

Operational Definitions

In order to collect meaningful and relevant data, you need to determine how you will measure the characteristics that you are interested in studying.

For example, consider measurements taken on parts in a machining operation. Parts are machined, one at a time. You measure these three characteristics on each part: time, temperature, and length. Here are the measurements for one part, with values for the three characteristics: What do these values mean?

Let's add some context. Here are definitions for these three measurements: Time is how long it took to complete the machining operation. Temperature is the temperature of the part during the operation. Length is the length of the part. Is it now clear what the three values represent? What's missing from these definitions?

What if you were provided with this information instead? Time is the number of minutes between the start and end of the machining operation. Temperature, in Celsius, is the maximum temperature of the part during the operation. Length, in mm, is the outer diameter of the part after the operation. Does this give you a better understanding of what the numbers represent?

These attempts to provide clear and detailed definitions of the measurements are important, because they enable you to understand precisely what was measured and how to interpret the values. A clear and unambiguous definition of a measurement is called an operational definition. The idea of operational definitions was introduced by the quality guru W. Edwards Deming. Deming suggested that "An operational definition is one that people can do business with... It must be communicable, with the same meaning to vendor as to purchaser, same meaning yesterday and today..." Deming recognized that, without operational definitions, different people might not have the same interpretation of the measured values.

For example, consider this statement from an airline: "The on-time arrival rate is 99%." This sounds pretty great, but what does it actually mean? Here are some unanswered questions: What does "on-time" mean? How does the airline determine whether a flight was on-time? 99% of what? Of all flights? Only domestic flights? What time frame does this value represent? A day? A month? A year?

When you are determining how to measure a characteristic, you might need to develop an operational definition. An operational definition has four elements: the subject, the measure, the method, and the standard.

The subject is the characteristic of interest. For the airline example, the characteristic is the on-time arrival rate.

The measure is a statement of what is being measured. For the on-time arrival rate, the measure, or metric, might be the average daily on-time arrival rate, where the rate is the percentage of all domestic flights that arrive at the scheduled time, calculated daily.

The method is how the characteristic is measured. This can include the gauge, the sensor, or the test equipment. It can also include the process or procedure that is used.

Here's an example. For each flight, the arrival time is the time at which the wheels touch down. If the arrival time is within five minutes of the scheduled arrival time, the flight is classified as on-time. Otherwise, the flight is classified as late. Notice that this definition might not be satisfying to the airline passenger, who is likely more interested in arriving at the gate on time.

The fourth element is the standard. The standard is the goal, target, or specifications for the measure. In the airline scenario, the specifications are the five-minute window from the scheduled arrival time.

After you develop your operational definition, you'll want to test the definition to make sure everyone agrees with it. You might need to modify the definition.

For example: You might need to be more specific and provide more details. Or you might need to determine a different method for measuring the characteristic.

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