EIN 5226

Measurements II

Chapter 3 Sections 3.9-3.18

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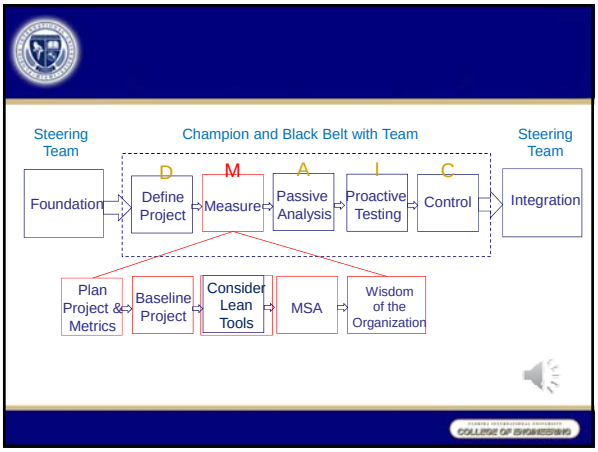


Chapter 3 Introduction

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.

3.9 Attribute vs. Continuous Data Response

- Continuous data can assume a range of numerical responses on a continuous scale. (e.g., micrometer reading)
- Attribute data can assume only discrete levels. (e.g., operator, machine, number of defects, pass/fail)
- Logic pass/fail

Types of Data
Categorical/Qualitative

- Non-numeric
  - Nominal
    - Categories for which no ordering is implied
    - Examples: gender, site location, color
  - Ordinal
    - Distinct categories in which order is implied
    - Examples: shoe size, satisfaction surveys

Types of Data
Numerical/Quantitative

- Two broad types numerical data
  - Continuous (or variable)
    - Observations are measured
    - Examples: weight, time, linear measurements
  - Discrete (or attribute)
    - Raw data can only logically be whole numbers
    - Examples: Defect count, % repeat customers

Which type of data is it?

1st shift, 2nd shift, 3rd shift

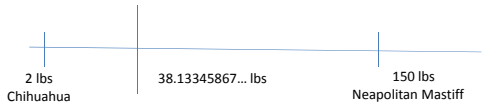
A. Qualitative/Categorical

B. Quantitative/Numeric

Continuous Variables

Continuous variable
- Exact value of variable can take on any value in an interval
- Possible outcomes are theoretically infinite

Example: Weight of dogs in kennel



Discrete Variables

- If possible values arranged in order, there is a gap between each value and the next.
- Often referred to as attribute data
- Can be a finite set or an infinite set of values
- Examples
  - Any counted data, i.e., counts of defects
  - Rating scale can only take on the values 1, 2, 3, 4, and 5

3.9 Attribute vs. Continuous Data Response: Examples

Hole diameter is a characteristic on a part from machining process. A part outside specification limits is a defective part.

Inspection method #1 – Use caliper to obtain measurement for comparison to specifications. (Continuous data)

Inspection method #2 – Use a go/no-go gage to determine pass/fail to calculate a defect rate (Attribute data)

3.9 Attribute vs. Continuous Data Response: Examples

Transactional Quality Metrics - defects

Measures (attribute data)	**Example**: It is important that product order forms are correctly completed. Multiple types of errors could occur on each form.
Number defective	Number of forms with one or more defects over given period of time.
Defective rate	Percent of defective forms (number of defective forms divided by number of forms sampled)
Number of defects	Total number of defects counted on all forms sampled.
Defects per unit	Average number of defects per form (total number of defects divided by number of forms sampled)
Defects per million opportunities (DPMO)	Total number of defects divided by the number of opportunities per defect times one million.

3.10 Visual Inspections

- Still remain a very large single form of inspection activity.
- Characteristics often do not completely describe what is needed, and the inspectors need to make their own judgment.
- A visual inspection does not necessarily address the real desires of the customer.
- Visual inspections often lead to the thinking that quality can be inspected into a product.

3.11 Hypothesis Testing

Hypothesis tests - used when decisions need to be made about a population.

- Hypothesis - Assertion or theory made about a population based on some background information or sample data.
- Hypothesis test - Statistical test of hypothesis based on sample data collected from the population of interest.
- To be covered in DMAIC Analyze Phase (Part III of text)

3.12-16 Experimentation Traps
3.17 Some Sampling Considerations

Possible Experimentation Traps

- Sampling errors
  - Randomization issues
  - Assumption violations: Stable process, Independence of observations
- Measurement error
  - Overlooking precision/accuracy of measurement system.
- Confused effects –
  - Multiple influences on a process are not considered.

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3.18 DMAIC Measure Phase

- Select what to measure:
  - Consider the questions that need to be answered and the data that will help answer these questions.
  - Consider also the final and internal customers to the process and how the measures will be tracked and reported.

3.18 DMAIC Measure Phase

- Develop operational definitions:
  - Consider how to clearly describe what is being measured to ensure that there is no miscommunications.
- Identify data source(s):
  - Consider where someone can obtain data and whether historical data can be used.

3.18 DMAIC Measure Phase

- Prepare collection and sampling plan:
  - Consider who will collect and compile the data and the tools that are necessary to capture the data.
  - Create a data-sampling plan that addresses any potential data integrity issues.

3.18 DMAIC Measure Phase

- Implement and refine measurement:
  - Consider what could be done to assess an initial set of measures and procedures for collecting the data before expending a lot of resource collecting/compiling questionable data.
  - To ensure ongoing data integrity, consider what procedures will be followed to monitor data-collection practices over time.

Related Assignments

Please see Blackboard for related assignments