Lecture #16

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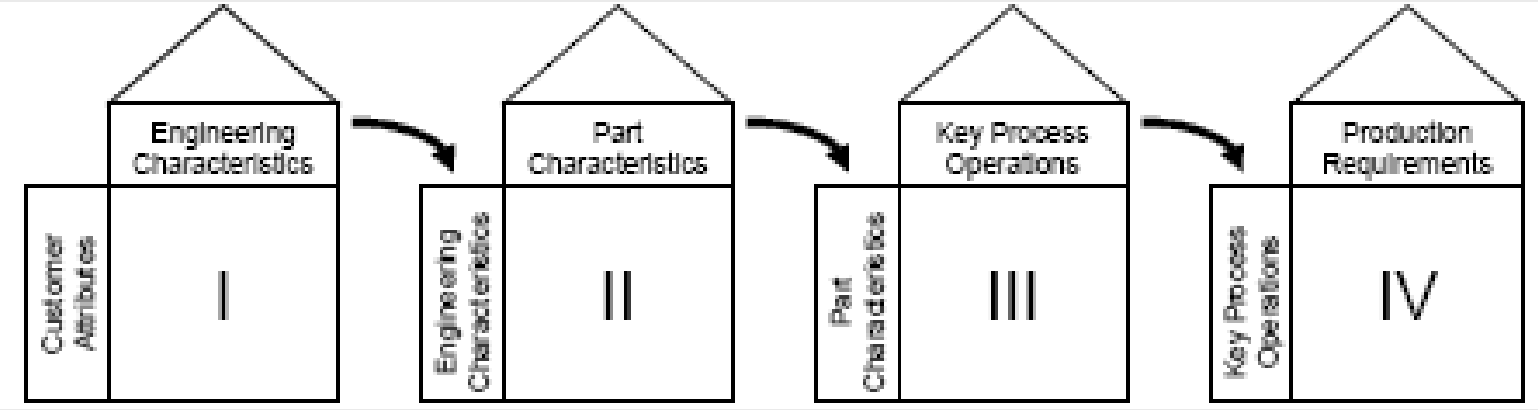
Service Processes & Systems
Dept. of Mechanical Engineering - Engineering Mechanics
Michigan Technological University

Quality Design

- **Quality Function Deployment (QFD)**
  - Developed in Japan to provide customer input at the product design stage
  - Uses a matrix, referred to as a "house of quality", that relates customer attributes to engineering characteristics.
  - Can use to find the features of the service process



QFD example for Village Volvo

- Village Volvo – independent auto service garage that specializes in Volvo auto maintenance and competes with Volvo dealers for customers.
- VV has decided to assess its service delivery system in comparison with that of the dealer to determine areas for improving its competitive position.

QFD example for Village Volvo

- Establish the aim of the project
  - Assess VV's competitive position
- Determine customer expectations
  - The target customer group is Volvo owners with non-routine repairs. Customer expectations could be solicited by interviews, questionnaires, etc.

QFD example for Village Volvo

- **Describe elements of the service**
  - **Columns of the house are the service elements that management can manipulate to satisfy customer expectations, for this example we've selected: training, attitudes, capacity, information and equipment.**

QFD example for Village Volvo

- Note the strength of relationship between the service elements
  - "Roof" of the house provides an opportunity to note the strength of correlation between pairs of service elements
  - 3 levels noted:
    - Strong, medium and weak
    - Another alternative (SP, P, 0, N, SN)

QFD example for Village Volvo

- Note the association between customer expectations and service elements
  - The “body” of the matrix contains numbers between 0 and 9 (9 indicating a very strong link) to indicate the strength of the link between a service element and a corresponding customer expectation

QFD example for Village Volvo

- **Weighting the service elements**
  - Measures importance of customer's assessment of the service element.
  - "Chimney" lists relative importance of each customer expectation
  - Weights on scale of 1-9 – importance that customers place on each expectation and could be determined by a customer survey.
  - Relative importance: Weight multiplied by strength in body of matrix (for service element) – sum these to achieve score

QFD example for Village Volvo

- **Service element improvement difficulty rank**
  - **In the "basement" of the house is a ranking for the difficulty of improving each service element, with a rank of 1 being the most difficult**
  - **Elements that require large capital investments have high difficulty.**

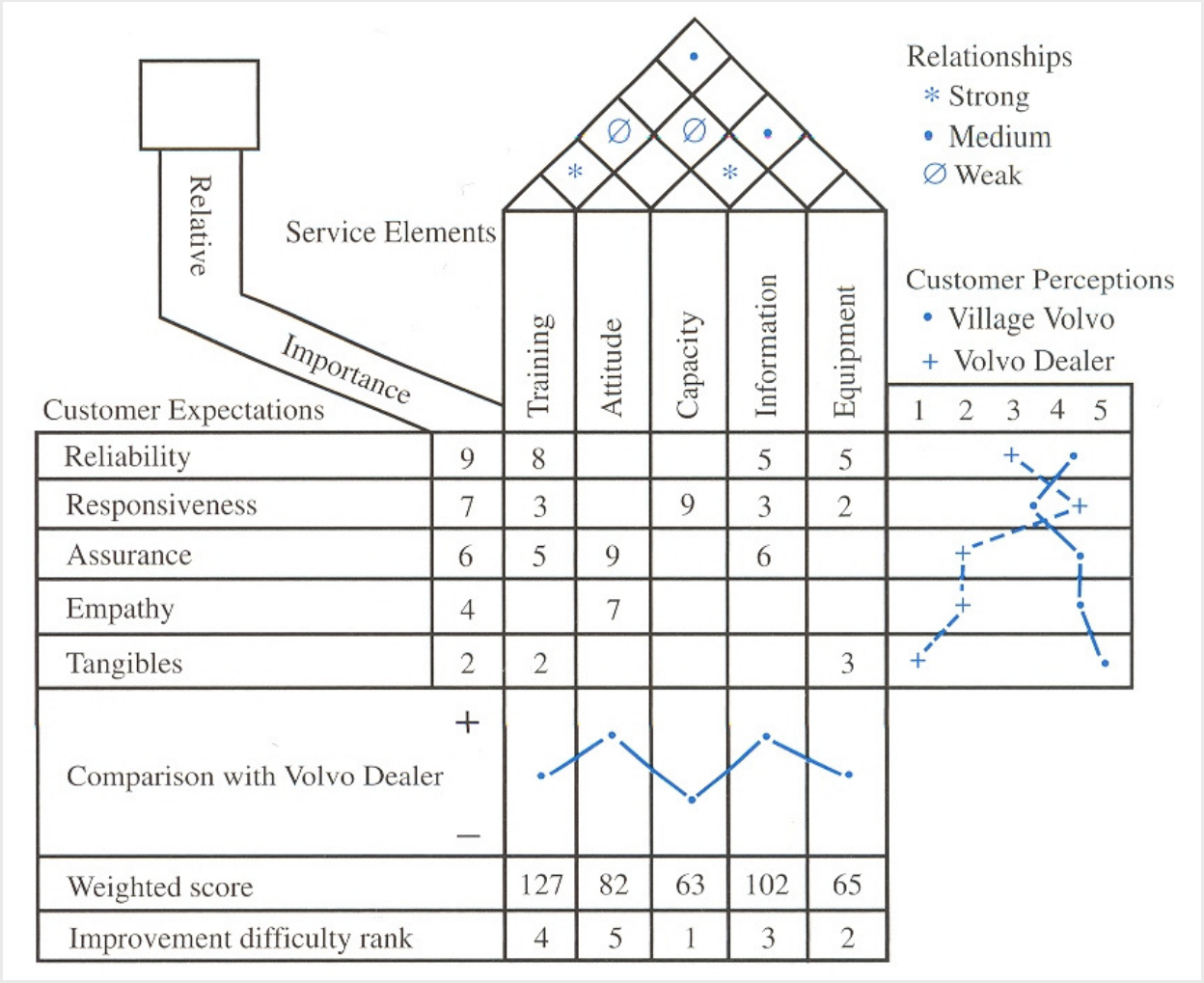
QFD example for Village Volvo

- **Assessment of completion**
  - A study of the Volvo dealer is made to assess customers' perceptions of service at the dealer compared with that at VV.
  - The result of a customer survey using a five-point scale is plotted to the right of the matrix
  - Based on knowledge of the dealer, a relative comparison of the level of each service element is plotted at the bottom of the matrix

QFD example for Village Volvo

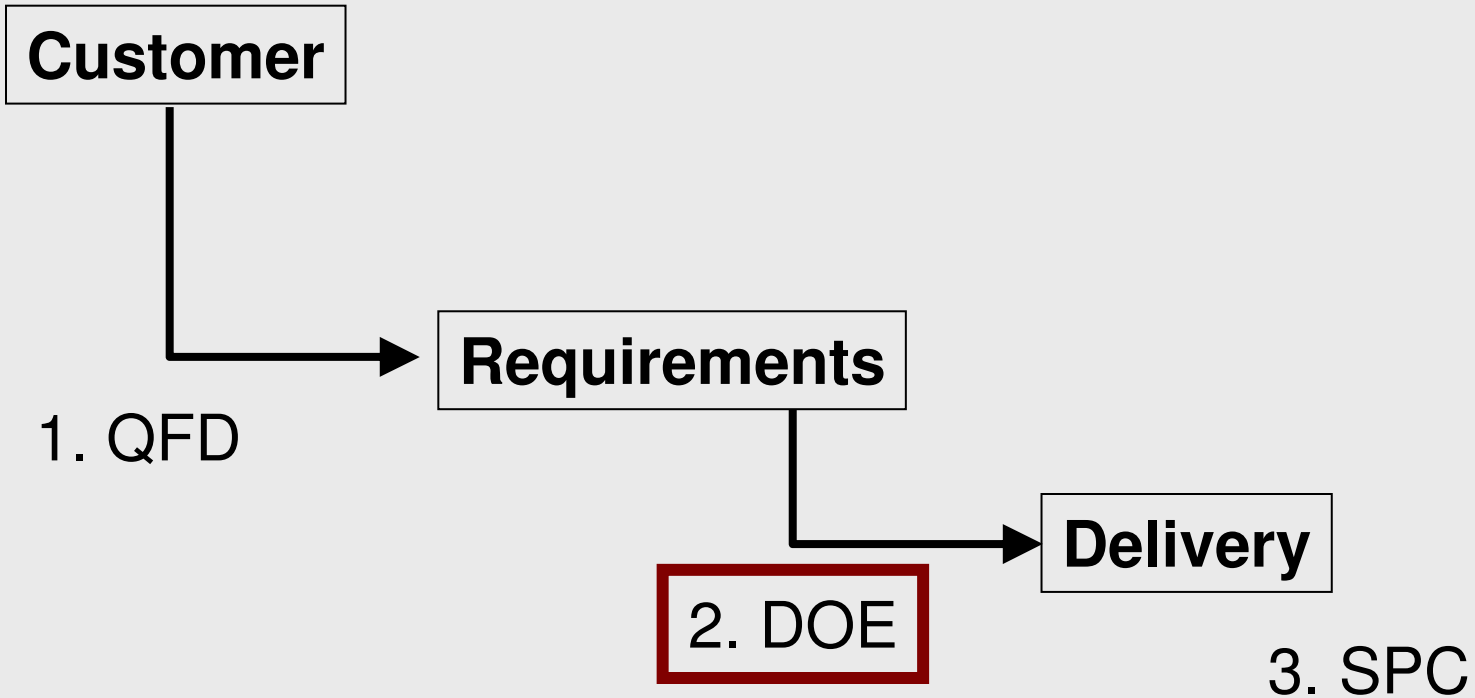
- **Strategic assessment and goal setting**
  - Strengths and weaknesses of VV (relative to dealer) evident from completed house of quality
  - Except for responsiveness, viewed favorably by customers
  - Attitudes and information – VV looks good – perhaps a problem with capacity, training, and equipment
  - The high weighted score given to training suggests that a first priority is to invest in training

QFD example for Village Volvo



Customer Expectations		Training	Attitude	Capacity	Information	Equipment
Reliability	9	8			5	5
Responsiveness	7	3		9	3	2
Assurance	6	5	9		6	
Empathy	4		7			
Tangibles	2	2				3
Comparison with Volvo Dealer (+ / −)						
Weighted score		127	82	63	102	65
Improvement difficulty rank		4	5	1	3	2

From Last Time…



Role of DOE in Design

- Testing vs. Experimentation
- DOE used for parameter selection at the product and process design stage
- The objective is to:
  - Experiment with various combinations of the important design parameters for the purpose of identifying the particular combination(s) that optimize certain design criteria or performance measures

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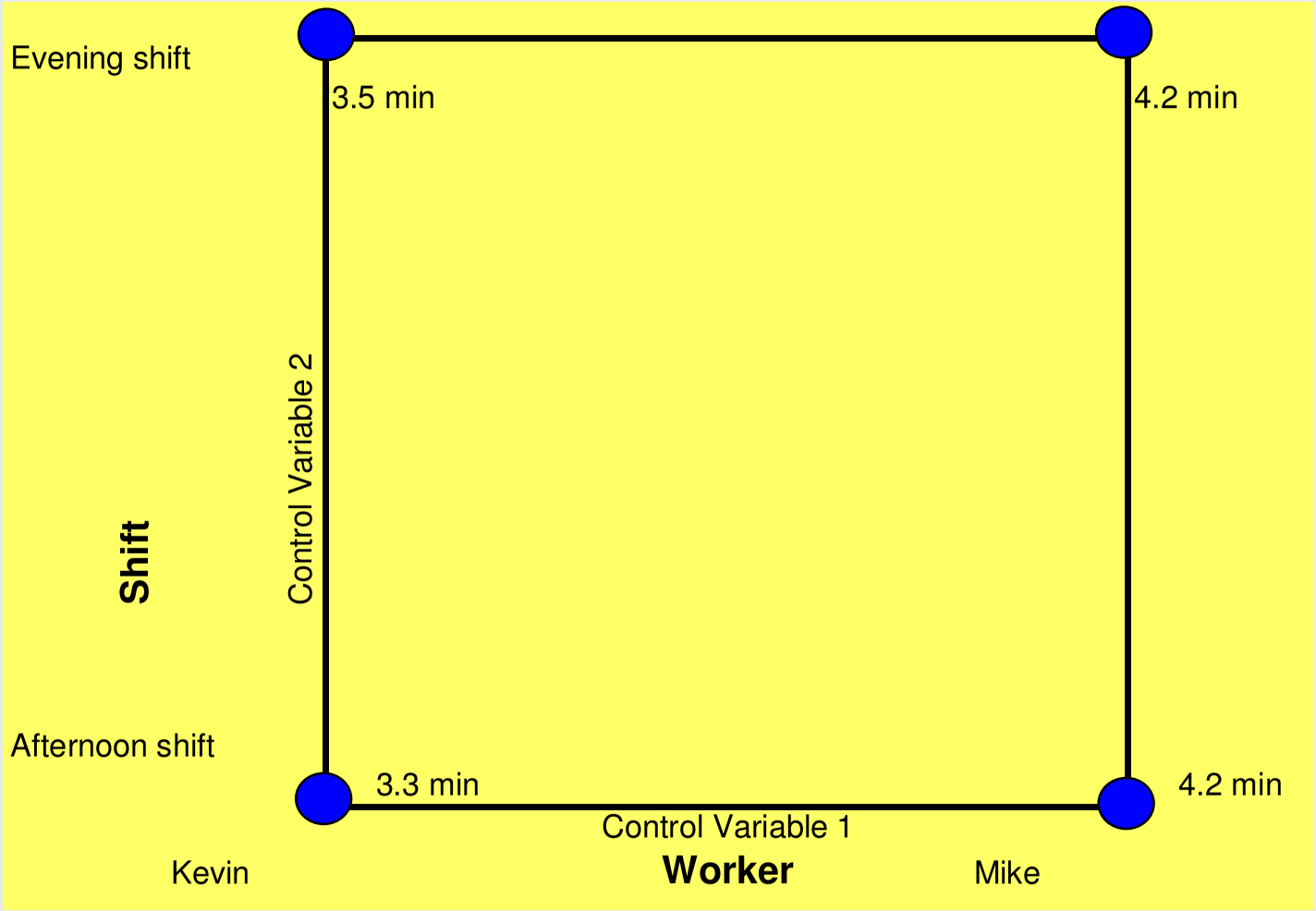
DOE example

- Suppose we want to control the time that a worker takes to prepare a sandwich at Subway
- We study by a simple experiment – role of two variables on prep time
- Experiment results shown in the following figure, where the points on the square correspond to the four test conditions examined.

DOE example

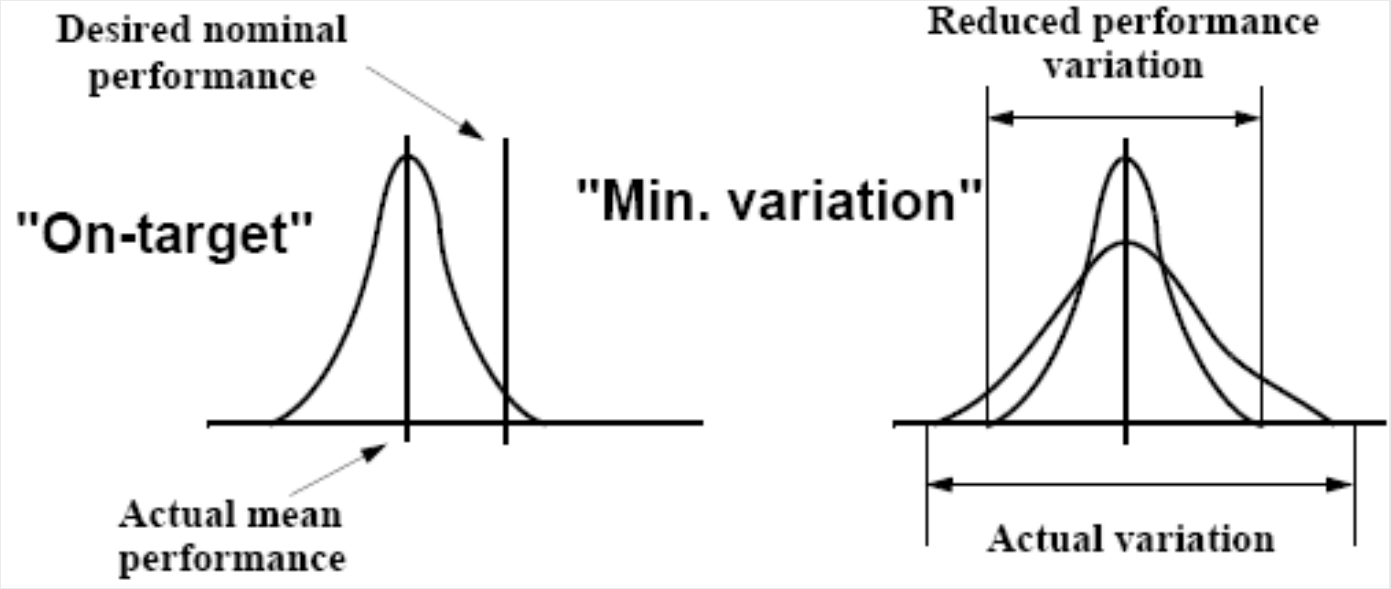

Evening shift
3.5 min
4.2 min
Control Variable 2
Shift
Afternoon shift
3.3 min
4.2 min
Control Variable 1
Kevin
Worker
Mike

DOE example

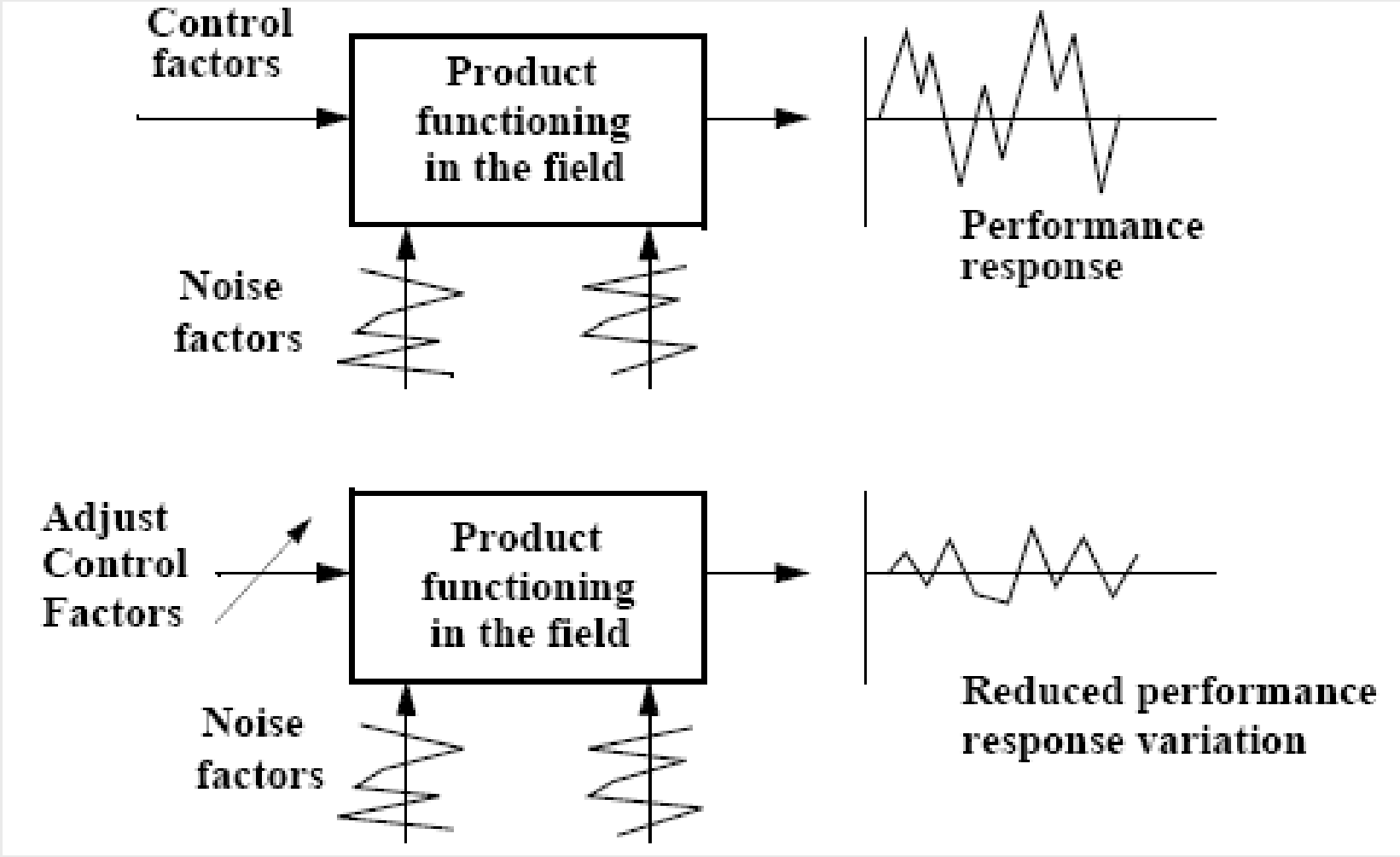
- Each time response is the average of 25 consecutive service outcomes
- Results of experiment indicate that by manipulating control variable 1 we can control the service time
- Control variable 2 seems to have little to do with service time, on average
- We can set it (or vary it) however we wish and nothing will happen to service time

DOE example

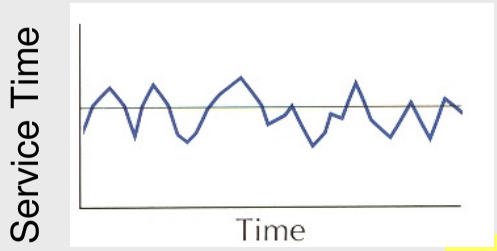
- Now suppose that we make a time plot of the 25 consecutive service times

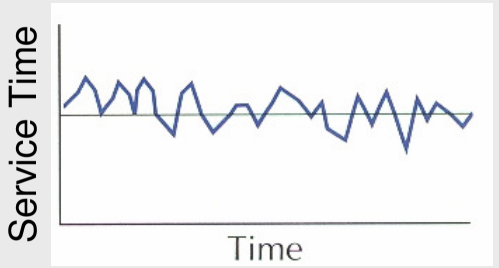


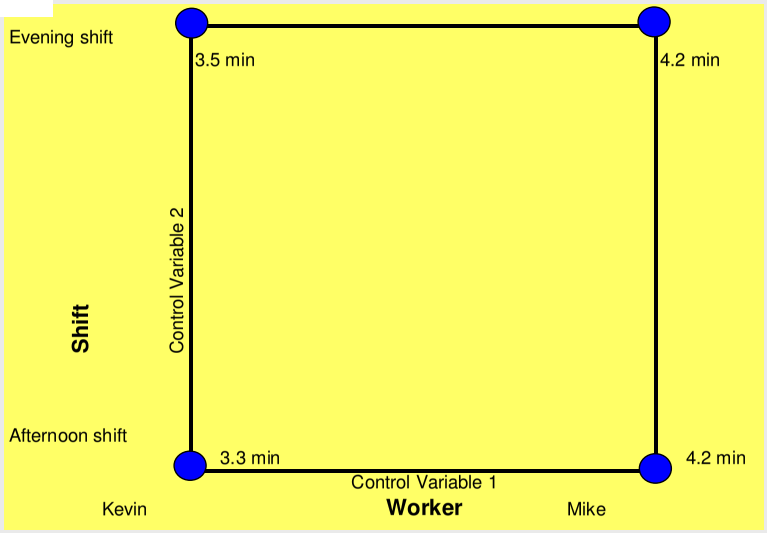
DOE example


Control factors
Product functioning in the field
Noise factors
Performance response
Adjust Control Factors
Product functioning in the field
Noise factors
Reduced performance response variation

DOE example


Service Time
Time


Service Time
Time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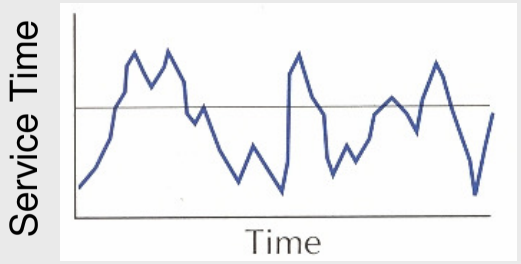
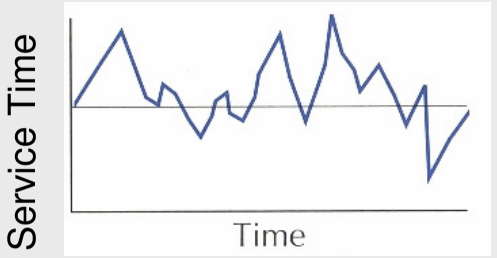
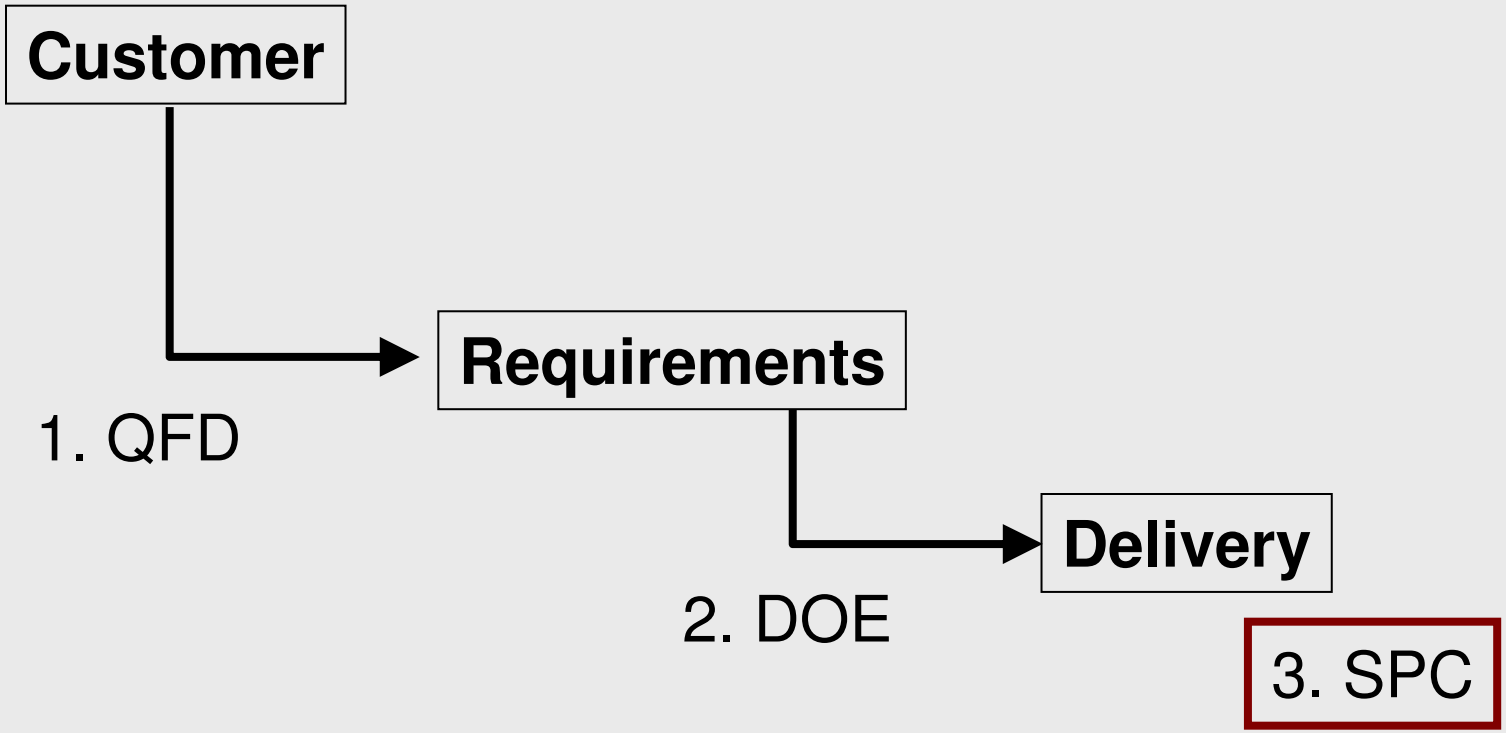

Service Time
Time


Service Time
Time

DOE example

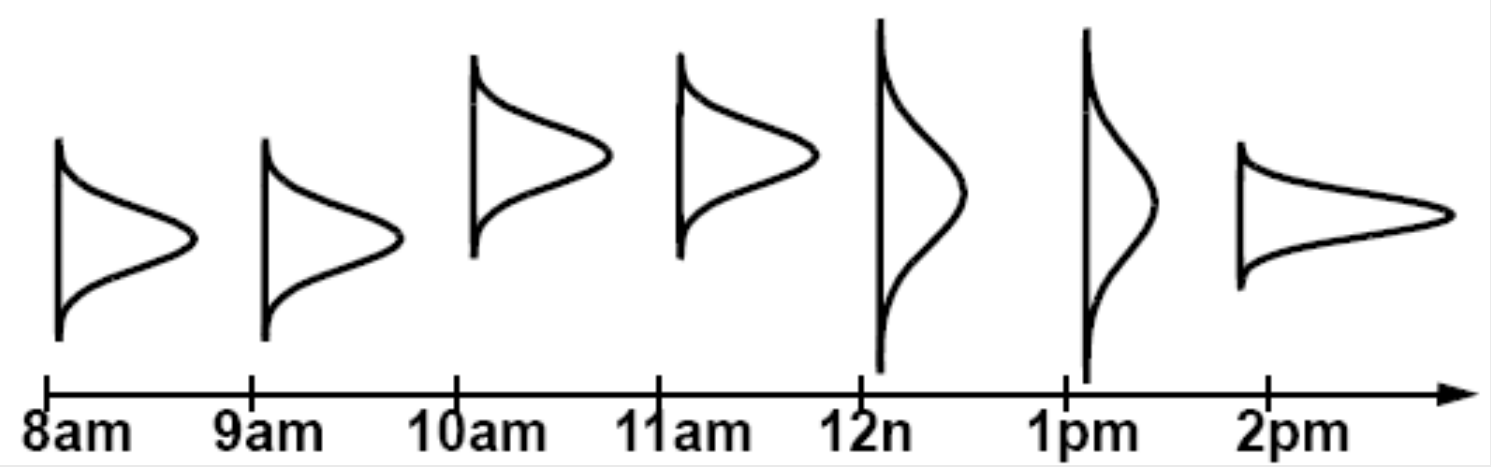
- Although variable 2 does not affect the service time on the average, it does appear to affect the variation in service time
- The results of the experiment seem to be telling us:
  - To control the average service time – manipulate variable 1
  - High level for variable 2 (evening shift) has less variation – need to understand why – what is the reason for this behavior??

Last but not least…

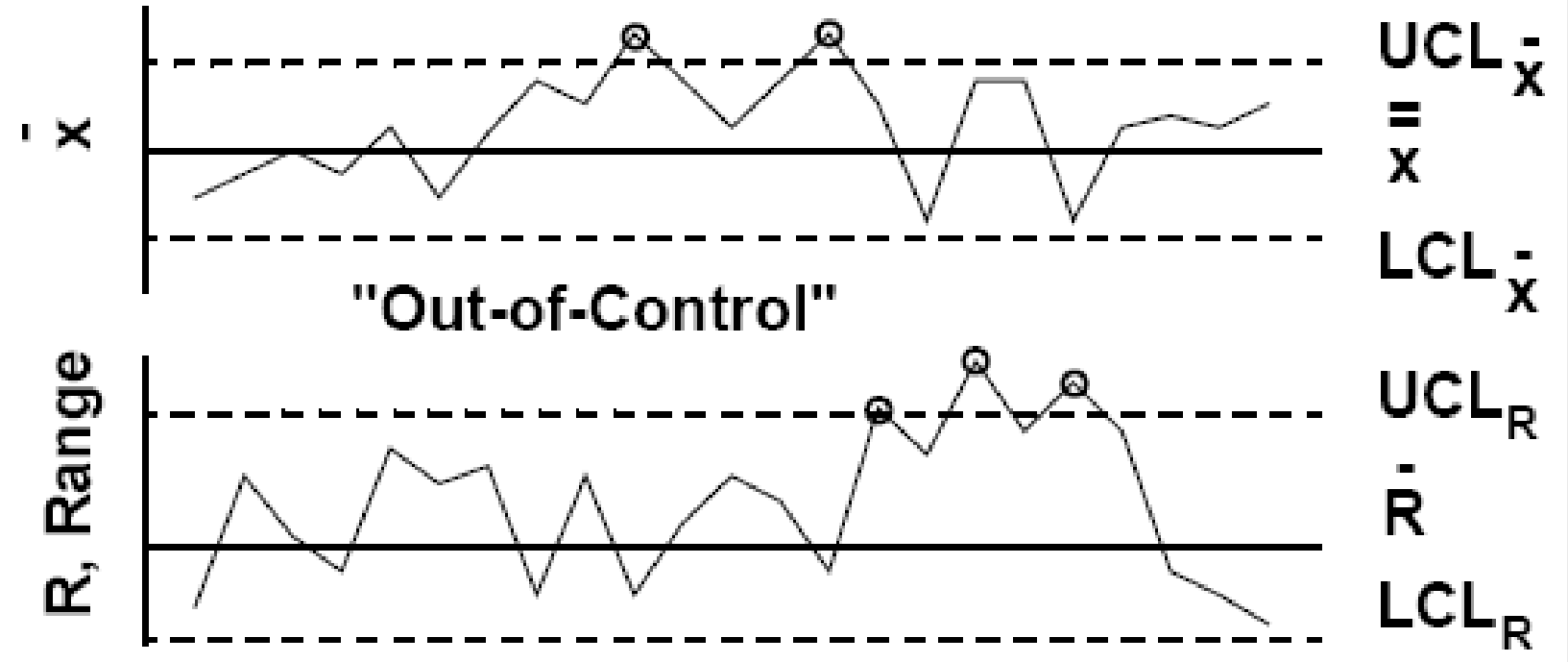


Statistical Process Control

- With SPC, we are concerned about the operation of the service process.
- Is the process stable, consistent, etc.? Just common causes? Or, are special causes present?

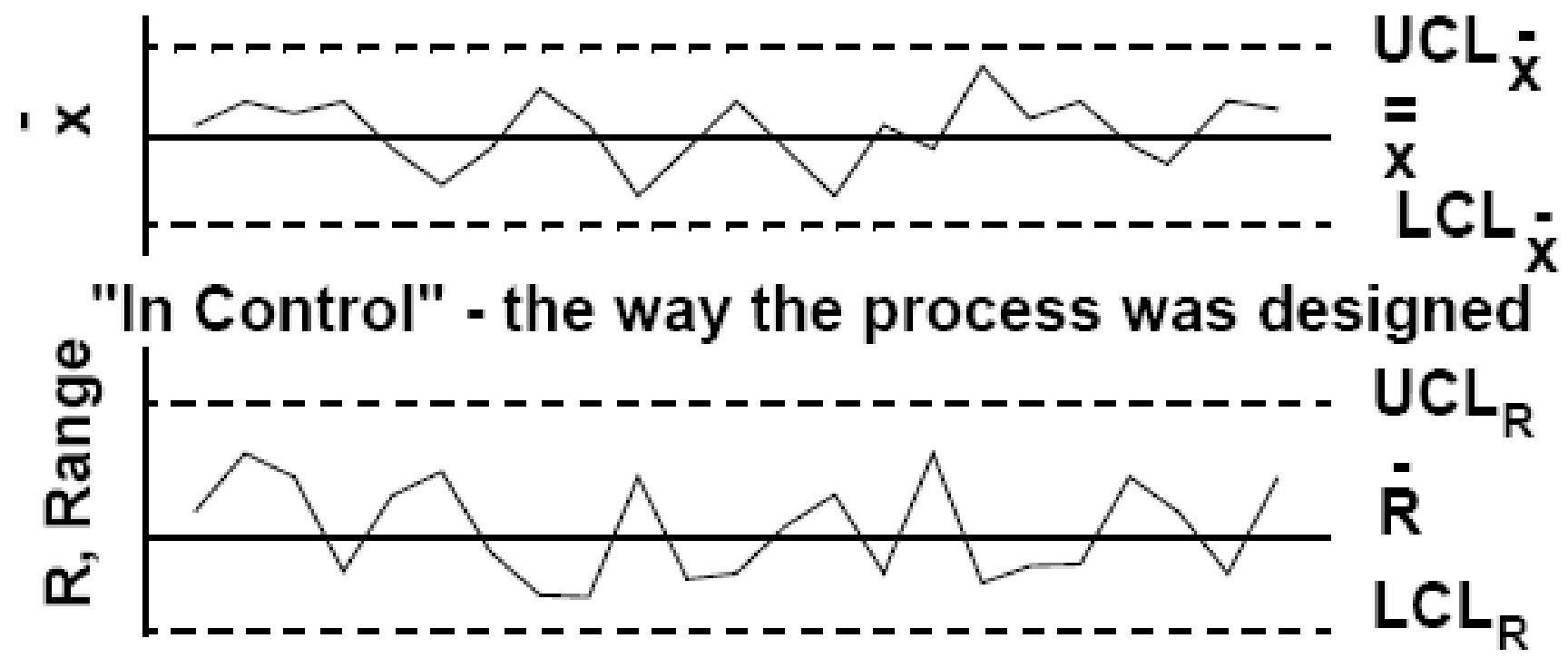


Control Charts – Special Causes



- Circle the points that are "statistical signals" – special causes are present - process not routine

Control Charts – Only Common Causes



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Responding to CC Results

Process In Control?	Customers Satisfied?	Action
N	N	Special Causes – Identify root cause of local fault
Y	N	Common Causes Only – System change needed
N	Y	Special Causes – Identify root cause of local fault – it's robbing us!
Y	Y	Common Causes Only – Spend time on other processes for now