

Problem Solving Using Designed Experiments

We can help you:

- Resolve your critical production and manufacturing problems?
- Reduce manufacturing and production process *variations, rework, and rejects*?
 - Improve *first time capability*?



The technical problems you experience are like leaky water faucets. Longer you postpone, more it hurts your bottom line. While many problems may be resolved by common problem solving disciplines, there are a few that require special techniques. Fortunately, the solution to most such engineering problems lies in the collective experience and skill of your technical professionals. So, why aren't such problems solved?

Many such problems do not have a single source. The solution, often, is obtainable by properly adjusting many factors that influence the outcome. To determine the solution, your project team needs to follow a proven structure of thought process and be guided by an experienced facilitator who can help them develop consensus on key technical inputs and confidently rely upon data-driven conclusions derived by conducting economically planned experiments.

We support your application effort from "cradle to grave". Whether you are interested in solving an immediate problem, or wish to optimize your product/process, our comprehensive consulting services will support you in the following three of the following 5 steps in your application.

Standardized Application Steps

PLAN – Experiment planning is the necessary first step in conducting experimental investigation. The problem solving team spends a day with experienced facilitator (consultant) to determine parameters and scopes of the study. **(WE DO)**

PRESCRIBE – Based on the discussions in the planning session, an experiment is designed. The prescription also includes individual test recipes and the data collection schemes. **(WE DO)**

PERFORM – Experiments are carried out as per the recipes and the results recorded. **(YOU DO)**

PREDICT – Results of the experiments are analyzed and the condition for best solution is identified. Improvement expected from the new solution is also estimated. **(WE DO)**

PROVE - The predicted solution is tested with additional tests and prediction confirmed before changes are incorporated. **(YOU DO)**

We provide you complete support to fix the problem.

- Work with your project team and facilitate planning session for experimental investigation.
- Lay out test plans and describe how to collect test results
- Analyze results of experiments and identify the most desirable design condition (optimum).

All you need to do is to carry out experiments as planned and confirm recommendations.

Principal Consultant's Background:

Ranjit K. Roy, Ph.D., P.E., PMP (Mechanical Engineering), is president of NUTEK, INC. Dr. Roy has achieved recognition as a consultant and trainer for his down to earth teaching style of Taguchi experimental design methods. He was employed with General Motors Corp. (1976 - 1987, Technical Center, Warren, Michigan, USA.) assuming various engineering responsibilities with his last position as that of Reliability Manager. While at GM, he consulted on a large number of documented Taguchi case studies of significant cost savings.

Support Cost Guidelines

Project Support – Fixed cost for a project

(Retainer) – Remote support through telephone and email on as needed basis. (Fixed annual cost)

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Our comprehensive consulting services supports you in the following three phases of your projects:

Phase-I Facilitate Experiment Planning Session

This is the most critical phase in the application process and is done on-site with the project team (generally a one-day session). Here our specialist will work with your project team and facilitate the experiment planning session. Your team members need to set aside the entire day to work with the consultant. The success of the study depends on identifying the appropriate factors for the project through an open and participative brainstorming session.

In most engineering projects, the desired **project objectives are generally more than one**. Usually these objectives are also measured in different units (say size, weight, surface finish, etc.) of measurements. How do you handle multiple objectives? How do you determine the project parameters that are not just the best for one objective, but better overall for all objectives? We will help you address your individual concerns by consensus weighting and show you a way to formulate an **Overall Evaluation Criteria (OEC)**, which is appropriate for your project objectives.

Details of services we provide:

- *Facilitate the brainstorming session*
- *Work with team and help identify and reduce experimental parameters by **CONSENSUS** decisions*
- *Establish performance evaluation criteria*
- *Establish scopes of the study (# of experiments, samples required)*

Phase-II Lay out Experimental Plan and Prescribe Data Collection Procedure

Work in this phase is generally done at Nutek. A successful planning session produces all information necessary to layout the experiment. The size of the experiment designed depends on the number of factors selected for the study and their levels chosen. Based on the designed experiment, individual trial conditions are described. These descriptions serve as the work order for each separate experiment setup (called the Trial condition). Along with the prescription for the experiment setups, the method of data collection is also described. (1 - 2 days at Nutek, 1 day on-site is optional. Written report provided)

Specific Services provided:

- *Design experiment*
- *Prescribe the recipe of each separate experiments to be conducted*
- *Establish the evaluation criteria*
- *Defined and the method of data collections, etc.*

[The project team follows the prescribed test recipes and completes tests. The team leader forwards the collected test results to Nutek for analysis.]

Phase-III Analyze Results and Report Findings

Results of experiments carried out contain a vast amount of information. But there are FOUR basic categories of information which even the smallest (L-4 experiment with 1 sample/trial) experiment can yield. Analysis of DOE results contain information such as: (1) Factor Influence (Factor average effect or Main effect), (2) Relative influence of the factors to the variation of results (**ANOVA**, which is short form for **Analysis of Variance**), (3) Optimum condition, and (4) Expected performance at the optimum condition. Other types of information like Confidence level, Significance tests; Confidence Interval (C.I.), Loss, etc. are easily obtained with slight additional effort.

For simple experiments, i.e., those with single objectives and one sample/trial condition, calculations are relatively straight forward. With multiple objectives and multiple samples in each trial condition, analysis can become complicated. (Time: 1-3 days at Nutek and 1 day with the project team. Report provided)

Specific Services provided:

- *Perform complete analysis*
- *Present the findings (formal report)*
- *Recommend the optimum design*
- *Predict the expected performance with confidence interval*
- *Establish relative influence of factors*
- *Determine interactions possibilities between factors*

Complete Project Support - Retain our services (All three phases of applications) for a fixed cost. The cost range between 15 - \$20K per project depending on the size of the experiment and analysis needs. This plan will include:

- *Experiment planning facilitation*
- *Experiment design (recipe of test and data collection scheme)*
- *Analysis of results and recommendation of optimum condition.*

Call or write us for more detail support information.

Nutec, Inc.

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