Lecture #3

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Sept. 2, 2005

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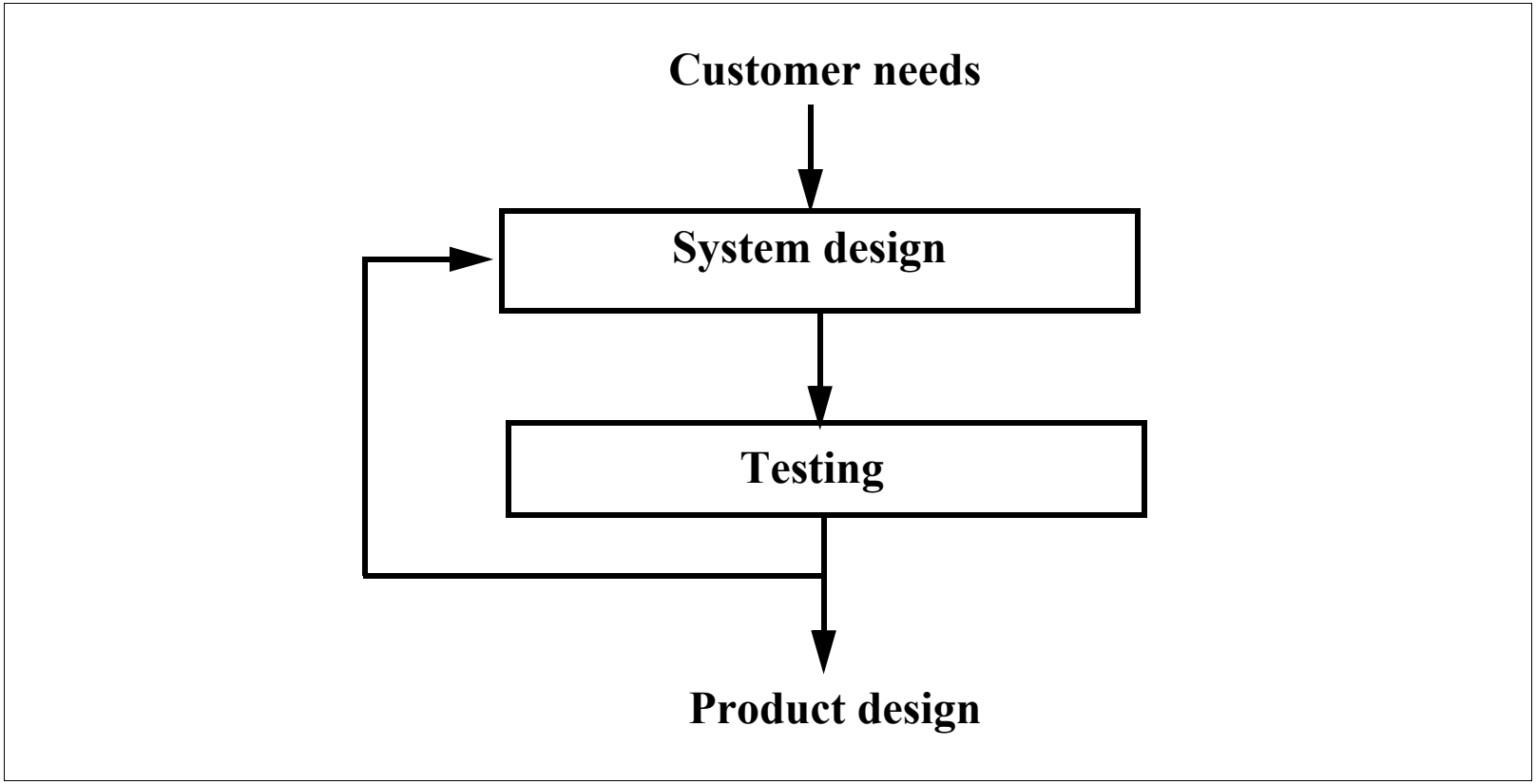
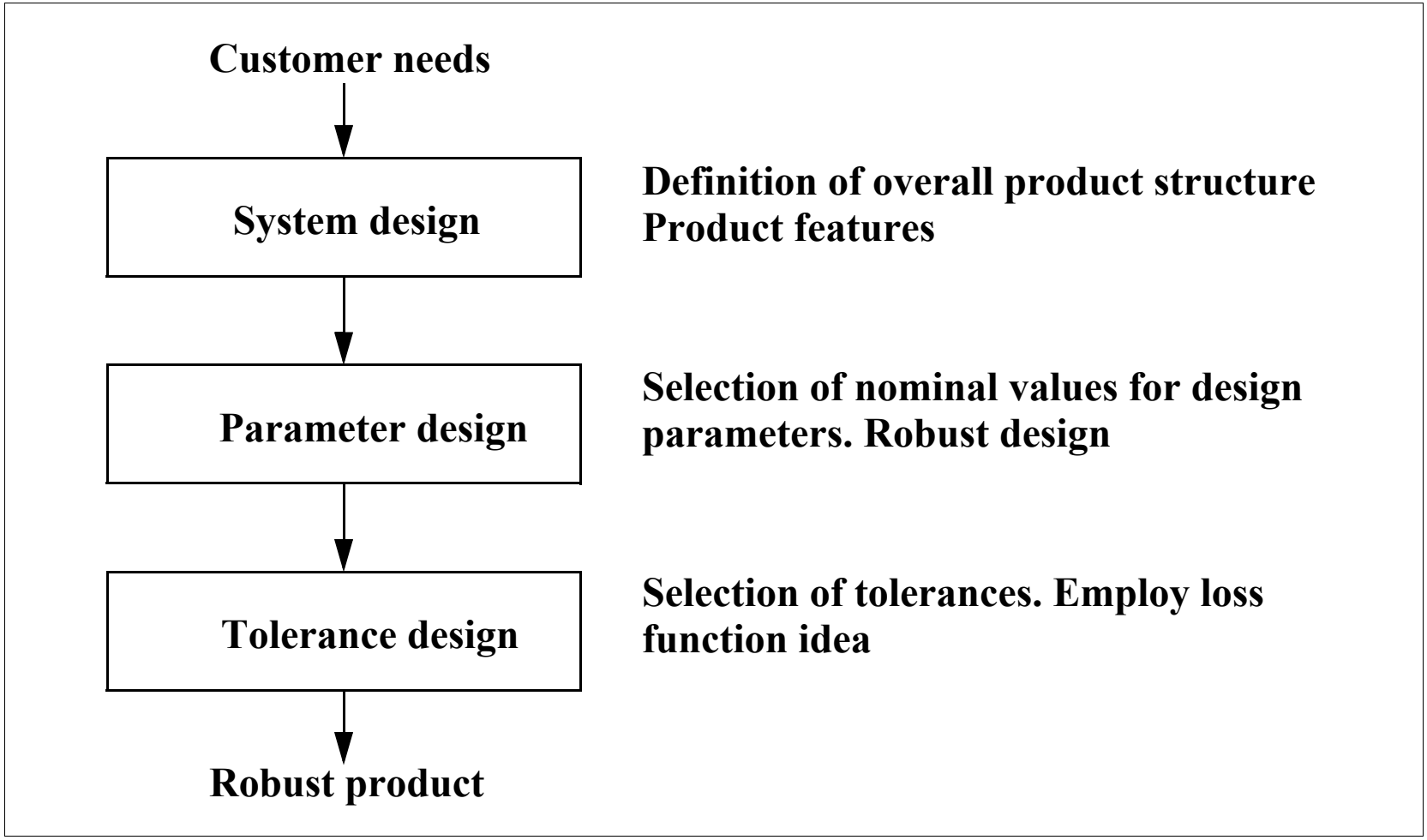
Engineering Design

Traditional View



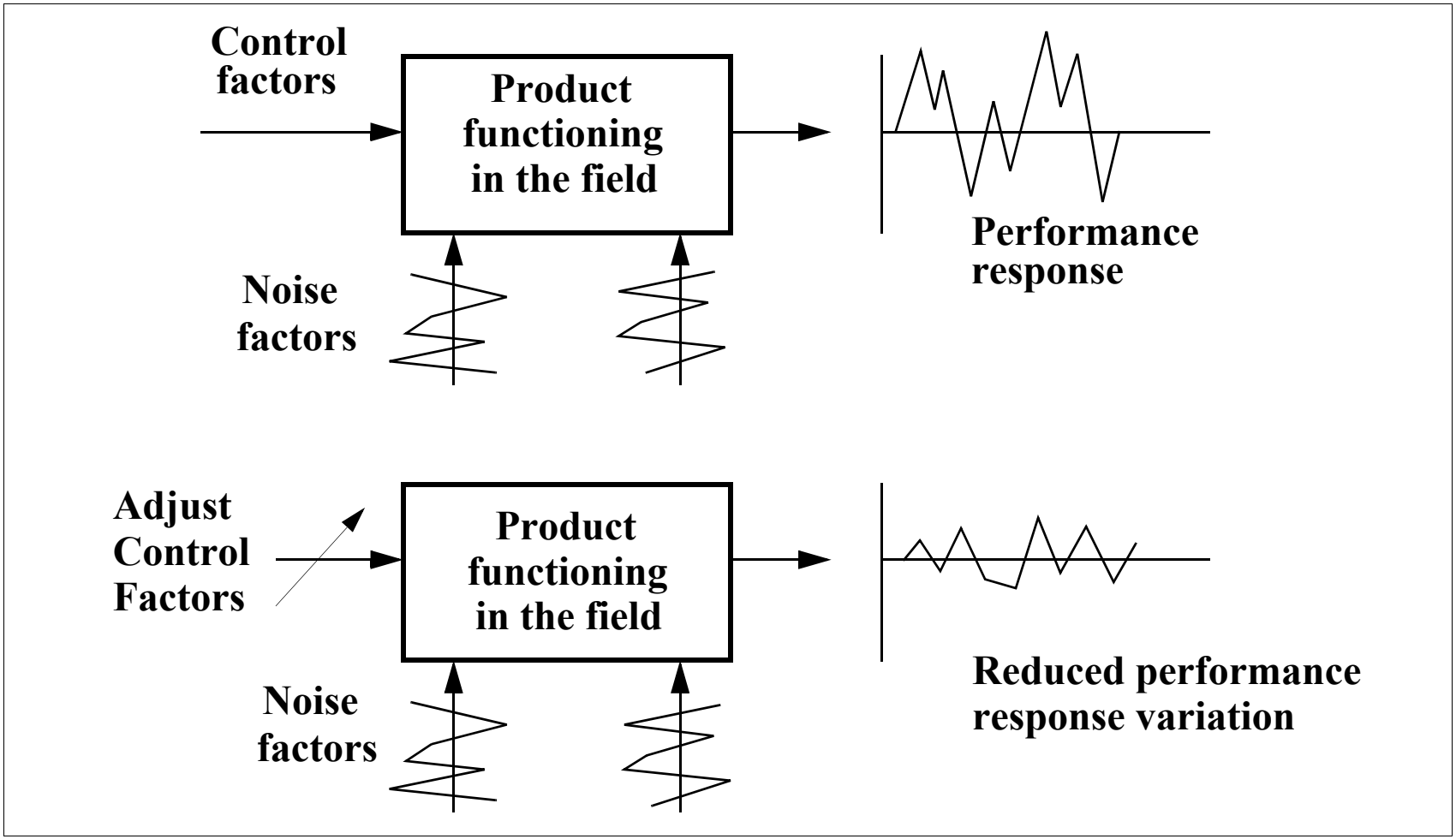
Taguchi's View of Engineering Design



Strengths of Taguchi's Approach

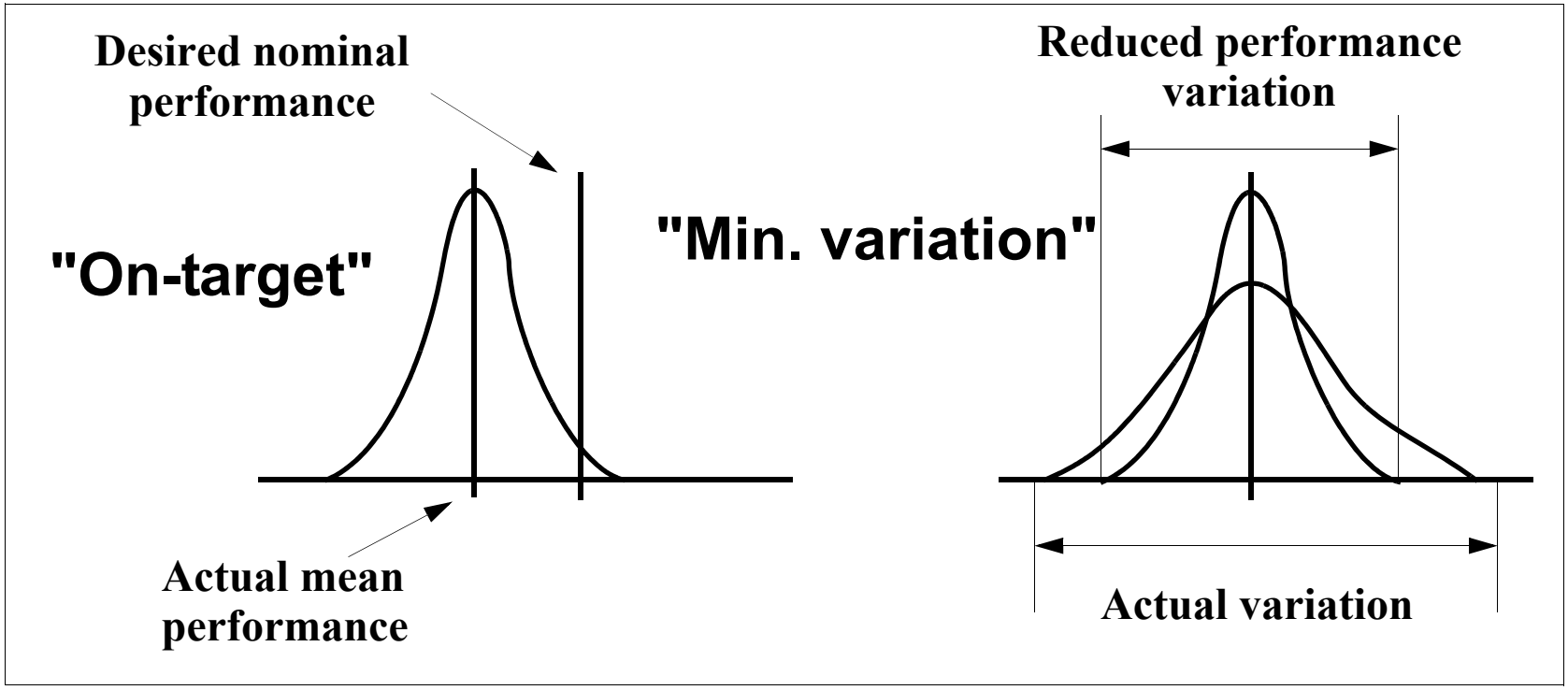
- **Center of Gravity: Engineering Design process**
- **Definition of the roles of factors that influence product/process performance**
- **Robust Design -- Parameter Design Concept**
- **Use of the Loss Function -- link between variation and economic performance**

Robust Design

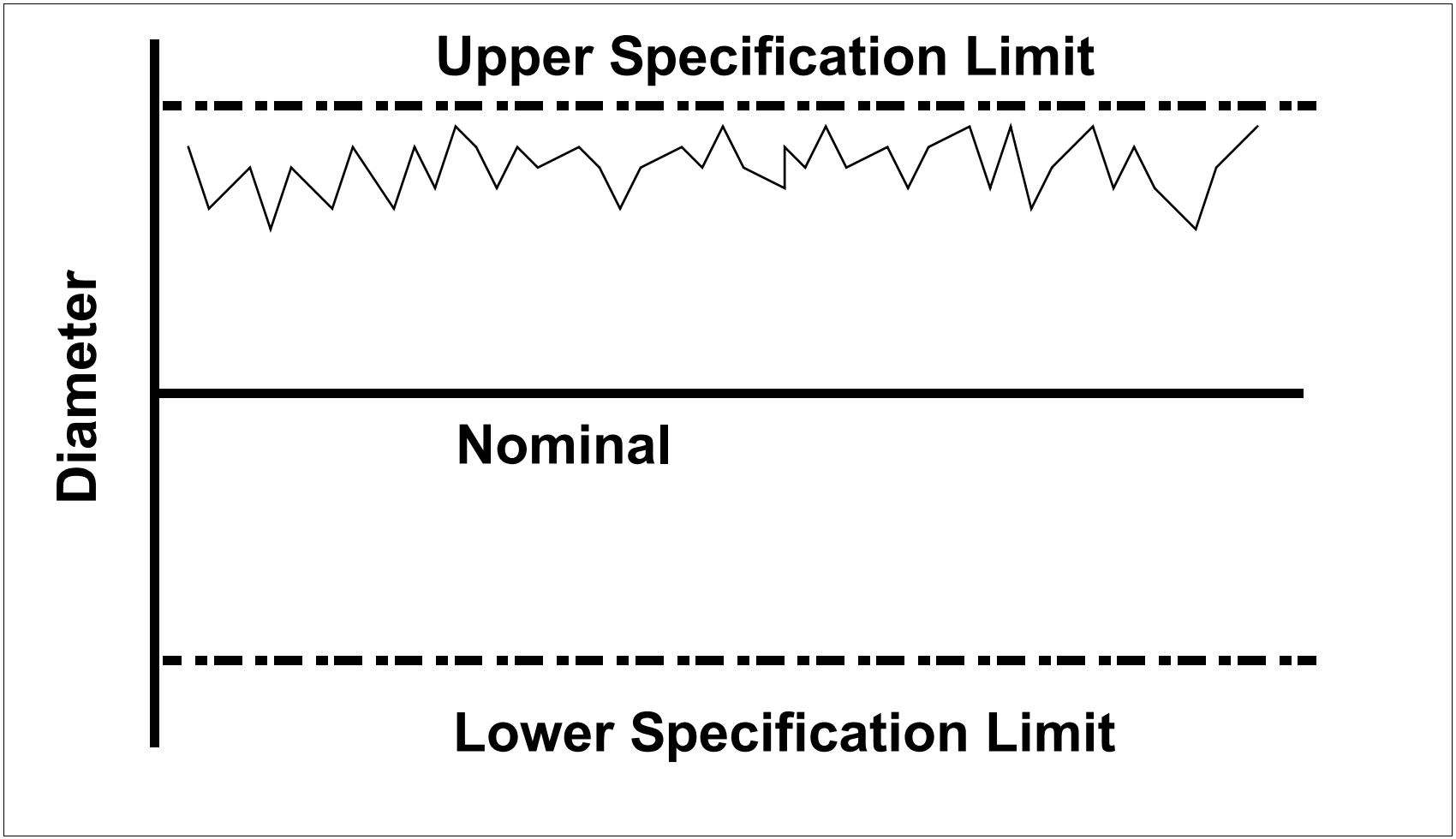


Performance

- **Source of variation - a fundamental measure of product/process performance**



Process Centering?



Why Emphasis on Variation?

- **Traditionally, quality & productivity are conflicting goals**

  True under product control model.

  Enter the *New Philosophy* --- the subject of this course

- **What motivates us to reduce the variation?**

  Deming: "sources of variation are sources of waste and inefficiency"

More on Variation

- **Of course, as sources of variation are identified and eliminated - - quality improves**

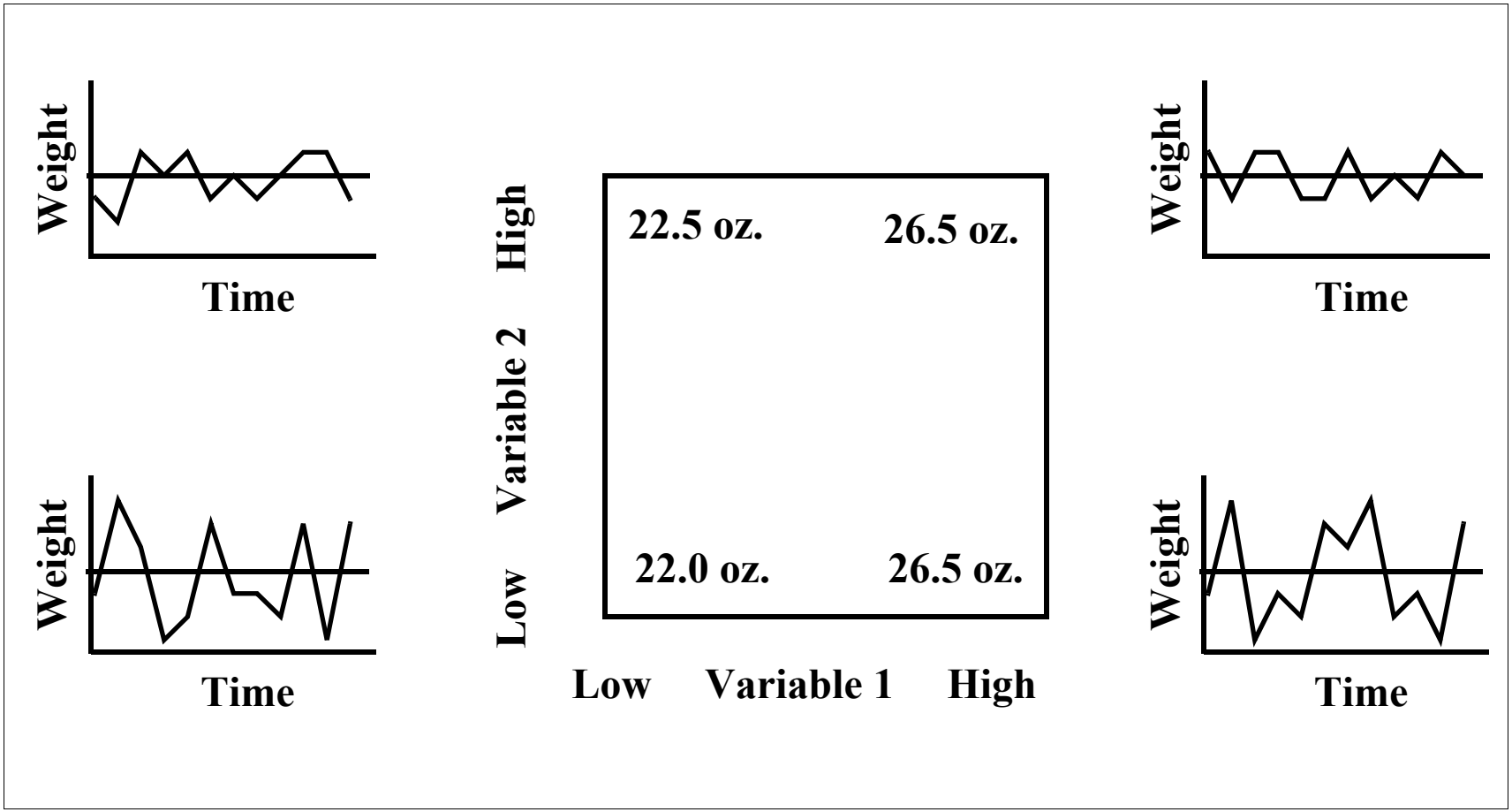
- **Also, as sources of variation are identified and eliminated - - productivity improves**

  We can have our cake and eat it too!!

  Summary: with process control we will look for process faults, and then take actions to eliminate them. In doing this we will improve quality & productivity

DOE & Variation

(DOE: Design of Experiments)



Signal-to-Noise (S/N) Ratio

Taguchi advocates its use in robust design

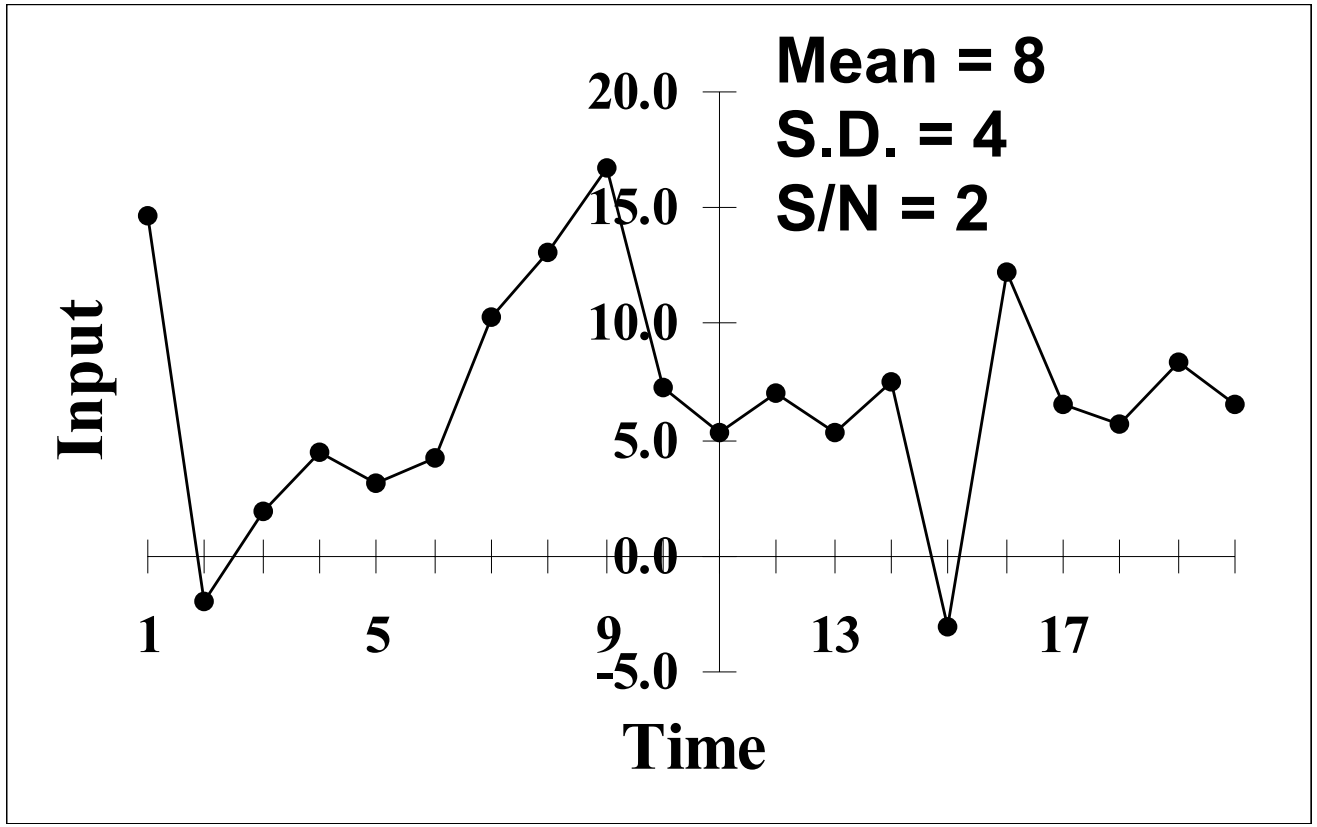
How to increase??

- Increase signal - Western approach
- Reduce noise - Eastern approach

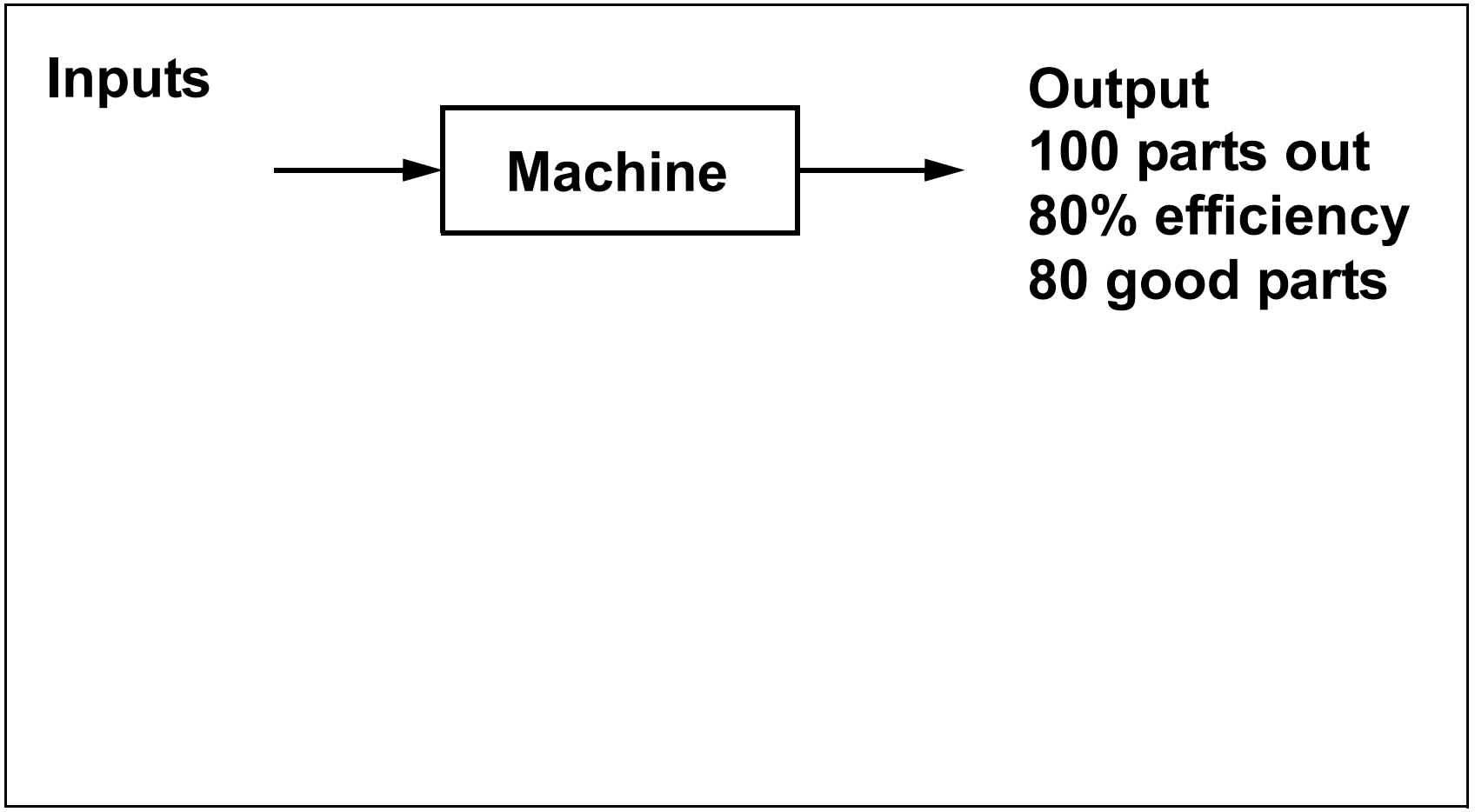
$$S/N = \frac{\text{average}}{\text{standard deviation}} = \frac{\bar{x}}{s_x} = \frac{\mu_x}{\sigma_x}$$

Does it make any difference how we increase it?

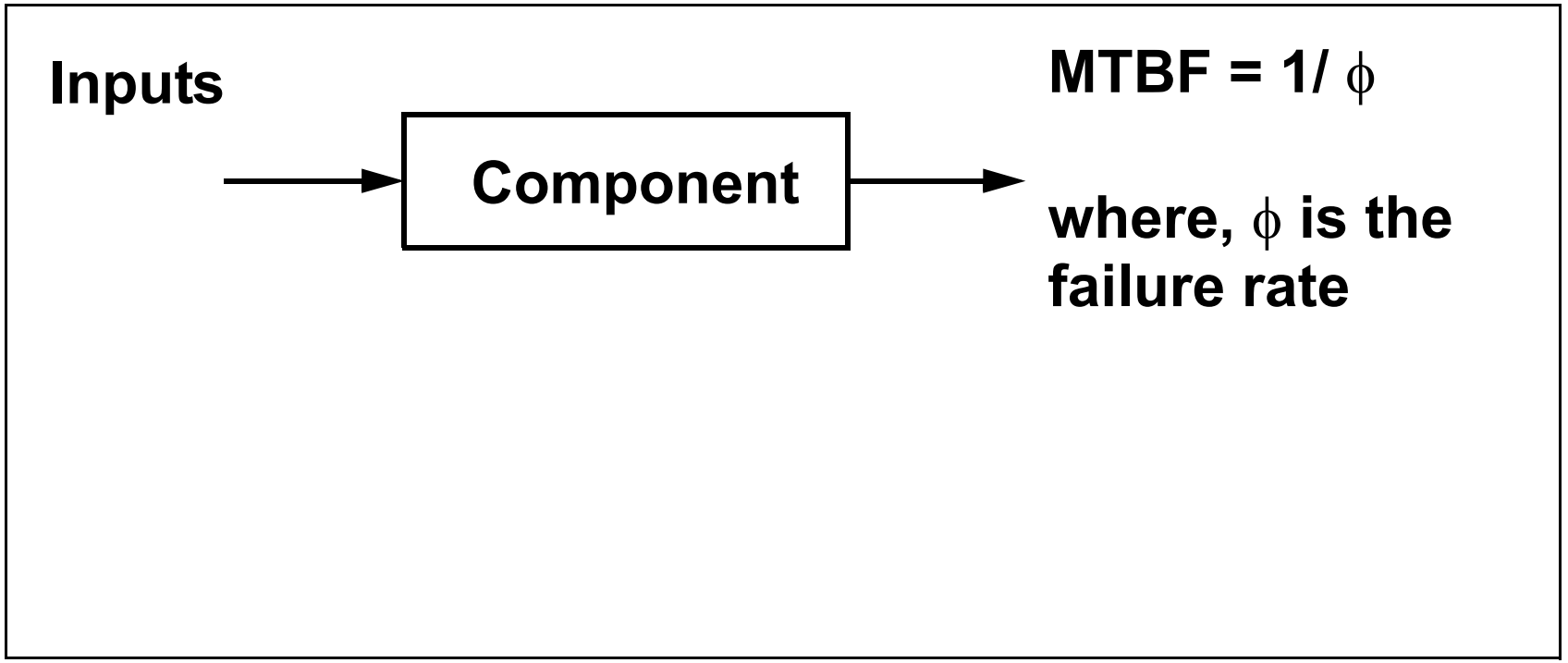
S/N Example



Increasing S/N - Machine Output

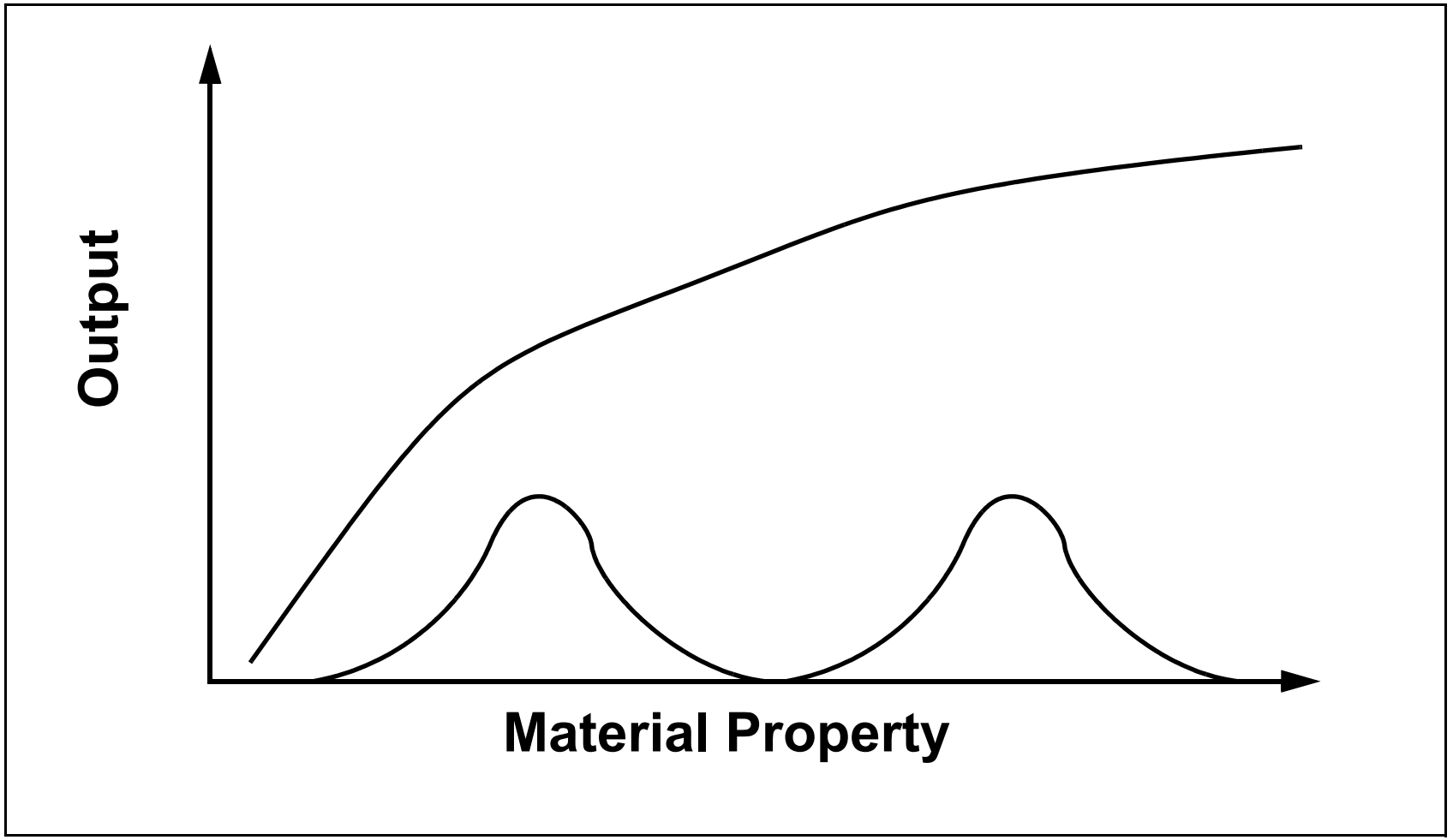


Increasing S/N - Product Reliability



$$MTBF = \frac{\left(1 + \frac{1}{2} + \frac{1}{3} + \ldots + \frac{1}{n}\right)}{\phi}$$

Increasing S/N - Material Properties



Deming's 14 Points

- More precisely, Deming's 14 Obligations of Top Management
- Developed during his interactions with industry
- His "take" on what management should be doing to adopt the new philosophy
- Not a menu - can't just pick the points you want