# Understanding Variation is Essential - Part 1

## COSTLY EFFECTS OF DEMING'S MISTAKE 1

In a post on a Linked In user group, one member asked the question, "What is variation?" One way to answer that question would be to suggest that there are two species of variation: controlled variation and uncontrolled variation (per Walter Shewhart); or common cause and special cause variation (per W. Edwards Deming). There are many, many – in some cases countless numbers of – common causes of variation at work in any process, no one of which will have a significant effect on the process output. On the other hand, there will be a lot fewer special causes of variation at work on any process, any one of which will have a significant effect – so significant that it will fall outside the limits we used the same values to calculate.[1]

### Controlled (Common Cause) Variation

If data plot in a random pattern over time, we can conclude that the source of the enemy is common causes of variation from within the process or system. Therefore, if we are not pleased with any discrete outcome, our corrective strategy is and must be to change the process. If we do not change the process that produced the failure, we will continue to experience the same failure in the future – at random.

One strategy for attacking common cause (or controlled) variation would be to form a cross-functional team and direct them to study the process and develop recommendations for changes to improve the process and thereby reduce the variation. The team must develop recommendations (plural) for changes (plural), because the source of the failure is common causes (plural) of variation. In other words, there will be no silver bullet fix (singular) for a process that's under the influence of controlled or common cause variation.

A higher-order strategy for attacking common cause variation is to apply Design of Experiments (DOE) methodology. DOE enables us to take a balanced, holistic, multi-variate approach to the problem. We must include multiple variables (plural) because we're up against the effects of multiple causes of variation. In other words, no more single-variable, one-factor-at-a-time (or OFAT) experiments – we're no longer in Sister Carmella's high school chemistry class!

**Uncontrolled (Special Cause) Variation**

If, on the other hand, the data plot in a non-random pattern, we reach a different conclusion. The outcome is under the influence of some special cause of variation from outside the process or system. No amount of work on the process will address a special cause because by its very nature a special cause is not a part of the system.

Another way to put it is that the process did not produce the failure! The corrective strategy in this case would be to take out a rifle, aim at that specific event, and take special action to find, remove, and prevent the re-occurrence of the special cause in the future. If we do not find, remove and prevent the re-occurrence of a special cause, it will come screaming in without warning in the future – unpredictable by its very nature – and defeat any efforts to improve the process.

**Understanding variation is essential.**

Dr. Deming insisted that failure to understand and differentiate between these two very different types of variation is a source of staggering waste throughout American industry. One example has to do with rising costs of malpractice insurance, not to mention the costs of settling malpractice lawsuits. Deming wrote,

> Every suit for malpractice in medicine, or in engineering or accounting, implicates the event to a special cause - somebody was at fault. Study with the aid of a bit of knowledge of variation leads to a different conclusion: the event could have come from the process itself. It could have been built in, guaranteed.[2]

Deming documented two costly mistakes people will make if they lack knowledge of theory of variation.

**Mistake 1.** To treat as a special cause any failure, problem, accident, complaint, breakdown, etc., that in fact was the result of common causes from within the process. This leads to tampering, not process improvement.

**Mistake 2.** To treat as a common cause of variation from within the process any problem, failure, breakdown, accident, complaint, etc., that was in fact due to some special cause from outside the process. We will examine the costly effects of Mistake 2 in a future blog. For now, let's consider the costs of Deming's Mistake 1.

**High Costs of Mistake 1**

Many companies' quality systems have institutionalized Deming's Mistake 1. Every customer complaint, every field failure, every internal non-conformance report requires formal corrective and preventative action (CAPA). A team or an individual is deployed to investigate the failure as a discrete event and then focus corrective action on that discrete event. Later, people are surprised when the failure occurs again in the future. ("I thought we fixed that!")

But what if the failure was the result of common causes of variation from within the process? In other words, there was no discrete, special cause of the event. In that case, the appropriate corrective strategy would have been to make changes to the process, to improve the process, so that the failure could not occur again in the future.

If a process is under the influence of common cause variation, engineers directed to investigate every failure and take action to correct it will end up tampering - not improving the process. In such a situation, Deming noted that the engineers were "confusing common causes with special causes. Every fault to them was a special cause, to track down, discover, and eliminate."[3] They ended up making things worse because they were so busy reacting to random events that there was no time or energy left to improve the process that was the source of the failures to begin with!

Outside a business or manufacturing setting, we can consider the staggering cost of Mistake 1 in American education. If we conclude that low-scoring students are in need of special help, we sort them out for tutoring or remediation. If we conclude that high-scoring students need more enrichment than others, we sort them out for the gifted and talented program. But the question is not whether or not the scores were different. The question is whether or not the scores were *significantly* different.

If the variation in test scores is random (i.e., not significantly different), then there's nothing special about the low-scoring and high-scoring students. Instead, the variation in test scores resulted from common causes of variation from within the teaching and learning process. Sorting, tracking, and grouping students do nothing to address the true source of the enemy – the process that generated the wide and/or unacceptable variation in test results. Thus, sorting the students is a wasteful form of tampering, not process improvement.

Sorting and tracking students in America's schools have made things worse. Over time, the slower students have gotten slower, median scores have dropped, and the fast students' scores have gotten lower, too. This phenomenon will be found in any objective review of SAT and other standardized test scores over time.[4] It's equally obvious in the seemingly endless waves of school reform, America 2000, No Child Left Behind, A Vision for Better Education, Common Core, and other programs that people keep throwing at America's declining test scores.

More tampering, the same mistake, no improvement. Absent guidance by knowledge of theory of variation, it keeps getting worse.

**Notes**

[1] J. F. Leonard, "Characteristics of Special Cause Variation," *www.jimleonardpi.com* (Jan 27, 2016).

[2] W. E. Deming, *The New Economics for Industry, Government, Education*, The MIT Press, Cambridge, MA (1994), p. 193.

[3] *Ibid*. p. 186.

[4] J. F. Leonard, *The New Philosophy for K-12 Education: A Deming Framework for Transforming America's Schools*, ASQ Quality Press, Milwaukee, WI (1996), p. 110.