EIN 5226

Measure Phase from DMAIC

Part II Introduction

Understanding Variation

Chapter 3 Sections 1-4

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Part II Introduction

- Part II (Chapter 3-14) addresses process definition, process performance, and the quantification of variability.
- KPOVs and KPIVs are identified through consensus.
- Basic analysis tools are introduced:
  - Probability Distributions
  - Six Sigma measures
  - Measurement systems analysis (MSA)
  - Failure mode and effects analysis (FMEA)
  - Quality function deployment (QFD)

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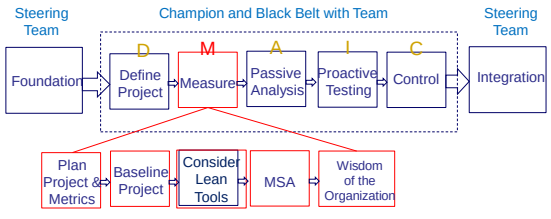
Part II Introduction



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Chapter 3
Measurements and
S^4/IEE Measure Phase

Sections 3.1-4

Chapter 3 Introduction

An objective of the measure phase is the development of a reliable and valid measurement system of the business process identified in the define phase.

- Overview of basic descriptive statistics;
- Data gathering, presentation, and simple statistics;
- Introductory discussion of confidence interval and hypothesis testing;
- Attribute vs. continuous data;
- Ineffectiveness of visual inspections;
- Examples of experiment traps.

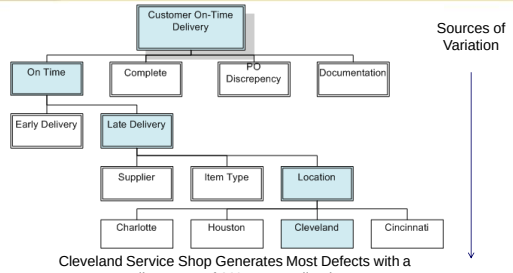
3.1 Voice of the Customer

- VOC assessment is needed up front when executing S^4/IEE projects at the 30,000-foot level.
  - Define your customer.
  - Obtain customer wants, needs, and desires.
  - Ensure that focus of project is addressing customer needs.

3.1 Voice of the Customer

- Important customer key process output categories are often classified with regard to their area of impact:
  - Critical to quality (CTQ): flatness, diameter, etc.
  - Critical to delivery (CTD): on-time, accuracy, etc.
  - Critical to cost (CTC)
  - Critical to satisfaction (CTS)
- Important key process input issues are classified as critical to process (CTP)

3.1 Voice of the Customer: Critical to Satisfaction (CTS) Tree



Cleveland Service Shop Generates Most Defects with a Failure Rate of 89% Late Deliveries

Understanding Variation

- All processes have variation. No two outputs will ever be exactly the same.
- In processes, there are many causes of variation combining to produce an overall effect.
- Variation can be inherent within a system, or can act upon a system to change the system characteristics.

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Understanding Variation

Types of variation:

- **Common Cause**
  - From a stable system
  - Exhibits random behavior
- **Special Cause**
  - From outside influences

W. Edwards Deming nomenclature (Deming 1986). 10

Understanding Variation

System	Measurement
Driving a car	Gas mileage

common cause –

What can cause gas mileage to vary with normal use of the car?

special cause -

What might cause an abnormal variation to gas mileage?

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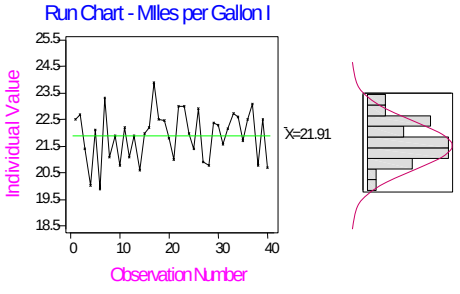

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Understanding Variation

Requires understanding of

- Response over time
- Central tendency
- Spread of data
- Shape of the distribution

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Understanding Variation

- A process that is operating with only common causes of variation present is said to be in statistical control.
  - Random process within identifiable bounds
  - Process stable over time
- Other commonly used terms:
  - Common causes = chance causes
  - Stable system = system in statistical control

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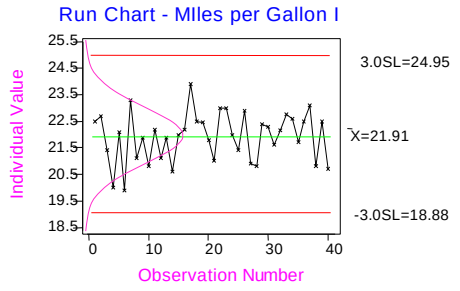

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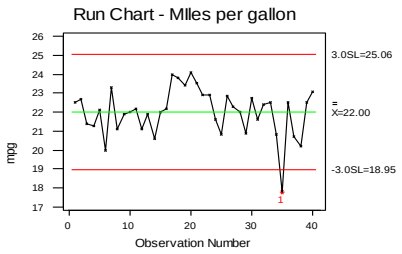

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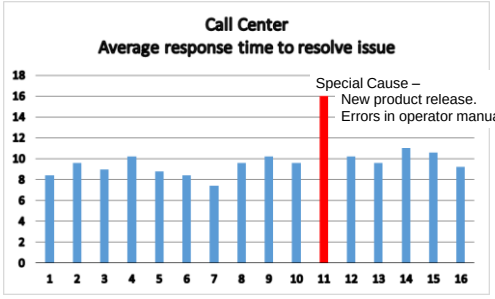
Common Cause versus Special Cause



Average Call time for weeks 1-16 = 9.8 minutes

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Improving a process

- Where special causes are identified attempts need to be made to avoid the source of special cause, or prevent it from happening again (assuming negative impact).
  - Investigate
  - Determine cause/s
  - Fix current issue
  - Take action to prevent reoccurrence in the future.

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Improving a process

- If variability is too large because of common causes, the process needs to be changed.
  - Fully understand the process
  - Determine causes of variation in the process
  - Reduce variation to improve process.

(If a process metric is too high or too low, that also requires a process change.)

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3.3 Common vs. Special Causes and Chronic vs. Sporadic problems

J. M. Juran (Juran and Gryna 1980) considers the corrective action strategy for sporadic and chronic problems.

- **Sporadic problems** are defined as unexpected changes in the normal operating level of a process.
  - Sporadic problems = due to special causes
- **Chronic problems** exist when the process is at a long-term unacceptable operating level.
  - Chronic problems = due to common causes

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3.3 Common vs. Special Causes and Chronic vs. Sporadic problems

Breakthrough sequence for solving chronic problems

1. Convince those responsible that a change in quality level is desirable and feasible.
2. Identify the vital few projects; that is, determine which quality problem areas are most important.
3. Organize for breakthrough in knowledge; that is, define the organization mechanisms for obtaining missing knowledge.
4. Conduct the analysis; that is, collect and analyze the facts that are required and recommend the action needed.
5. Determine the effect of proposed changes on the people involved and find ways to overcome the resistance to change.
6. Take action to institute the changes.
7. Institute controls to hold the new level.

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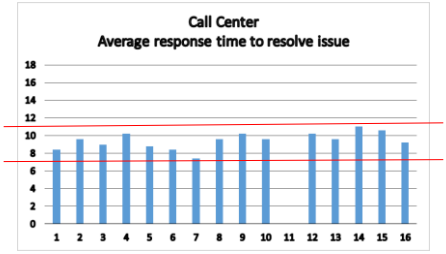
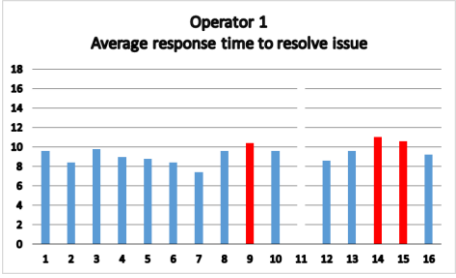
Bounds of the process (± 2 std dev) (Common Cause Variation)



Process mean = 9.2, std dev = 0.95
95% interval {7.3, 11.1} assuming normally distributed

Common Cause versus Special Cause



Operators given deficiency notice if average over 10 minutes in any given week.

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3.4 Reacting to Data

76.2	76.9	75.1
78.2	78.3	75.4
74.1	72.7	73.0
74.1	76.3	74.6
75.0	78.5	76.1
74.5	76.0	79.3
75.0	76.8	75.9
75.0	73.2	75.7
71.8	78.8	77.9
76.7	77.6	78.0
77.8	75.2	
77.1	76.8	
75.9	73.8	
76.3	75.6	
75.9	77.7	
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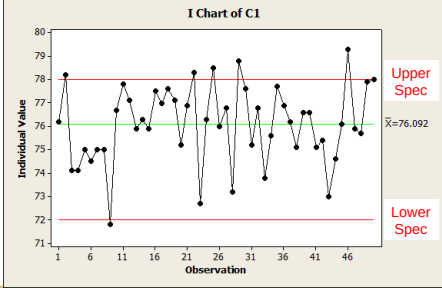
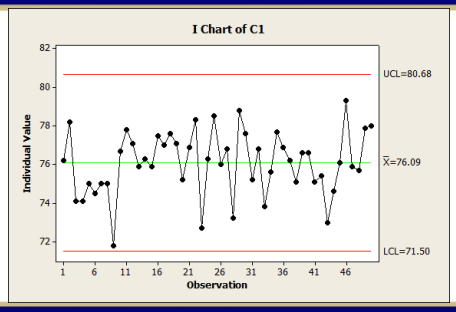
77.0	76.2	
77.6	75.1	
77.1	76.6	
75.2	76.6	



3.4 Reacting to Data



The Deming Funnel Experiment

Tampering – adjusting a process based on a sample measurement

Examples

- Adjusting machine setting after each part is run to "get back to target"
- Increasing advertising because sales are down in a month

If a process is stable, tampering will lead to greater variation, NOT improvement!

Related Assignments

Please see Blackboard for related assignments.