A Conceptual Framework for the Design and Validation of Discrete-Event Simulations

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For every project anew, simulation practitioners have to specify the design features of a simulation model. At issue are: which type of performance measures to use, which way to validate the model, and, of course, the question if a steady-state simulation is appropriate in order to generate useful results. In resolving these issues, however, practitioners are left alone: with the exception of some casuistic approaches (Bratley/Fox/Schrage 1987, Hoover/Perry 1989, Law/Kelton 1991), there is no encompassing framework available which supports the classification of a system to be simulated.

Our argument is backed by two case studies. We present two real-life systems—a clinical laboratory and a data communication network—that show rather similar characteristics as to the life cycles of entities and the daily workloads. However, these two systems require rather different modelling approaches. While a steady-state approach lends itself to simulate the clinical laboratory, it does not in the case of the data network. Thus, a closer scrutiny shows that also practical considerations have to be incorporated into a classification scheme that establishes the link between the real-world system and the design issues.

Drawing on these experiences we propose a structured process that helps to identify the appropriate type of simulation model to be implemented. This structured process can be reduced to a three-dimensional framework that takes into account the following criteria:

- the stationarity properties of the simulated system,
- the time horizon of the real-life system compared to the time horizon of the simulation runs, and
- the research purpose.

This framework not only allows to meaningfully categorize simulation problems but also to assign the appropriate methods for tackling the start-up problem, collecting output data, implementing variance-reduction techniques, and validating the simulation model (cf. Liebl 1992).

References:

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 Hoover, S. V.; Perry, R. F.: Simulation – A Problem-Solving Approach; Reading, MA 1989
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