System Dynamics Based Learning Environments: A New Type of Decision Support Technology for Public Sector Management

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INTRODUCTION

Managing a public sector organization is a highly complex task involving multiple stakeholders coupled with informational and resource material flows. Decision making in such complex tasks, for example heath-care system, presents challenges. On one hand, the complexity of public sector organizations does not lend itself well to real-world trial and error approach. Practical, political, and/or ethical constraints often restrict any experimentation with many real-world phenomena such as medical decision-making, hazard-waste management, climate change, and so forth. On the other hand, most of the real-world "decisions and their consequences" are hardly related in both time and space, which makes learning even harder to occur (Hogarth, 1981; Sterman, 1989).

Recent advancements in computer technology, together with developments in system dynamics simulation methods, provide a potential solution that involves design and development of the decision support systems to aid decision making in complex public sector systems (Qudrat-Ullah, 2005). In this paper we argue that system-dynamics-based interactive learning environments (SDILEs) could serve as an effective decision support system for public sector management.

BACKGROUND

The term ILE (interactive learning environment) refers to the computer-simulation-based decision support systems aimed at improving users' decision-making capabilities. In an ILE, the learning goals are clearly made explicit to the decision makers. Therefore, the computer games played for fun will not count as ILEs. An ILE consists of three components: (i) a computer simulation model to adequately represent the domain or issue on hand (Davidsen, 2000; Homer and Hirsch, 2006; Kriz, 2003), (ii) a user interface capable of allowing the decision makers to make decisions and access the feedback on interactive basis, (iii) a human facilitator or coach responsible for conducting a debriefing session (Davidsen, 1996, 2000; Davidsen and Spector, 1997; Ledrman, 1992). When an ILE's underlying simulation model is based on system dynamics methodology (Forrester, 1961) we term that ILE as SDILE. Some popular SDILEs are People Express (Sterman, 1988), FishBankILE (Qudrat-Ullah, Saleh, & Bahaa, 1997) and Healthcare Microworld (Hirsch, Immediato, & Kemeny, 1997).

DECISION MAKING AND LEARNING WITH SDILE

The Role of a System Dynamics Simulation Model

The core of SDILE is a system-dynamics-based simulation model. System-dynamics-based simulation models have strengths to map (i) the multiple stakeholders' interests, (ii) available but limited resources, and (iii) decisions at different levels in the organization, a general characterization of most of the task systems (e.g., health care system, education system, energy system, etc.) in the public sector. The key capabilities of a system dynamics model are:

- Over time feedback processes and interaction between the system variables in and across various functional entities (e.g., human resource, demand sector, supply sector, financials, etc.) are explicitly represented. (see examples in the work of Bunn and Dyner (1996) and/or Qudrat-Ullah (2005a)).

- Both physical (e.g., equipment, machines, infrastructure, etc.) as well as non-physical resources (e.g., knowledge and know-how, moral of employee, satisfaction level, etc.) are distinguished and explicitly modeled. (see examples in the work of Bunn and Dyner (1996) and/or Qudrat-Ullah (2005a)).
- Delays and distortions in real-world public policy decisions and their outcomes are clearly represented. (see examples in the work of Bunn and Dyner (1996) and/or Qudrat-Ullah (2005a)).

Learning begins to happen during model building process itself: decisions and policies are represented through the consultation with the actual decision makers and the organization logs and data. Once a simulation model is built to adequately represent the real task system then it is subjected to both structural

Figure 1: The "Decision Panel" of FishBankILE