Chapter VII
Simulation in the Social Sciences

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ABSTRACT

Advancing the state of the art of simulation in the social sciences requires appreciating the unique value of simulation as a third way of doing science, in contrast to both induction and deduction. Simulation can be an effective tool for discovering surprising consequences of simple assumptions. This chapter offers advice for doing simulation research, focusing on the programming of a simulation model, analyzing the results, sharing the results, and replicating other people's simulations. Finally, suggestions are offered for building a community of social scientists who do simulation.

SIMULATION AS A YOUNG FIELD

Simulation is a young and rapidly growing field in the social sciences.[1] As in most young fields, the promise is greater than the proven accomplishments. The purpose of this chapter is to suggest what it will take for the field to become mature so that the potential contribution of simulation to the social sciences can be realized.

One indication of the youth of the field is the extent to which published work in simulation is very widely dispersed. Consider these observations from the *Social Science Citation Index* of 2002.

1. There were 77 articles with "simulation" in the title.[2] Clearly, simulation is an important field. But these 77 articles were scattered among 55 different journals. Moreover, only two of the 55 journals had more than two of these articles. The full set of journals that published articles with "simulation" in the title come from virtually all disciplines of the social sciences, including anthropology, business, economics, human evolution, environmental planning, law, information, organization theory, political science, and public policy. Searching by a keyword in the title is bound to locate only a fraction of the articles using simulation, but the dispersion of these articles does demonstrate one of the great strengths as well as one of the great weaknesses of this young field. The

strength of simulation is applicability in virtually all of the social sciences. The weakness of simulation is that it has little identity as a field in its own right.

2. To take another example, consider the articles published by the 26 authors of a colloquium on 'agent-based modeling' sponsored by the National Academy of Sciences (USA) and held October 4-6, 2001.[3] In 2002 they published 17 articles that were indexed by the *Social Science Citation Index*. These 17 articles were in 13 different journals. In fact, of the 26 authors, only two published in the same journal. While this dispersion shows how diverse the field really is, it also reinforces the earlier observation that simulation in the social sciences has no natural home.
3. As a final way of looking at the issue, consider citations to one of the classics of social science simulation, Thomas Schelling's *Micro Motives and Macrobehavior* (1978). This book was cited in 21 articles in 2002, but these articles were maximally dispersed among 21 different journals.

In sum, works using social science simulation, works by social scientists interested in simulation, and works citing social science simulation are all very widely dispersed throughout the journals. There is not yet as much concentration of articles in specialist journals as there is in other interdisciplinary fields such as the theory of games or the study of China.[4]

This chapter is organized as follows. The next section discusses the variety of purposes that simulation can serve, giving special emphasis to the discovery of new principles and relationships. After this, advice is offered for how to do research with simulation. Topics include programming a simulation model, analyzing the results, sharing the results with others, and replicating agent-based models. The final section suggests how to advance the art of simulation by fostering a community of social scientists (and others) who use computer simulation in their research.

THE VALUE OF SIMULATION

Let us begin with a definition of simulation: "Simulation means driving a model of a system with suitable inputs and observing the corresponding outputs"(Bratley, Fox, & Schrage 1987, p. ix). While this definition is useful, it does not suggest the diverse purposes to which simulation can be put. These purposes include: prediction, performance, training, entertainment, education, proof, and discovery.

1. **Prediction:** Simulation is able to take complicated inputs, process them by taking hypothesized mechanisms into account, and then generate their consequences as predictions. For example, if the goal is to predict interest rates in the economy three months into the future, simulation can be the best available technique.
2. **Performance:** Simulation can also be used to perform certain tasks. This is typically the domain of artificial intelligence. Tasks to be performed include medical diagnosis, speech recognition, and function optimization. To the extent that the artificial intelligence techniques mimic the way humans deal with these same tasks, the artificial intelligence method can be thought of as simulation of human perception, decision making, or social interaction. To the extent that the artificial intelligence techniques exploit the special strengths of digital computers, simulations of task environments can also help design new techniques.