

Chapter XIX

Using Varieties of Simulation Modeling for Criminal Justice System Analysis

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ABSTRACT

Criminal justice systems are complex. They are composed of several major subsystems, including the police, courts, and corrections, which are in turn composed of many minor subsystems. Predicting the response of a criminal justice system to change is often difficult. Mathematical modeling and computer simulation can serve as powerful tools for understanding and anticipating the behavior of a criminal justice system when something does change. The focus of this chapter is on three different approaches to modeling and simulating criminal justice systems: process modeling, discrete event simulation, and

system dynamics. Recent advances in these modeling techniques combined with recent large increases in computing power make it an ideal time to explore their application to criminal justice systems. This chapter reviews these three approaches to modeling and simulation and presents examples of their application to the British Columbia criminal justice system in order to highlight their usefulness in exploring different types of “what-if” scenarios and policy proposals.

INTRODUCTION

Computational criminology, a new and expanding field driven by the growth in the computational power available to criminological researchers, is opening many exciting avenues of research. The use of simulation modeling to understand, depict, predict, and conduct experiments on the patterns in criminal events is widely illustrated throughout the other chapters in this volume. Simulation modeling can also be used to understand, depict, and conduct policy experiments on the activities and operations of the criminal justice system. This is important because the criminal justice system is the social response through which crime patterns that cannot be prevented must be handled. This chapter explores some contemporary possibilities in the application of computer simulation to criminal justice system issues.

Common law criminal justice systems are composed of complex subsystems, such as police, courts, and corrections, operating in an interconnected yet autonomous fashion. These complex subsystems both contribute to and respond to operational fluctuations amongst their own elements, in other subsystems and across the system as a whole. Social systems structured in this way can be characterized as feedback systems in which system outputs affect the behavior of the system itself over time. Criminological analyses that focus on single components of the justice system are often unable to anticipate or account for the effects of feedbacks from their own operations or from changes in policy or operations in other subsystems. (Brantingham, 1977; Hann, Bailey,

& Ross, 1973; McAllister, Atchinson, & Jacobs, 1991). The complexity inherent in the criminal justice system means that policy decisions, such as legislative shifts towards harsher sentences for serious offences, often produce unintended consequences because distal parts of the total system, well-removed from the elements directly effected by the decision, adapt to change in unanticipated ways (Merritt, Fain, & Turner, 2006).

The purpose of this chapter is to show how advances in the application of mathematics in modeling, queuing theory and simulation can help both academic researchers and justice practitioners to emulate and predict the behavior of the justice system more effectively. Modeling and simulation are appropriate tools for analysis of criminal justice system behaviors because they make it possible to handle the uncertainty and variability inherent to complex system interactions with minimum resource expenditure (Harper, 2002; Lowery, 1998).

This chapter examines three different modeling and simulation approaches to the analysis of integrated justice systems: discrete event modeling (Schriber & Brunner, 2004: p142); process modeling (Baquette, 2003); and, system dynamics (Homer & Hirsch, 2006)¹. Future research may include multi-agent based simulations (MABS) and distributed artificial intelligence models (DAI). In the sections that follow, we discuss the concept of an “Integrated Justice System” as reflected in the law and practice of Canada², provide an introduction to mathematical modeling and simulation of complex systems, and provide initial reports of three different simulation models of the British Columbia criminal justice system.

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