

# A USER'S GUIDE TO THE BRAVE NEW WORLD OF DESIGNING SIMULATION EXPERIMENTS

## Abstract

Many simulation practitioners can get more from their analyses by using the statistical theory on design of experiments (DOE) developed specifically for exploring computer models. In this paper, we discuss a toolkit of designs for simulators with limited DOE expertise who want to select a design and an appropriate analysis for their computational experiments. Furthermore, we provide a research agenda listing problems in the design of simulation experiments as opposed to real-world experiments that require more investigation. We consider three types of practical problems: (1) developing a basic understanding of a particular simulation model or system; (2) finding robust decisions or policies as opposed to so-called optimal solutions; and (3) comparing the merits of various decisions or policies. Our discussion emphasizes aspects that are typical for simulation, such as the much larger number of factors than in real-world experiments and the sequential nature of the data collection. Because the same problem type may be addressed through different design types, we discuss quality attributes of designs, such as the ease of design construction, the flexibility for analysis, and efficiency considerations. Moreover, the selection of the design type depends on the metamodel (response surface) that the analysts tentatively assume; for example, complicated metamodels require more simulation runs. We present several procedures for the validation of the metamodel estimated from a specific design, and provide a brief summary of a case study to illustrate several of our major themes. We conclude with a discussion of areas that merit more work in order to achieve the potential benefit either via new research or via incorporation into standard simulation or statistical software packages. A list with many references enables further study.

## Full citation:

Kleijnen, J. P. C., S. M. Sanchez, T. W. Lucas and T. M. Cioppa (2005), "A User's Guide to the Brave New World of Designing Simulation Experiments," *INFORMS Journal on Computing*, Vol. 17, No. 3, 27 pages.