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# Designing a Measurement System Study

To understand the sources of variation within a measurement system, we use many of the same tools used for exploring variation in a production process.

For example, when you develop a process map of the measurement process, you understand the steps involved, the inputs to the process, and the outputs.

A cause and effect diagram can also help you identify potential sources of variation in the measurements.

These and other problem-solving tools were introduced in the first module.

Together, they help you understand the characteristic that is measured, how often it's measured, who measures it, which gauges are used, where the measurement takes place, and what happens if the measurement is bad.

You use this information to plan and design your measurement system study.

For a simple example, let's say that the quality characteristic of interest is the diameter of metal bearings.

The diameter is measured by hand using micrometers.

The bearings have targets ranging in size from 4.0 cm to 5.5 cm.

Based on historical data, you know that there is too much variability in the diameters of the bearings. For example, the most popular bearing size in this range is 4.5 cm.

The specs are 4.35 to 4.65 cm. From a capability study, you learn that the process is barely capable, with a $C_p$ of 1.017 and a $C_{pk}$ of 0.975. The process is accurate, or unbiased, but there is too much variability relative to the spec limits.

You suspect that some of this variation is caused by the measurement system.

You study the measurement process, talk to the inspectors, and ask a lot of questions.

You learn that there is one micrometer that is generally used, and that different quality inspectors might take the measurements.

You use this information to guide the development of your measurement system study. We return to this example in future videos.

Now, let's consider a different measurement process. Suppose that you are the measurement instrument, and that the characteristic of interest is the area of a two-dimensional object.

You have been trained to visually estimate the area by eye and have a grid to help you with your estimation. The objects that you will measure are polygons with different shapes. In this example, the shape is a rectangle. The area is 8 units.

In the following activity, we conduct a measurement system study to test your capability as a measurement instrument.

You are presented with multiple objects of varying sizes and asked to estimate the area to the nearest 0.1 unit.

You then analyze the resulting data and compare your abilities to others who have performed this same task.

Now, let's go to the activity.

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*Statistical Thinking for Industrial Problem Solving*



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