



## TenStep Supplemental Paper

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### **Design of Experiments**

What do you do when many parameters influence the performance of a system or a process? The traditional way of finding the best possible solution/value is by trying out as many permutations of the parameters as possible using the trial and error method.

Design of Experiments (DOE) is a way to choose the best set of experimental values suitable or relevant to a specific working environment. The concept first emerged in 1919, when British statistician Sir Ronald A Fisher devised a strategy for systematic experimentation. This strategy, thanks to certain developments and modifications by Genichi Taguchi (the father of Experimental Design), is now universally known as Design of Experiments. DOE owes its popularity to the fact that it provides the best and most cost effective solutions to process and design problems.

DOE helps in understanding the entire working of a process and devising experiments that render a process efficient. DOE is one of the many problem-solving tools used to find significant factors in a process, determine the effects of each factor on the outcome, troubleshoot problems, select process or design parameters and model processes. In short, when applied appropriately, it can enhance both process and product quality.

### **Controlled Processes Yield High Quality Products.**

Many factors affect the performance of a process. To improve process performance, one has to identify and measure characteristics and attributes crucial to customers. Once this is done, experiments can be carried out to study the affect of variance in factors on the process.

The success of DOE depends on aspects such as precise planning of the experiment, identifying factors that affect process performance, practical application of the experiment, and teamwork.

Identifying the problem is most critical. Erroneous results will be generated if the problem is not diagnosed accurately. According to industrial gurus, this is the common reason for failure of most DOE projects. Furthermore, a successful DOE project also demands the enthusiastic involvement of everyone involved in it.

### **Why DOE?**

Today's competitive and customer driven markets demand high quality products and services at economical prices. In the past, organizations tried many methods to improve overall product quality - sometimes with little success. Improved quality and process performance can be achieved by effective decision-making, using process attributes along with precise and comprehensive measured data.

Quality is a touchy issue for most industries, and the drive to improve it is widespread. Moreover, because high quality demands precise planning of every minute operation, the



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need to improve quality comes with the need to optimize the huge amount of available data.

With so many variations in the available data, encompassing all combinations is impossible. Contrary to other common techniques, design of experiments (DOE) minimizes the number of experiments necessary for problem solving. DOE also helps reduce the variance of related variables, especially during failure.

Cost and quality are the basic elements of value. Thus, DOE is a powerful tool in designing for value. Through DOE, even a relatively inexperienced front-line engineer can easily arrive at reliable conclusions despite innumerable changing variables.

### **Brainstorming is the first step towards DOE.**

It plays an integral part in the design of effective experiments. This is because there is no precise or planned way to devise a DOE approach for the problem at hand. DOE depends entirely on the nature of the problem at hand, which can be determined by brainstorming.

- Is experimentation the only way to tackle the problem at hand?
- How well will experimentation simulate the customer's/user's conditions?
- How will roles and responsibilities be allocated on the project?
- What financial and human resources will be required for the project?
- What are the other factors and details of the experiment (i.e. number of levels)?

Every DOE project demands that the quality characteristic subjected to experimentation be accurately measurable. Accuracy is critical as it determines the outcome of the DOE project. Furthermore, these characteristics must relate to or influence the performance of the product and its quality.