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Measure

Key Learning Points

1. Explain how to measure baseline performance of the Y in Y=f(x).
2. Describe how to confirm the improvement projects problem and goal.
3. Explain how to determine current performance of a product.

The DMAIC Methodology: Measure

DMAIC Steps	Tools Used
Measure Step: Measure the Y in its current state in numbers.	
Identify existing metrics on the baseline performance of the Y Develop a Detailed Process Map Conduct Pareto Analysis Begin Developing Y=f(x) Relationship	Detailed Process Map Baseline Data Collection Pareto Analysis
Measure Tollgate Review	

Purpose of the Measure Step

Measure is the second step of DMAIC.

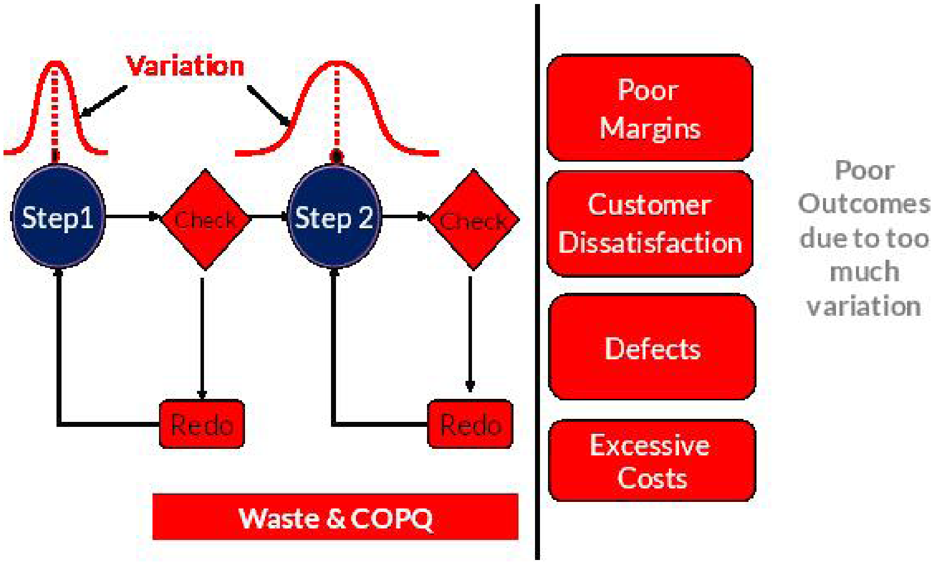
During this step, improvement teams measure the Y in its current state in numbers. The problem the team is trying to solve is the result of too much process variation.

By understanding the current performance of the Y in numbers the team will be able to validate the project goal and financial benefits.

With this information, the team will be able to focus on the ”vital few” aspects of the Y, and begin to identify potential Xs, or causes of the problem.

Natural Variation (Where to Find Variation)

Below is a graphic representation of the sequence of steps in a given process. As seen red, too much variation leads to poor results.



Process Variation (All Things Vary)

Variation represents the difference between an ideal and an actual situation.

An ideal represents a standard of perfection—the highest standard of excellence—that is uniquely defined by stakeholders, including direct customers, internal customers, suppliers, society and shareholders.

The fact that you can strive for an ideal but never achieve it means that stakeholders always experience some variation from the perfect situations they envision. This, however, also makes improvement and progress possible. Reducing the variation stakeholders experience is the key to quality and continuous improvement.
According to the law of variation as defined in the Statistical Quality Control Handbook:

- “Everything varies.” In other words, no two things are exactly alike.
- “Groups of things from a constant system of causes tend to be predictable.” We can’t predict the behavior or characteristics of any one thing. Predictions only become possible for groups of things where patterns can be observed.

If outcomes from systems can be predicted, then it follows that they can be anticipated and managed.

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Definition of a Process Measure

A measure describes the dimension, quality, or capacity of an overall process, at a specific point in the process, at a specific point in time, or over a period of time.

Improvement baselines and targets are created through measures, and provide a common language and focus for teams.

A measure describes:

- Dimension
- Quality
- Capacity
- Performance
- Characteristics of a process or population

Characteristics of a Unit of Measure

The ideal unit of measure is:

- Is understandable: This is seldom a problem at the technological level, where the meanings of the words have been highly standardized. However, many units of measure at the managerial level involve terms which lack standardized meanings, i.e., world-class quality. Local dialects may be understood by insiders but not by outsiders, i.e., on-time arrival. Any such vagueness or confusion becomes a natural source of divisiveness. Those who lack understanding of the unit of measure become suspicious of those who possess that understanding.
- Provides an agreed basis for decision making: One purpose of measurement is to provide factual assistance for decision making by a diverse number of people. The greater the validity of the measurement concept, the greater the likelihood of securing a meeting of those minds.
- Applies broadly: Measures of quality features are widely used as a basis for comparative analysis. You will need answers to questions such as: Is your quality getting better or worse? Are you competitive with others? Which one of your operations provides the best quality? How can you bring all operations up to the level of the best? Units of measure that have broad applicability can help you answer such questions.
- Is conducive to uniform interpretation: Identical numbers can nevertheless result in widely different interpretations. What is critical is whether the units of measure have been defined with adequate precision. Is the measure operationally defined?
- Is economical to apply: A balance must be struck between the cost of making evaluations and the value of having them. The most basic question is whether it is worthwhile to measure at all. If so, then the next question relates to the precision of measurement. The precision needed is whatever

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enables you to make valid decisions from the data. To go beyond this adds cost without adding value.

- Is compatible with existing designs of sensors: Measurement of quality is wonderfully simple if there exists a ready-made instrument that you can plug in to read the result in terms of the unit of measure. Such simplicity is widely prevalent at the technological level of the pyramid of units of measure. However, as quality grows in importance, you are faced with creating many new units of measure.

- Is measurable even in the face of abstractions: Some quality features seem to stand apart from the world of physical things. Quality of service often includes courtesy as a significant quality feature. Even in the case of physical goods, there are quality features, such as beauty, taste, aroma, feel, or sound. The challenge is to establish units of measure.

What to Measure

A measure describes the dimension, quality, or capacity of an overall process, at a specific point in the process, at a specific point in time, or over a period of time.

Improvement baselines and targets are created through measures, and provide a common language and focus for teams.

Effectiveness Measures

Effectiveness measures are those that illustrate the degree to which stakeholder needs and requirements are met and exceeded. Effectiveness is the purpose of the process.

Example:

- Percent defective
- Response time
- Billing accuracy

Efficiency Measures

Efficiency measures illustrate the amount of resources allocated in meeting and exceeding customer requirements or needs. Efficiency is how well the process operates in achieving its goal.

Example:

- Total cost of achieving effectiveness
- Cost per transaction
- Turnaround time
- Time per activity
- Amount of rework

Notes:

- Cycle time
- Throughput

Typical Measures

There are some process measures that fall into both categories of effectiveness and efficiency.

Examples:

- Timeliness: The degree to which a service is provided in a consistent, predictable, repeatable manner.
- Availability: Pertains to both machines and people. It is the available operational time to meet and assist the customers' needs.
- Reputation: The degree to which a service is perceived or judged by people can often outweigh price.
- Reliability: Knowing that an organization can repeatedly provide the same service over and over is a hallmark of being customer focused.
- Competence: Possession of the required skills needed to perform a service is often taken for granted.
- Access: Access refers to approachability and ease of contact.
- Respect: Respect refers to the real and imagined behaviors that the customer perceives. This includes clean and neat appearance.
- Credibility: Credibility is conveying that you have the customer's best interests at heart.
- Security: Freedom from danger, risk, or doubt.
- Intangibles: It is often difficult to see, touch, feel, hear, or taste a service. When an organization is able to make a service more tangible to the customer, it can often benefit greatly. Every company can find encounters where they can do something to demonstrate the value they are providing. For example, a company proactively provides a desktop fax to clients on the status of problems, i.e., a claim for material, showing the client that they are working on their behalf behind the scenes.

Types of Data

If you want to look at the variation in the time required to complete a task, you need accurate times (perhaps recorded to the nearest minute) for 40 or more repeated observations of the task. On the other hand, if you simply intend to look at the number of incidents by day when the task took more than 30 minutes, then all you need is a count of such incidents without regard to the exact task time.

This example illustrates the differences between two types of data: categorical and continuous. (Sometimes the one is called "discrete" or "attribute," and the other is

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referred to as "continuous" or "variable.") As you study the individual tools, you will notice that some of them rely on the availability of continuous variable data and that they cannot be used with categorical data.

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Categorical Data

Categorical (Discrete) data describe categories of characteristics, or attributes. This includes both ordinal and nominal data. Ordinal data are arranged into some assigned order. Nominal data are not arranged into any order. A more contemporary name for discrete data is categorical data because it shows the count in each category.

Examples:

- Ordinal: short, medium, tall; rare, medium, well-done
- Nominal: color (red, blue, green); department (HR, Marketing, Nursing), customer, pass/fail

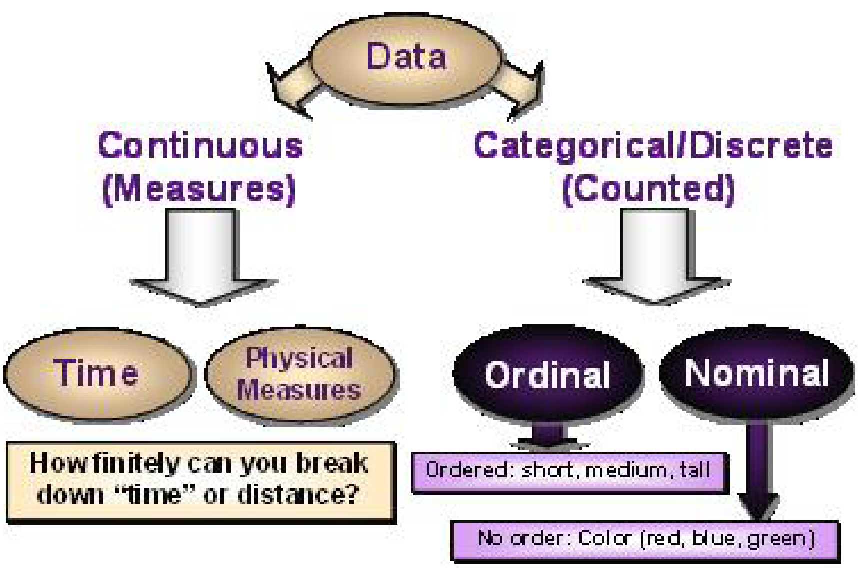
Continuous Data

Continuous data measure specific quality characteristics which fall along a continuum. These characteristics often include distance, weight, speed, etc.

Examples:

- The time it takes to process an insurance claim form
- The inner diameter of an endotracheal tube

Continuous vs. Categorical Data



This example illustrates the differences between two types of data: categorical and continuous. (Sometimes the one is called "discrete" or "attribute," and the other is referred to as "continuous" or "variable.") As you study the individual tools, you will notice that some of them rely on the availability of continuous variable data and that they cannot be used with categorical data.

Sources of Variation

To a large extent, many organizations have traditionally focused on people (e.g., their skills and behaviors), when working on problems.

DMAIC focuses on understanding all of the sources of variation to find and fix the true causes of the problem.

To identify the causes team members must understand that process variation causes the Y to not meet stakeholder requirements. There are two ways in which variation effects the Y.

Common Cause Variation

Common cause variation is from the inherent interaction of all the possible sources of variation. It is natural, inherent to the process, and reflects fluctuations because of differences in materials, people, procedures, the environment, etc. Its origin can be traced to an element of the system, which only management can correct.

Special Cause Variation

Special cause variation is from especially large influences by one of the possible sources of variation. It is unnatural to the process and results from specific assignable causes. They are not consistent over time. It is an intermittent source of variation that is unpredictable or unstable and is signaled by a point beyond the control limits of a control chart.

Sources of Variation

To a large extent, many organizations have traditionally focused on people (e.g., their skills and behaviors), without the measurement system, when working on problems. DMAIC focuses on understanding (or manipulating) all of the sources of variation to find and fix the true problem source(s).

Sources of variation include:

- Poor process design
- Skills and behaviors
- Poor quality software and hardware
- Insufficient process capability
- Measurement system

Examples:

- The time it takes you to drive home from work
- How long different people live
- The stock market's Dow Jones Average

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Basic Data Summary Numbers

The two most fundamental concepts in statistical analysis are central tendency and distribution.

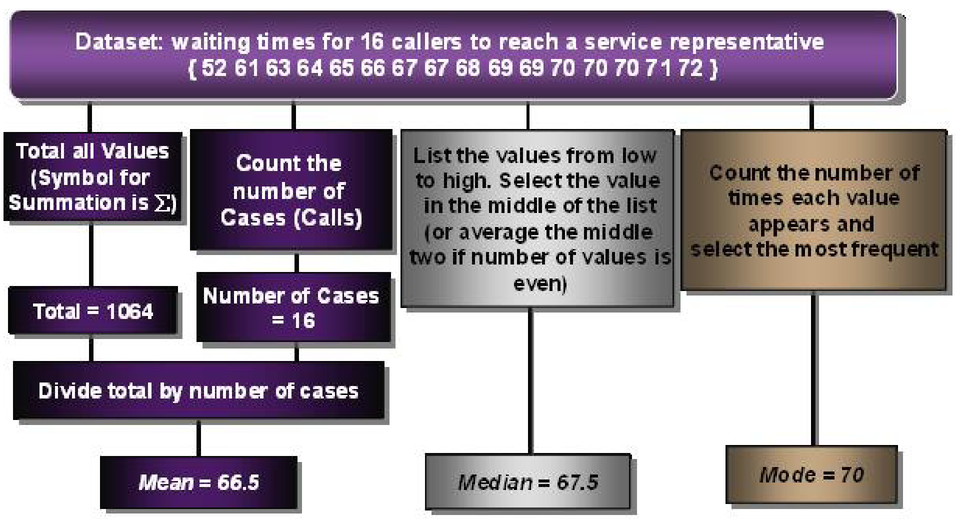
- Central tendency refers to the location of data.
- Distribution refers to the dispersion of data.

Central Tendency

Central Tendency measures:

- Mean – the average
- Median – the middle value
- Mode – the value that occurs most often

Calculating Central Tendency



Distribution

Distribution or dispersion refers to the scattering of data around the central tendency. The measures of dispersion are:

- Range – the difference between the maximum and minimum values
- Variance – deviation from the average
- Standard Deviation – a measure of variability
- Minimum – The smallest value in a sample or population
- Maximum – The largest value in a sample or population
- Count – The number of data points

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Common vs. Special Causes

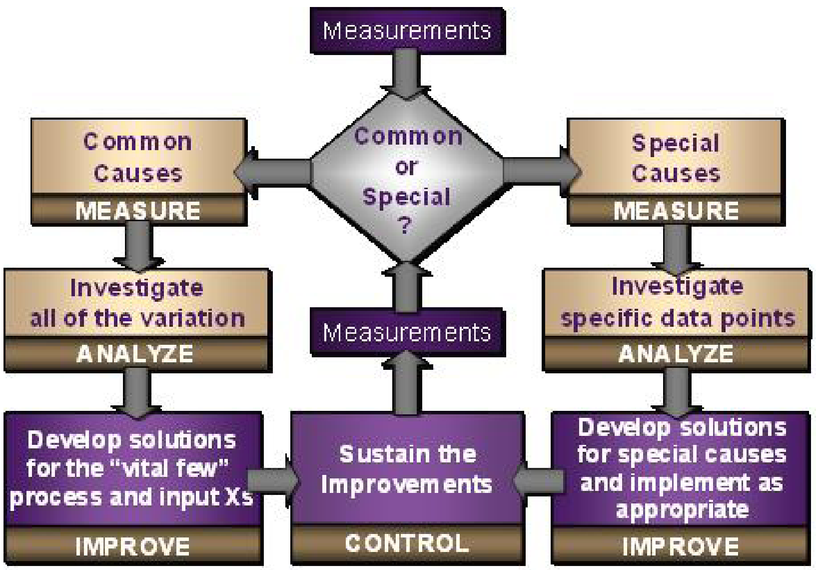
Recall that Common cause is the normal random variation in a process. Special cause is a specific, unique and assignable cause of a failure.

When a process exhibits common cause variation, the appropriate action is to investigate all of the data points. Note however that finding the "vital few" causal factors (Xs) that explain common cause variation is more difficult than finding causal factors for special causes because they are not as obvious.

As you recall, the Juran Trilogy identifies three quality managerial processes. Chronic versus sporadic spikes are addressed in different ways.

Dealing with Common vs. Special Causes

Below is a helpful model to follow when analyzing potential Xs.



Establishing Measures for Quality are Vital

When measurements don't exist they have to be invented. In this humorous segment you will learn how an objective system of measurement (Scoville Units) was created to determine the "hotness" of chili peppers.

Modify the Charter

After current baseline performance is measured, and Pareto Analysis is completed, your team must decide whether the project charter should be modified or can be confirmed as written.

If the problem or goal statement needs modification, you must present the revised goal statement to your Champion for approval.

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Updating the Charter

Problem Statement provided by Champion:

From 1/1/15 through 8/31/15 our hospital had 319 patients that had PAU charges as calculated by HSCRC. The current PAU rate is 10.9%. At the current PAU rate the revenue associated with the PAU rate $3,397,564.

Goal Statement provided by Champion :

Reduce the PAU rate by 15% (from 10.9% to 9.3%) by August 15, 2016.

Revised Problem Statement After Measure Step Completed:

From 1/1/15 through 6/30/15 our hospital had 61 patients that had inpatient admissions followed by a 30 day readmission to Inpatient or Observation with a LOS of >24 hours. The current risk adjusted readmission rate is 7.61%. Leaving the rate at the current level will result in a maximum of a 1.07% rate reduction in inpatient revenue based on the our hospital's Readmission Reduction Incentive Program (RRIP) which correlates to $199,108, following the improvement scoring methodology. However, a 1% reward could be allotted to our hospital by maintaining our current ranking of the attainment scoring which is in the top 25% of hospitals in the state for readmissions, or $191,491. Our hospital chooses the better of improvement or attainment scoring.

Revised Goal Statement:

Reduce readmission rate by 15% to 6.46% by August 31, 2016, and maintain top 25% ranking in state.

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