How do Classical Design-of-Experiments, the Taguchi Method, and the Shainin Red X Method differ.

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Classical design of experiment or DOE (1) is a structured approach to designing highly functional components and/or systems using a pre-defined test sequence called a matrix or array. In the test sequence, changes are made to the input variables, which in-turn affect component or system performance, as captured in the output response. The number of tests are balanced so that multiple variables may be changed simultaneously throughout the sequence; yet each variable is quantified independently. By performing response variable analysis with software, individual variable coefficients can be calculated, allowing the input and response variables to be correlated in a simplified predictive model.

Classical DOE allows the researcher to correlate system input variables and response variables into a simplified mathematical model. The major technical advantages of DOE over the one-factor-at-a-time (OFAT) method include: independent analysis of multiple factors changed throughout the experimental tests; the quantification of factor interactions; and hidden replication, the use of multiple individual tests to generate more accurate coefficient estimates.

The Taguchi method or Parameter Design (2) focuses on product robustness against uncontrollable influences, or noise. The method is designed to reduce variability, and optimize function or performance with the lowest cost components. Parameter Design is a modification of the classical DOE concept. The method applies two arrays, an inner for the main variables and the outer array for noise factors, in place of a single array in classical DOE. The strategy is to quantify the signal to noise interaction between the variable and noise factors, just as factor-to-factor interactions are quantified in classical DOE. Once determined, the more robust variable and variable levels are available to improve product design.

Parameter design focuses on the application of fractional factorial arrays in order to minimize the overall number of experiments. The justification for low resolution fractional arrays centers on the concept that factor interactions are minimized when a product displays 'ideal function', or efficient energy transformation. This point is often controversial among engineers and classical DOE proponents.

The Shainin Red X method (3) also is a modification of the classical DOE concept. The method focuses on identifying and ranking the causes for a given quality problem. The biggest cause is labeled the 'Red X', then the second most important cause for a given experimental series is called the 'Pink X', and the third most important cause is the 'Pale X'. This ranking method parallels the Pareto Concept or 80/20 Rule, the idea of identifying, and ultimately correcting, the 20% of variables that are causing 80% of the quality problem under investigation.

1. Montgomery, Douglas, Design and Analysis of Experiments, 5th edition, 2001.
2. Peace, G.S., Taguchi Methods: A Hands-On Approach to Quality Engineering, Addison-Wesley, 1993.
3. Bhote, Keki R., World Class Quality, AMACOM, 1991.