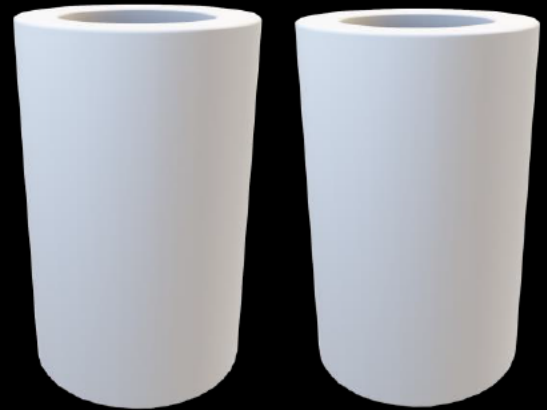
The SIPOC Model



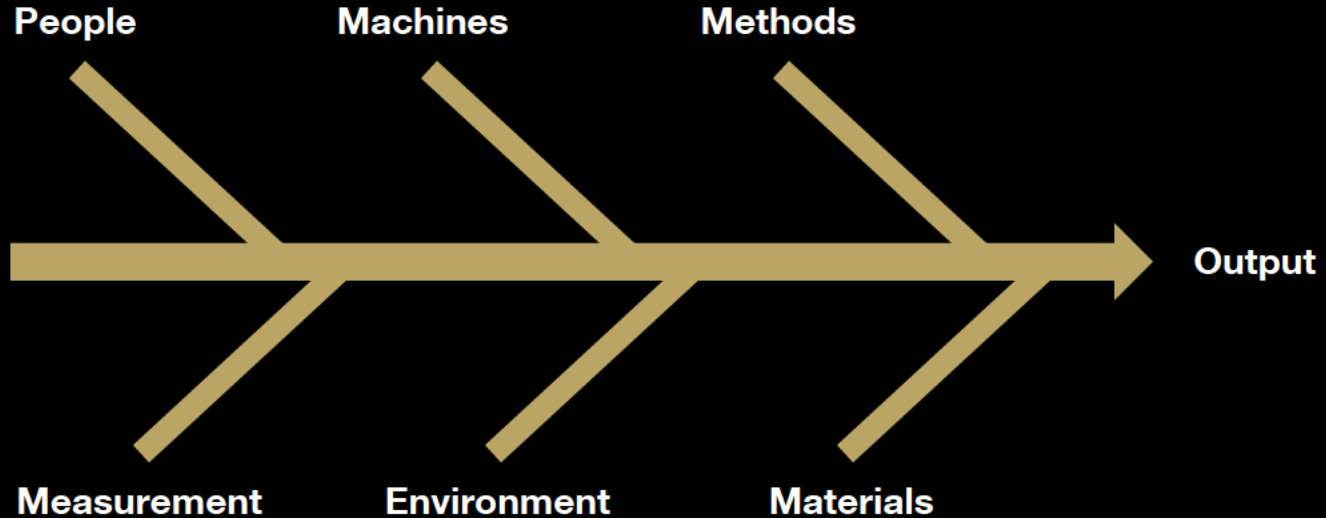
No Two Things Are Exactly Alike

They might be similar, but never exactly the same.

This is due to **variability**.



Sources of Variation



Example: A Plain Bushing

Sources of variability:

People

Materials

Machines

Measurement

Methods

Environment



A Plain Bushing: Variation Due to People

Experience

Knowledge

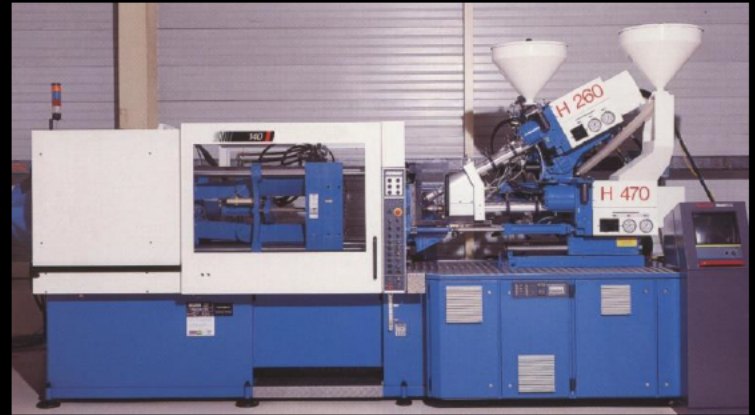
Training

Physical and sensory capability



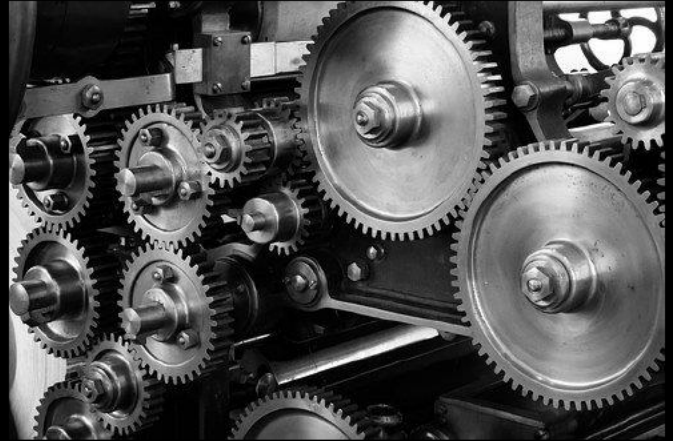
A Plain Bushing: Variation Due to Machines

- Setup inconsistencies
- Variation in tooling
- Backlash or play
- Wear of machine and tools
- Variation in speed, feed, temperature, and pressure
- Locating inconsistencies



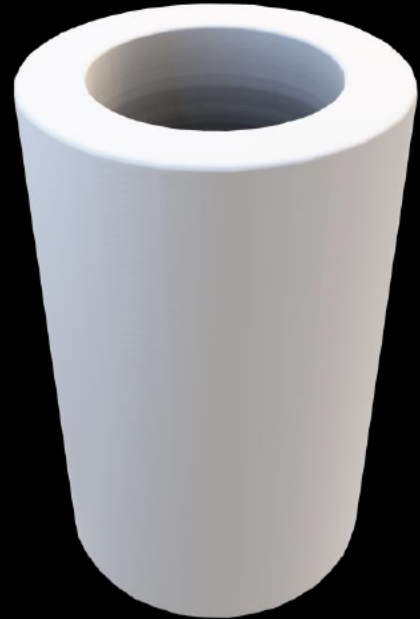
A Plain Bushing: Variation Due to Methods

- Variation in coolant application
- Setup techniques
- Cutting depths
- Settings for speed, feed, temperature, and pressure
- Criteria for tooling changeovers



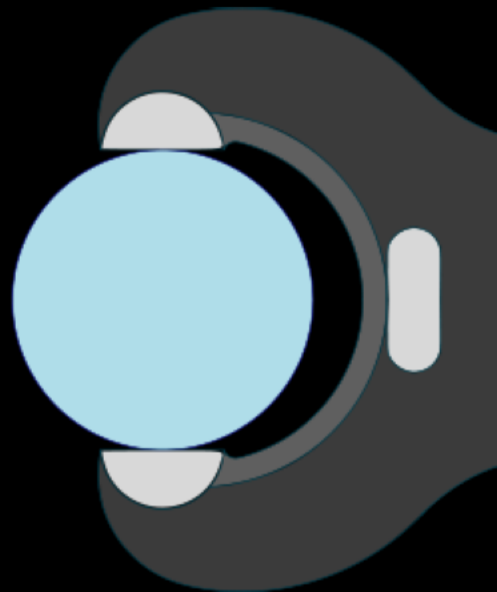
A Plain Bushing: Variation Due to Materials

- Variation in hardness
- Chemical composition
- Surface condition
- Incoming diameter
- Roundness and straightness
- Supplier-to-supplier and lot-to-lot differences



A Plain Bushing: Variation Due to Measurement

- Operator-to-operator differences in measures
- Gauge-to-gauge differences
- Differences found in repeated measures by same operator and same gauge



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A Plain Bushing: Variation Due to Environment

- Changes in ambient temperature and humidity
- Floor vibration
- Dust
- Fumes
- Light



Process Variation and Time

Short term effects

Example - Piece-to-piece variation resulting from:

- Slight differences in location of cutting depths
- Minor location differences within fixturing
- Small variation in coolant flows
- Minor temperature variations

Process Variation and Time

Long term effects

Example – Machine and Tool Wear:

- Tool wear may be seen after several hours.
- Machine wear might not be seen for several months.

Example – Environment

- Plant temperatures affecting output can change throughout the day, week, or year.

Process Variation and Time

Irregular effects

- Example: power / pressure surges, lot to lot differences in raw material

Sources

The material used in the PowerPoint presentations associated with this course was drawn from a number of sources. Specifically, much of the content included was adopted or adapted from the following previously-published material:

- Luftig, J. An Introduction to Statistical Process Control & Capability. Luftig & Associates, Inc. Farmington Hills, MI, 1982
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