The goal of **DOE** is to determine the best factor settings that will produce the desired result of a process. You have control over the process settings and assume a direct cause and effect relationship between the control factors and the output results. This is in contrast to collecting or using data that has been generated in a different manner.

Sometime we have data available and can use regression analysis to develop a mathematical relationship. In DOE, we design the data collection process scientifically and generate data according to a plan. This way we can generate valid data and do it in an economical fashion. And the result again is a mathematical model of that is an estimate of the true relationship between the input factors and the output variable. The simplest relationship to consider is linear. However, sometimes a more complex model involving higher order polynomial terms is required. For our purposes here, we will work with a linear model.

For example, if there are three factors that control a given process we can adopt the notation:

y^ = b0 + b1x1 + b2x2 + b3x3 + b12x1x2 + b13x1x3 + b23x2x3 ,   where  x1, x2, x3  are the control factors and  y^ is the estimate of the response, and b0 , b1 , b2 , b3 , b12 , b13 , and b23 are constants.

**Required Readings**

This website provides an overview of DOE:

NIST (2006).Engineering Statistics Handbook retrieved on Sept. 9, 2009, from <http://www.itl.nist.gov/div898/handbook/pri/section1/pri11.htm>

As you can see, there are interactions among the variables, and that is an important feature of DOE.  One way to design and conduct experiments is to vary one factor at a time (OFAT) while holding the others constant.

Read the following paper, starting on page 7, with the section "Economic Trade Off". Then read the final two sections, Interactions and Summary. This will provide a detailed explanation of Interactions and why OFAT is not a good method:

Dowd, John S. (n.d.). The Rationale of Scientific Experimentation. Retreived on Sept. 9, 1009, from <http://www.jsdstat.com/Statblog/wp-includes/The%20rationale%20of%20Scientific%20Experimentation.pdf>

There are different reasons and different ways to use DOE, since it is a multi-purpose tool. This section of the online Engineering Statistics handbook provides some examples of different uses of DOE.

NIST (2006).Engineering Statistics Handbook retrieved on Sept. 9, 2009, from <http://www.itl.nist.gov/div898/handbook/pri/section1/pri12.htm>