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The Taguchi Method: Japan's Hidden Secret

An overlooked key to industrial success?

by Charles D. Carpenter

There may be a hidden factor that explains Japanese industrial success. While U.S. students of industry point to the cultural work ethic, the Japanese methods of management, the use of statistical process control, and the application of Just-In-Time manufacturing techniques, one key remains almost unnoticed: Genichi Tagughi's System of Experimental Design, which uses laboratory techniques to improve factory productivity.

Experimental design was developed in the 1920s by Sir Ronald A. Fisher of England. His techniques were first applied in agriculture. These "classical" techniques required modification to be applied in a complex industrial setting, and Taguchi has been the primary contributor to upgrading experimental design methods for use in industry and design applications.

Taguchi, an engineer, has developed a powerful way to help improve the quality of products while simultaneously lowering costs. Between 1950 and 1970 Taguchi's methods of experimental design were developed at the Electrical Communication Laboratories (ECL), the Japanese counterpart of Bell Laboratories.

A notable application of these techniques was the development of a switch relay device. In 1971, the ECL beat Bell Labs to market with this device, completing the project with one-fifth of Bell's personnel and one-fiftieth of its budget. Bell Labs invited Taguchi to explain his methods in 1972. A few years after the introduction of the switch relay, Western Electric stopped production of the device and now imports them solely from Nippon Telephone and Telegraph.

The Taguchi method is best described as an engineering tool with a statistical base. This approach is concerned with gains in productivity. Cost-effectiveness is stressed, rather than statistical strictness. In the world of manufacturing, the classical assumptions of a detailed hypothesis, normality, or homogeneity of variance are generally impractical.

In manufacturing, cost savings are realized by the reduction of scrap, lowering of inspection costs and minimizing rework losses. These savings are achieved through process improvements and variation reduction. Design cost savings are realized by reducing the delivery cycle and minimizing engineering design changes. Reducing total product cost is the ultimate goal.

Industrial experiments consist of three groups of key elements. First are factors such as time, temperature, and speed. Second are the levels for these factors, such as one minute versus two minutes, or 100 degrees versus 200 degrees. Third are the outcome or quality characteristic being evaluated. Selection of these elements is an important step in developing a well-designed experiment.

The experimental design process flows through the following steps:

1. Define problem.
2. Determine objective.
3. Brainstorm.
4. Design experiment.
5. Conduct experiment and collect data.
6. Analyze data.
7. Interpret results.
8. Verify predicted results.

These steps do not guarantee a successful experiment, but they do force the experimenter to proceed in a logical manner. All experiments conducted in this manner provide useful information, although about 20 percent of them require a second experiment to achieve the desired improvement. Designing a successful experiment requires a team of people familiar with the process or design. The members of the team contribute "a priori" knowledge, which helps to facilitate a well-designed experiment.

Taguchi's methods provide a means for minimizing the effect of factors we can't control, by controlling factors we can. Thus, the process or product is made "robust" in the face of uncontrollable factors. Taguchi calls these uncontrollables "noise factors." A noise factor causes definite variation, but can't be eliminated from the design or the manufacturing process.

The aim of the experimental method is to provide required information in a cost-effective manner for sound engineering decisions. Also, factors are identified which do not affect the quality of the process or product but which can provide additional cost savings. Reproducible results are the key strength of Taguchi's methods. These techniques can improve quality without incurring capital and material cost increases. An important benefit is the separation of the "vital few from the trivial many."

Industrial experiments have too many variables with different characteristics for the cost-effective use of the classical experiment methods. Taguchi has modified these methods for manufacturing and design applications for cost-effectiveness and efficiency.

Ford Motor Co. embraced Taguchi's methods in 1980 and formed the American Supplier Institute, where Taguchi is based, in 1981. Since that time, companies in many different industries, including ITT, Hewlett-Packard, 3M, AT&T, Texas Instruments and Sheller Globe, have begun to use these methods. □

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