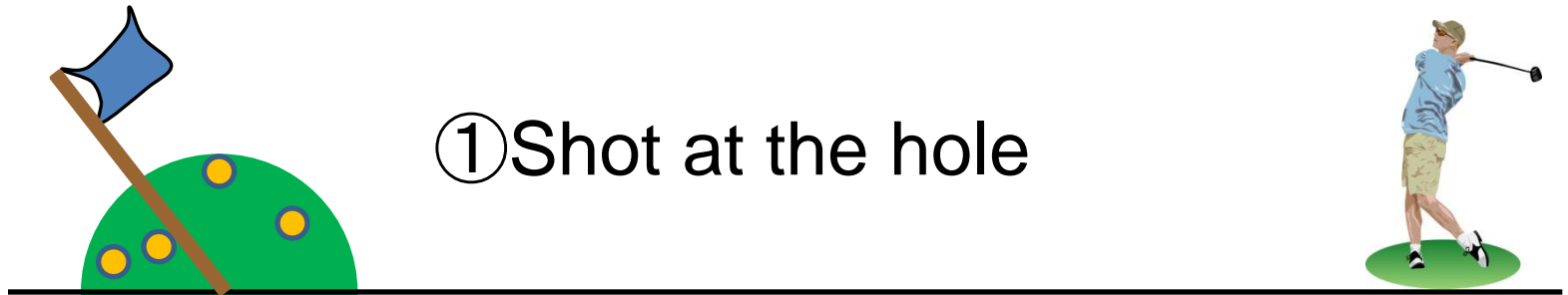
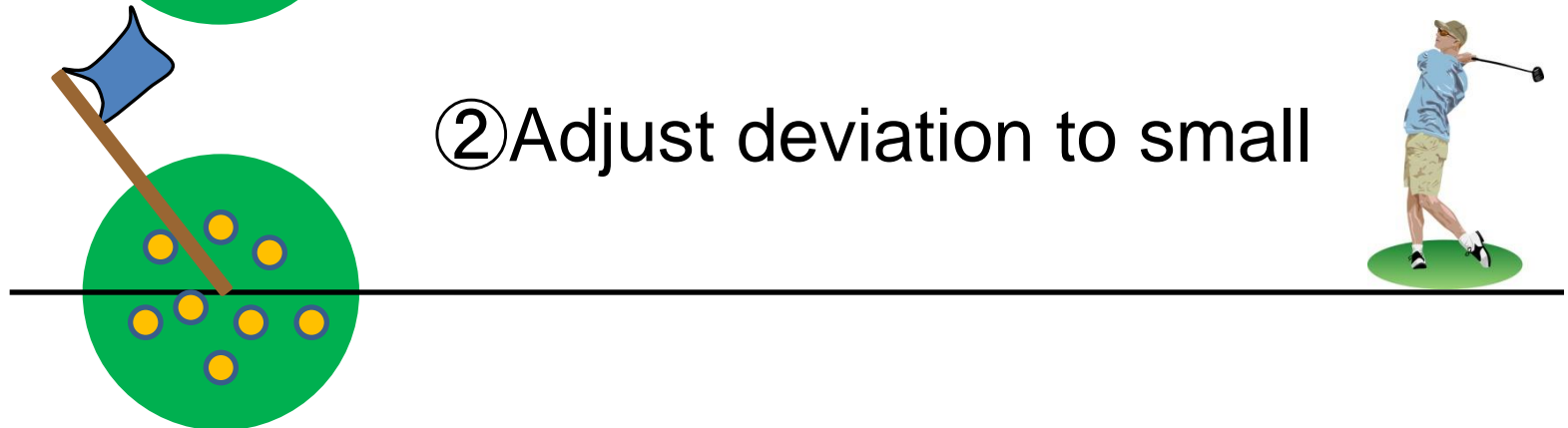


Conventional method: Adjust distance and then adjust swing



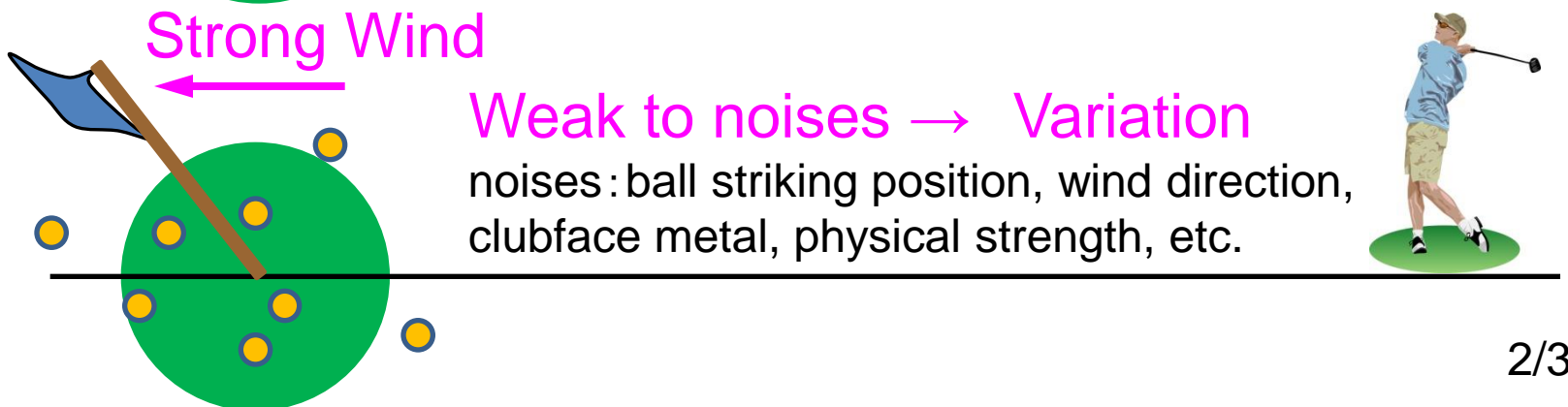
① Shot at the hole

This diagram shows a green circular target with a blue flag on a wooden pole. The target is divided by a horizontal line. Several yellow circles representing golf balls are scattered across the target. To the right, a golfer in a blue shirt and khaki shorts is shown in a mid-swing position on a green tee box.



② Adjust deviation to small

This diagram is similar to the first one, but the yellow golf balls are now clustered more tightly around the center of the target, indicating a smaller deviation.



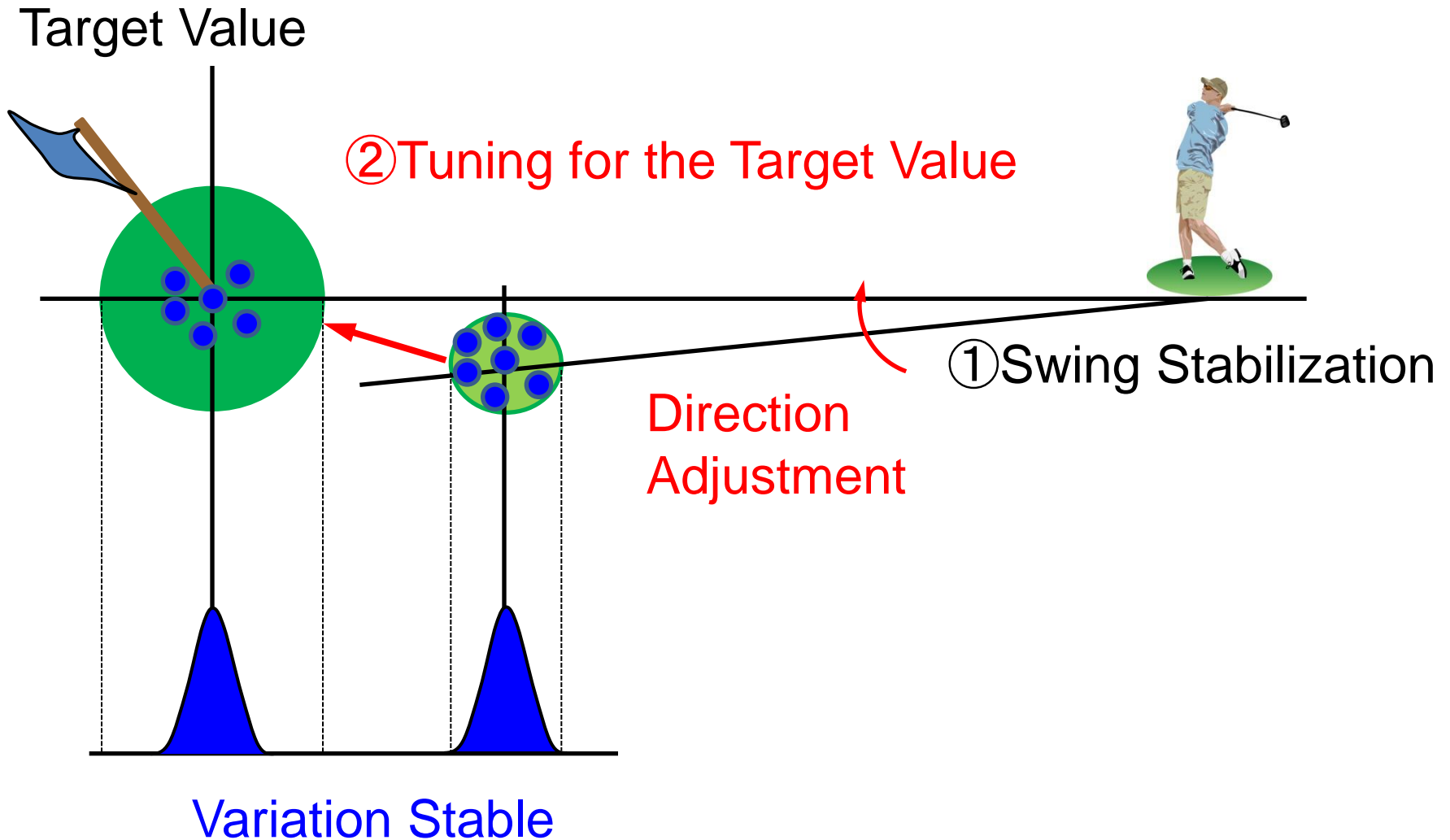
Strong Wind

Weak to noises → Variation

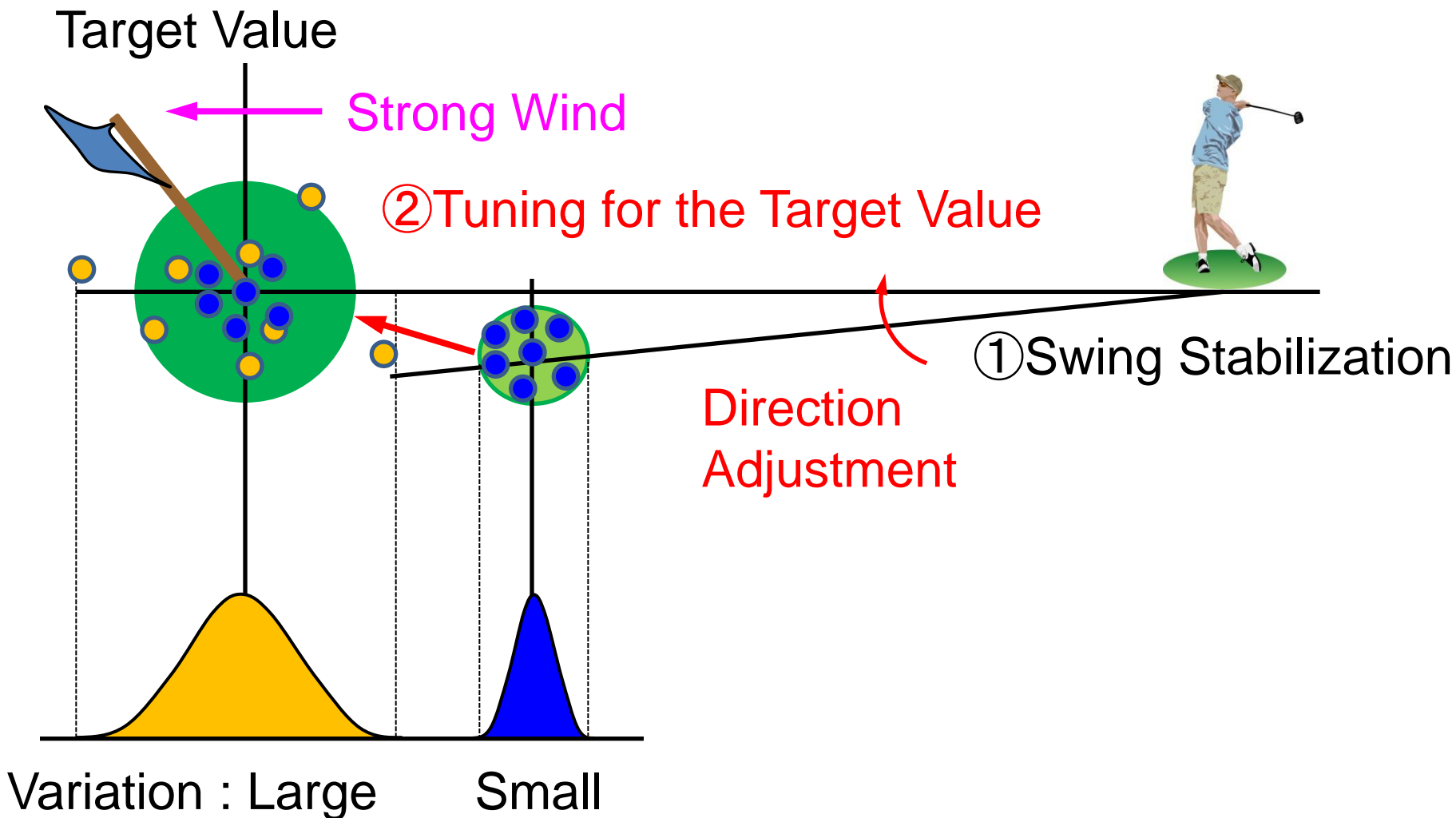
noises: ball striking position, wind direction, clubface metal, physical strength, etc.

This diagram shows the target with a pink arrow pointing left from the text "Strong Wind". The yellow golf balls are scattered across the target, with some outside its boundaries. The golfer is shown in a mid-swing position.

Quality Engineering: Stabilize swing first, then adjust distance

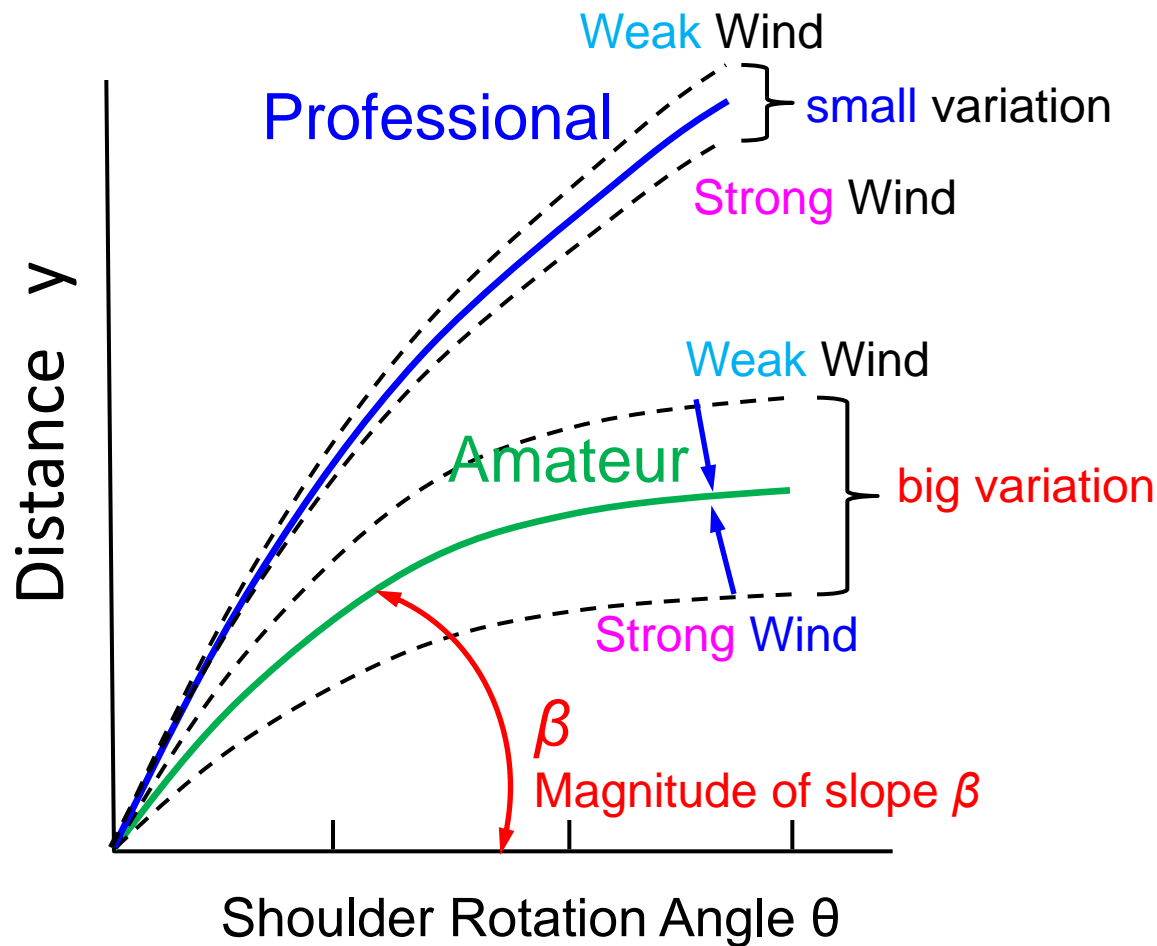


Comparison between Conventional Method and Quality Engineering



2-Stage Design: Improve Variation, then Adjust Distance

Ideal functionality: Body Rotation Angle and Distance are Proportional



$$\frac{1}{2} k \theta^2 = \frac{1}{2} m \left(\frac{dy}{dt} \right)^2$$

Body Rotation Energy Ball Movement Energy

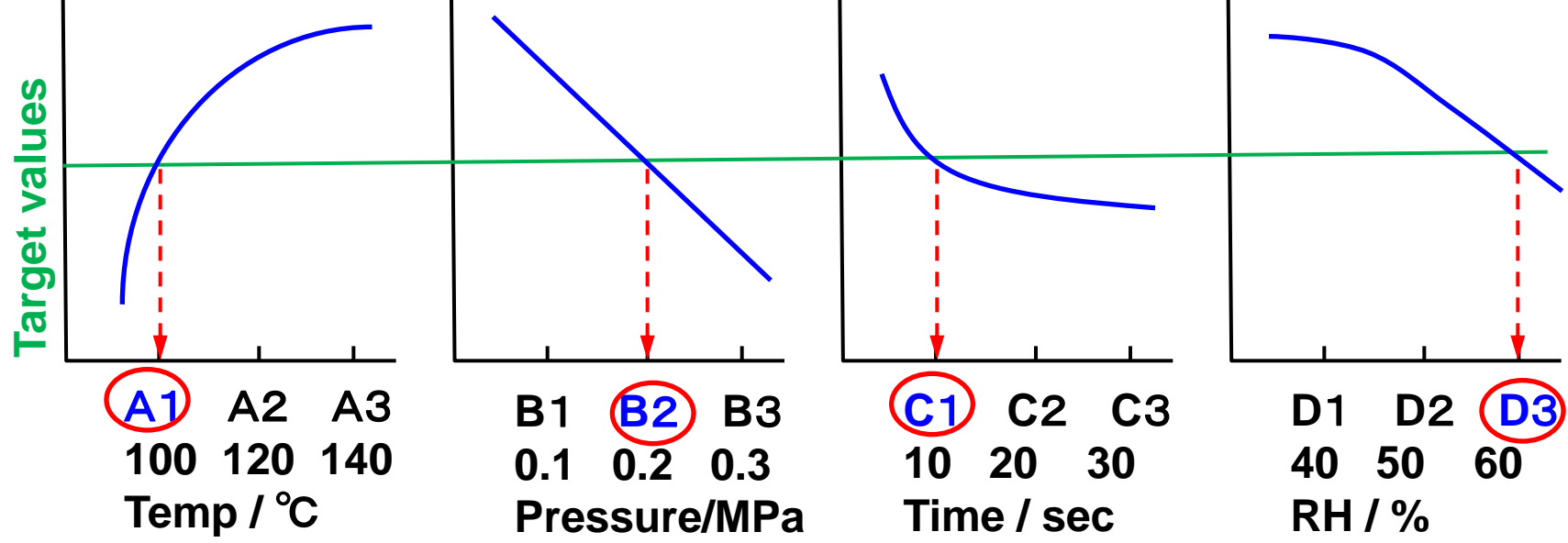


$$y = \beta \theta$$

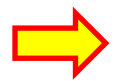
Control Factors: Position of Arms, Back, Legs, and Swing Path

Conventional 2-Stage Design

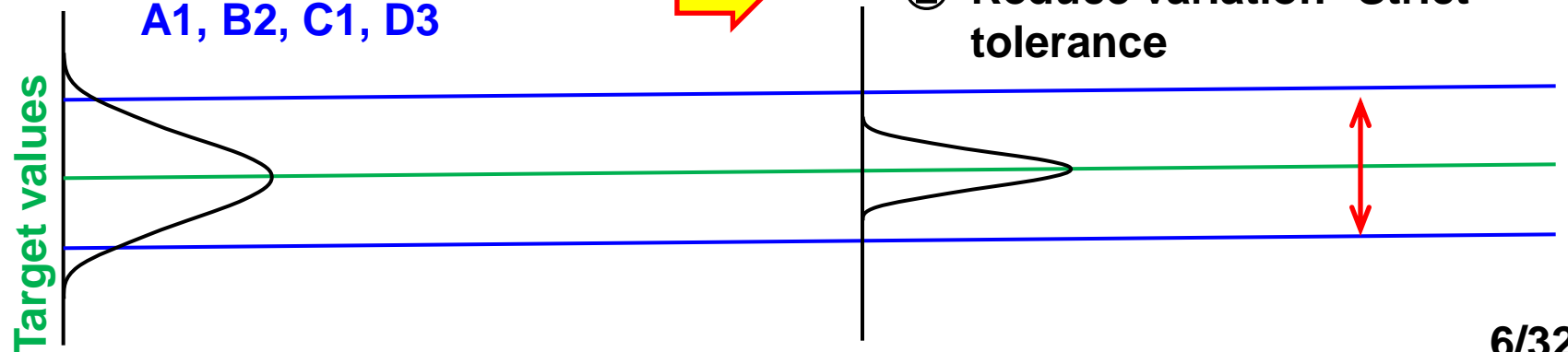
Characteristic values



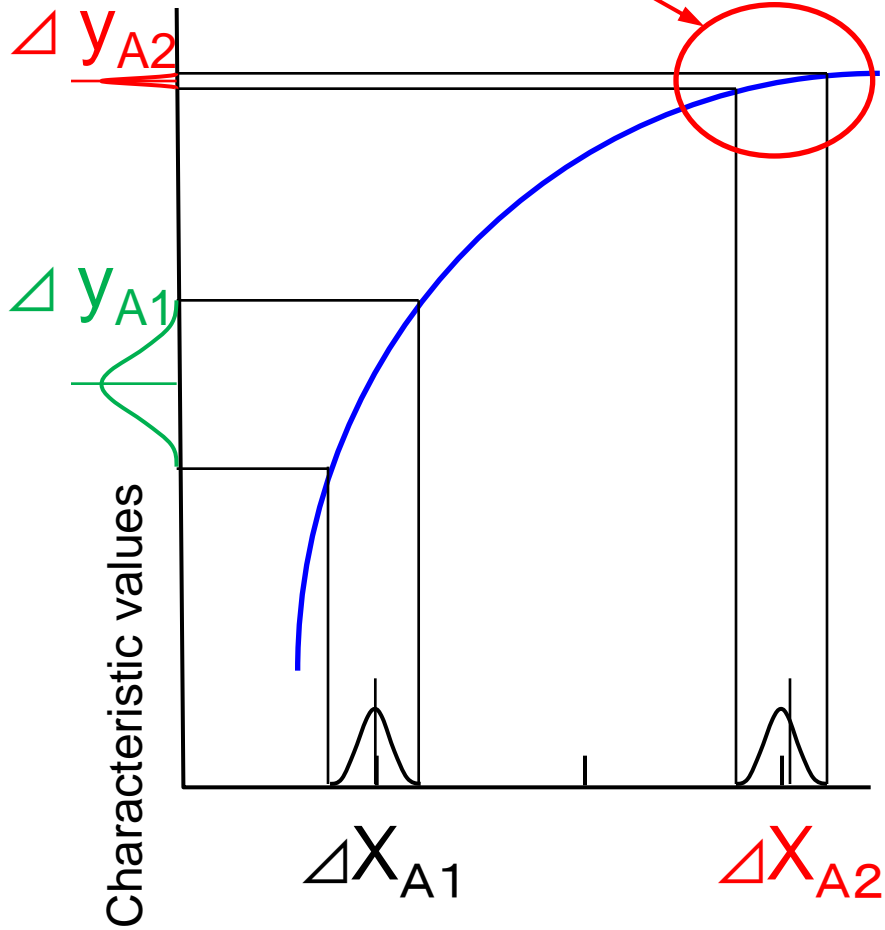
① Nearing target values
A1, B2, C1, D3



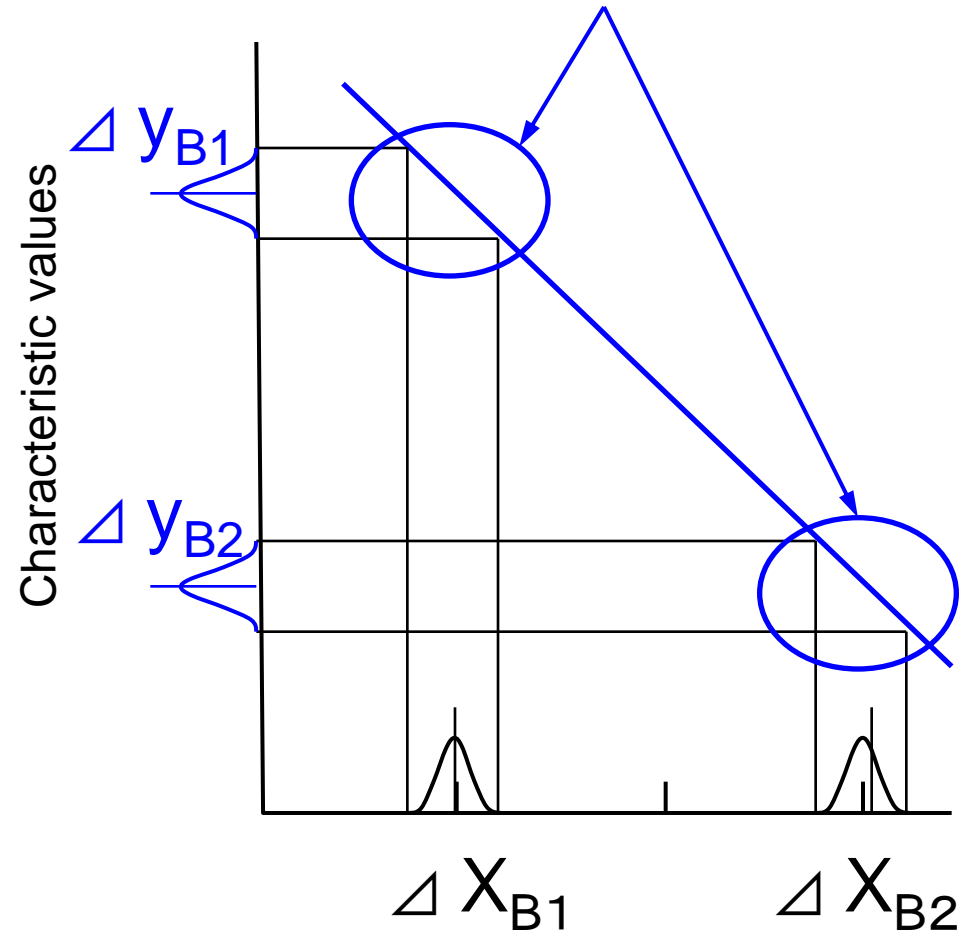
② Reduce variation Strict tolerance



Small Variation



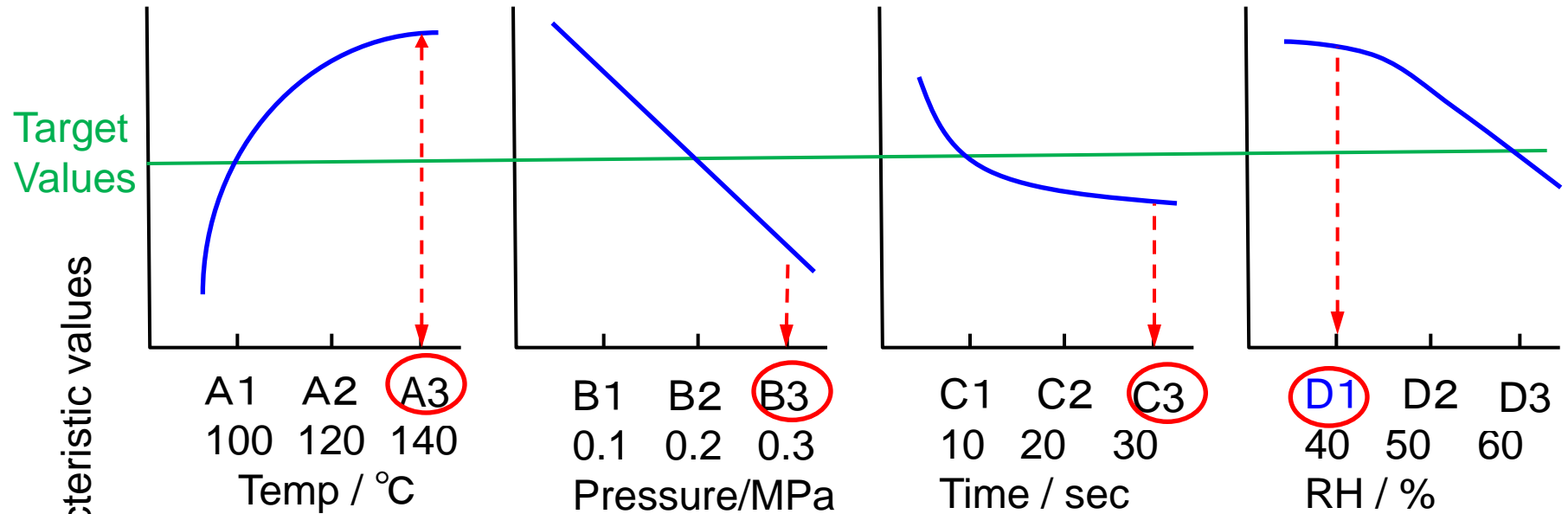
Same Variation



$$\Delta X_{A1} = \Delta X_{A2} = \Delta X_{B1} = \Delta X_{B2}$$

$$\Delta y_{A2} < \Delta y_{B1} = \Delta y_{B2} < \Delta y_{A1}$$

Quality Engineering 2-Stage Parameter Design

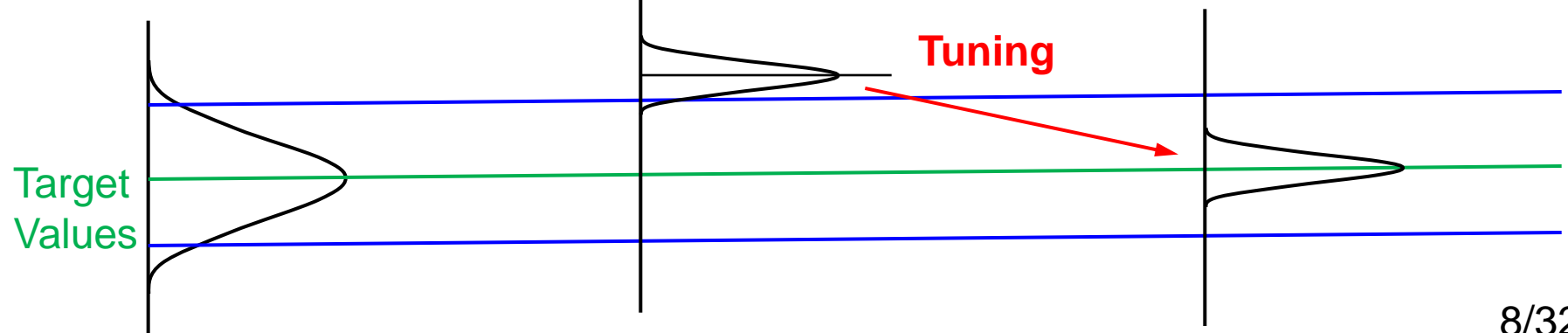


① Variation Minimalization

A3, C3, D1

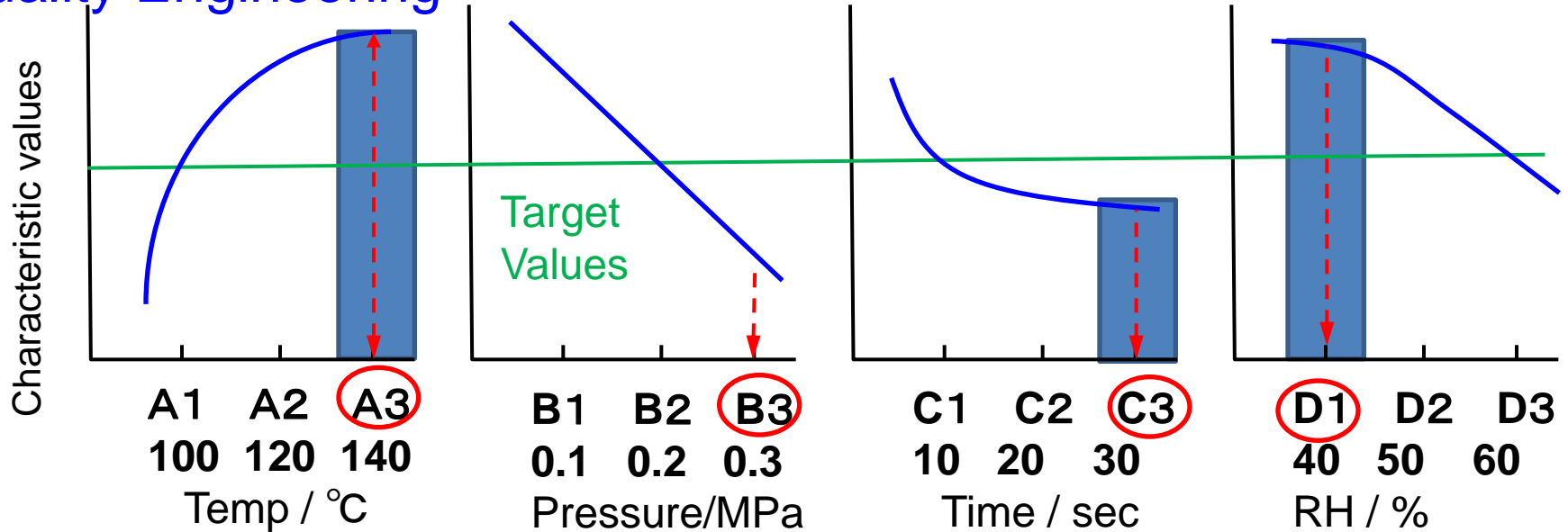
② Adjust to target values

A3, B3, C3, D1



Q. Which method do you select ?

Quality Engineering



Conventional Method

