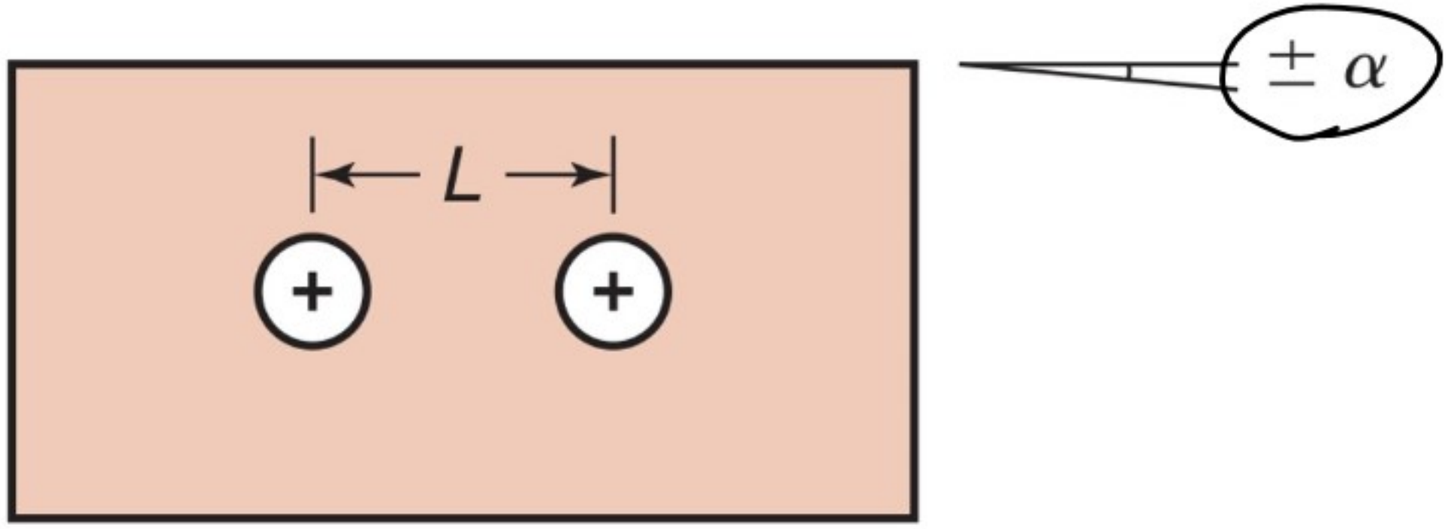
Manufacturing Philosophies

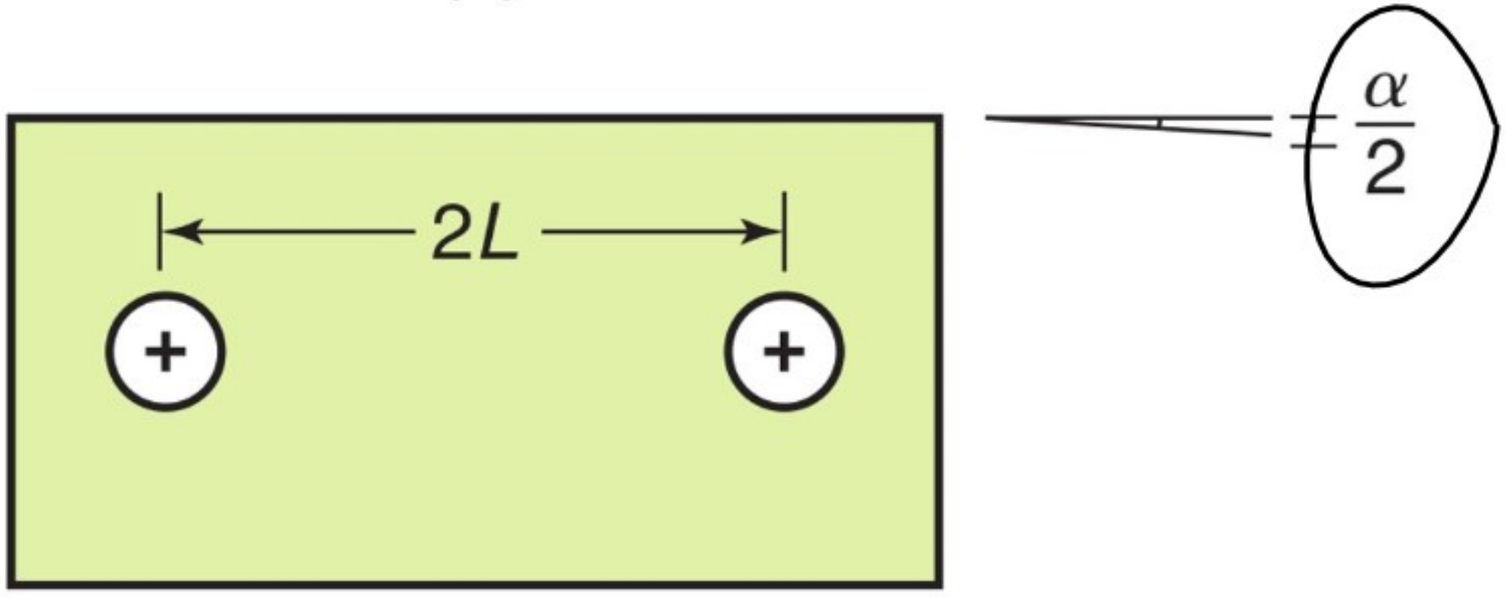
Taguchi

Genichi Taguchi: 1924-2012

- Robust design
- Robust manufacturing
- DOE Design of experiments (Taguchi Methods)



(a)



(b)

Assertions

1. Cost is the most important element for any product

2. Cost cannot be reduced without any influences on quality.

3. Quality can be improved without cost increase. This can be achieved by the utilization of the interactions with noise.

4. Cost can be reduced through quality improvement.

Taguchi loss function

replacement cost

paint cost

shipping cost

etc

$$K = \frac{\text{replacement cost}}{(LSL - T)^2}$$

Loss cost $= k((Y - T)^2 + \sigma^2)$

LSL	lower specification limit
T	target dimension
Y	mean dimension
σ	std deviation

Example

Tubes

wall thickness 2.6 ± 0.6 mm

$T = 2.6$ mm

$USL = 3.2$ mm

$LSL = 2.0$ mm $\quad \sigma = 0.2$

replacement cost \$10

10,000 parts per month

assume $Y = T$

$$k = \frac{10}{(2-2.6)^2} = 27.23$$

$$\text{Loss} = 27.23((\cancel{Y-T})^2 + 0.2^2) = \$1.11 \text{ per unit}$$

($(Y-T)^2 \to 0$)

$10000 \cdot 1.11 = \$11{,}100$ per month

Improvement

cost $50,000

$\sigma = 0.1$

Loss $= 27.23((\bar{y}-T)^2 + 0.1^2) = \$0.28$ per unit

$10000 \cdot 0.28 = \$2800$ per month

Savings with improvement $\$11{,}100 - \$2800 = \$8300$ per month

$\frac{\$50000}{\$8300/m} = 6.02$ months payoff

Kaizen

"Change for the better"

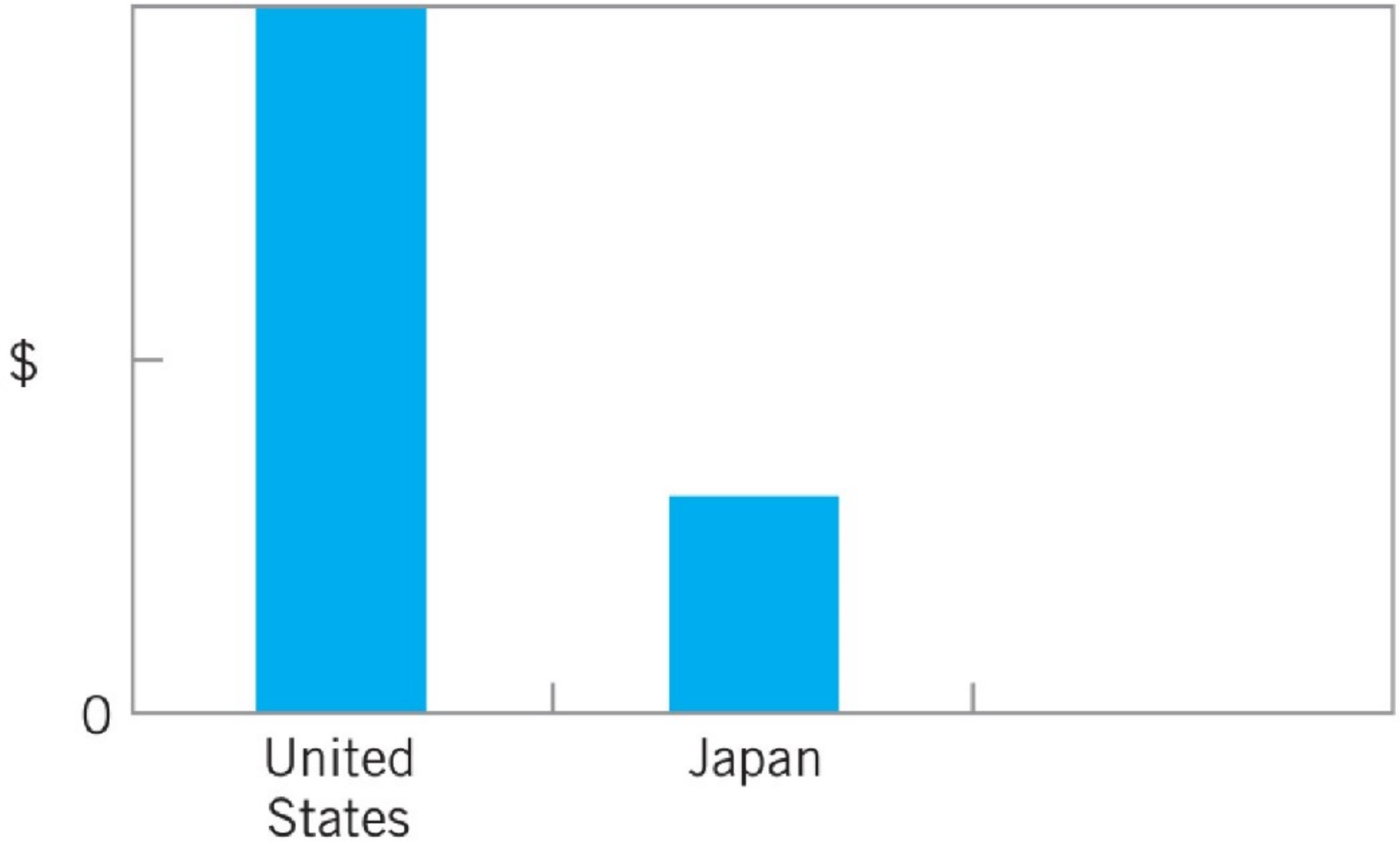
focused on continuous improvement

Six Sigma

Developed by Toyota

DMAIC

- Lean Manufacturing
  - Avoid Waste
    - Overproduction
    - Waiting Time
    - Unnecessary Transportation
    - Unnecessary Processing
    - Inventory
    - Unnecessary Motion
    - Production defects
- Lean Six Sigma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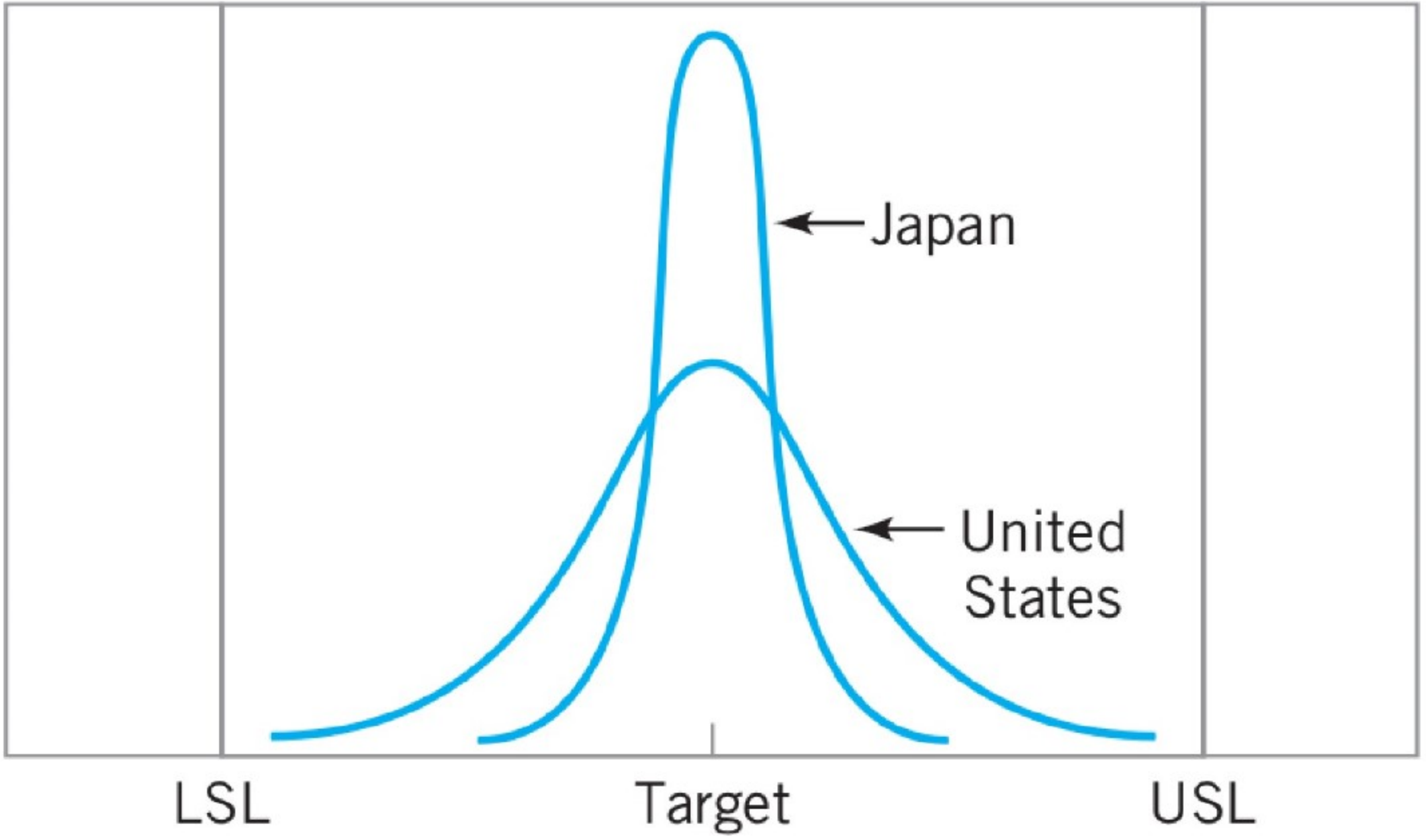
United States
Japan


Japan
United States
LSL
Target
USL

- Ford Transmission Quality Study (https://youtu.be/uAfUOfSY-S0)