BREAKTHROUGH
Lean Implementation & Training Resource Publication
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6σ ANALYZE PHASE

By Harold Chapman

IDENTIFYING TRUE ROOTS

In the previous issue in this series, we focused on the "M" in the DMAIC cycle for Six Sigma. We discussed the processes and tools used to MEAURE the output performance of the process. This month, we will focus on the "A" in the DMAIC cycle, which is the ANALYZE phase. In this phase, we will develop theories of root causes, confirm the theories with data, and finally identify the true root cause(s) of the problem. The true root cause(s) will form the basis for solutions in the next phase of the DMAIC cycle, which is the IMPROVE phase covered in our next newsletter.

There are many tools used in the ANALYZE phase, so it would not be practical to cover all of them in a newsletter format. We will focus on three of the most important or effective tools used instead. These tools are Design of Experiments (DOE), Hypothesis Testing and Regression Analysis.

TOP 3 EFFECTIVE TOOLS

1. Design of Experiments is an approach that effectively and efficiently explores the cause and effect relationship between numerous process variables (X's) and the output or process performance variable (Y).

- Identifies those vital few sources (X's) that have the highest contribution to variation in Y.
- Quantifies the effects of the important X's, including their interactions.
- Produces an equation that quantifies the relationship between X's and Y.

2. Hypothesis Testing is a procedure that summarizes data so one can detect differences among groups. It is used to make comparisons between 2 or more groups. Because of variation, no two things will be EXACTLY alike. The question is whether the differences you see between samples, groups, processes, etc. are due to random, common cause variation, or if there is a real difference.
To help us make this decision, various hypothesis tests provide ways of estimating common cause variation for different situations. Each test will indicate whether a difference is significantly bigger than the common cause variation we would expect for the situation. If the answer is "no", there is no statistical evidence of a difference. If the answer is "yes", we can conclude the groups are significantly different.

There are four types of Hypothesis Tests that can be used to compare data. The table below shows each test and its purpose:

Hypothesis Test	**Purpose**
T-Test	Compares two group averages.
Paired T-Test	Compares two group averages when data is matched.
Anova (F-Test, Analysis of Variance)	Compares two or more group averages. Compares two or more group variances.
Chi-Squared Test	Compares two or more group proportions.

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TOP 3 EFFECTIVE TOOLS, cont'd

3. Regression Analysis generates a line that quantifies the relationship between X and Y. The line, or regression equation, is represented by Y = B0 + B1X, where:

B0 = intercept (where the line crosses X = 0)
B1 = slope (rise over run, or change in Y per unit increase in X)

PREDICTIONS WITHIN RANGE

Once we establish the equation for X's effects on Y, we can make predictions on points that fall within our tested range. Trying to extrapolate outside of our tested range is like going from solid ground to thin ice, so it is not recommended. Always test the extremes of your concern area, so you don't get caught on thin ice.

By the end of the Analyze Phase, you will be able to show your sponsor which causes you will focus on during the IMPROVE phase by describing the following:

- Which potential causes you identified.
- Which potential causes you decided to investigate and why.
- Which data you collected to verify those causes.
- How you interpreted the data.

The next newsletter in this series will be focused on the "I" in the DMAIC cycle, which is the IMPROVE Phase. In the IMPROVE Phase, we get to implement our solutions and VERIFY that they are effective.

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