Demo: Identifying Poorly Performing Processes

Hi, my name is Kevin White. I'm an industrial statistician with over 25 years experience applying statistical process control and process capability analysis type tools. In this module, you have learned some fundamental concepts that are important to industrial problem solving. The first of those has to do with understanding variation, and the definition of statistical thinking, in that variation exists in all processes.

And it's important to understand that variation for improvement. So it is very critical that we understand before embarking on any process improvement effort whether our process is stable, or one that has common cause variation only, or if it's an unstable process, one that has both common and special causes.

Because the way you would go about improving those processes is very different. For an unstable process, which has those special causes in addition to common cause, the question often is, what happened? We're trying to identify those assignable causes and remove those from our process.

For a stable process with common cause only, then it's a very subtle difference, but the question becomes -- "What happens? What happens all the time?" -- because there are going to be fundamental aspects of the process that need to be changed to make improvement.

You've also learned about control charts and how those are also a fundamental tool for evaluating process stability in the framework of industrial problem-solving. It's also worth reinforcing the concept of short-term standard deviation and long-term standard deviation and how this relates to common cause and special cause.

The goal when estimating the short-term standard deviation is to capture that common cause variability. But when we calculate the long-term standard deviation, it's going to capture both common and special causes, so that's an important distinction there.

We also will often look at a ratio of the long-term standard deviation to the short-term standard deviation. And we call this the stability index. If that stability index is equal to 1, that means the long-term standard deviation and the short-term standard deviation are the same, which that implies that there are no special causes, or we have a stable process.

When that stability index is larger than 1 -- and we will sometimes use a rule of thumb of 1.33 -- that is indicative that we have instability or special causes in our process that should be investigated. In this module, you also learned some important process capability indices and process performance indices.

The two that I like to use a lot -- one is P_{pk}, because I like to think of it as being the best indicator of my actual process performance because it utilizes the process average in its formula as well as the long-term standard deviation. Then I also like C_p.

I like to think of it as the best indicator of potential process performance, because it does not consider the process average, and it uses the short-term variation. So those two indices -- C_p will only match P_{pk} if my process is stable and on target.

If those two indices do not match, then I know that there is either a process stability issue or a potential target issue. Now, I'd like to talk just a few minutes about how we can utilize some of these indices together, especially in the context of when you've got numerous parameters that you're wanting to evaluate.

It could be very time consuming and confusing when you're trying to look at control charts and process capability analysis for many of these at the same time. And this is when the process and performance graph can come in handy. If you will recall, the process performance graph plots P_{pk} versus the stability index.

And so this graph is really nice at summarizing when you have lots of parameters to look at for improvement opportunities. I generally start in the lower part of the graph in the incapable and unstable region. That is where some of your biggest opportunities will fall. And you may also find some opportunities in the incapable and stable region.

The last thing I want to mention here is a flow chart that is related to evaluating many metrics or many parameters together. The flow chart starts with P_{pk}. Again, I mentioned earlier that that's the best indicator of my actual process performance.

And the reason I like to start there is because if my P_{pk} is poor, there's a good chance that I'm making product that is out of spec, which means I have scrap or I have rework, or maybe I'm selling that product for a lower cost. So those are going to be some of the highest-priority issues that I'm going to want to look at is when P_{pk} is poor.

So then if I think about if P_{pk} is poor, why is that the case? Well, there could be three reasons. The first reason being my process could be unstable. So that's when I like to look at the stability index. Another reason that I could be unstable is because I could be off target, and that's why I like to look at the target index.

And finally, a third reason would be that my process is just not capable from a common cause perspective. So that's why I like to look at C_p. So again, industrial problem solving -- it's very important to understand the nature of the problem, because it's going to have a strong influence on how you go about solving that problem.

And these four metrics together do a great job of not only telling you if there's a problem, but what is the nature of the problem? Is it that I'm unstable? Is it that I'm off target? Or is it that I've just got too much common cause variability?

In closing, I just want to say that this type of statistical thinking is fundamental to industrial problem solving. You must understand the type of problem, the nature of it, before you embark on any kind of improvement effort. And now that you have completed this module, you are better equipped to go solve industrial problems.