Understanding the Legacy of Herbert Simon to Decision Support Systems[1]

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INTRODUCTION

Herbert Simon is unique in our discipline in terms of the far-reaching impact which his work has had on management and the understanding of managerial decision making, especially when his further work with James March is considered. Mintzberg himself, who considerably advanced our ideas on management practice, noted that he always considered Simon to be the most influential and important contemporary author in terms of organizational theory (1990, p. 94). Jared Cohon, president of Carnegie Mellon University, where Simon was a fixture for 52 years said "few if any scientists and scholars around the world have had as great an influence as had Simon across so many fields, economics, computer science, psychology, and artificial intelligence amongst them."

Indeed, Herbert Simon's contribution to management and DSS is such that the science and practice of management and decision making has been durably changed under his influence. This article considers the new ideas brought by Simon in management theory and looks at his contribution to our understanding of managerial decision making and DSSs.

BACKGROUND

Early in his career, Simon entered the city government in the town of Milwaukee. From the observations gathered during these years and from his teaching and lecturing at the University of Chicago, Simon formed the project to set up the basis for a science of management, a science that would be as falsifiable as the other sciences, though he did recognize that he was only at the very beginning of this ambitious project (Simon, 1947).

Taylor (1911) published his book *The Principles of Scientific Management* on improving the effectiveness of production processes and the role of human labor in the elementary operations in production. Simon confessed to his attraction for Taylor's ideas and it was no coincidence that Simon's book on the support of management with computer systems was entitled *The New Science of Management Decision.* In the preface to the 1977 edition, Simon (1977, p. x) actually wrote "The computer and the new decision-making techniques associated with it are bringing changes to white-collar, executive, and professional work as momentous as those that the introduction of machinery has brought to manual jobs."

Simon's basic idea, as expressed in "*Administrative Behavior*," is that managers must primarily be viewed as decision makers (Simon, 1977, p. 39). This is charted in the book with March (1993, p. 3) : "The central unifying construct of the present book is not hierarchy but decision making, and the flow of information within organizations that instructs, informs, and supports decision making processes." This became the unifying thread in Simon's future work on decision making and Simon described himself (Simon, 1991, p. xvii) as somebody "who has devoted his scientific career to understanding human choice." Thus, Simon's ambitious program was to understand organizations and their management as an aggregate of human choices, based on the real behavior of people.

Pre Simon, the dominant models for explaining decision making involved maximizing a utility function under constraints, following von Neumann and Morgenstern's (1944) game theory and the theory of markets and supply-demand equilibrium, as illustrated in the work of Pareto, Edgeworth, Walras, and von Neumann. But as Simon observed (1997), markets tell us nothing about organizations and firms, and in particular, economic theory tells us nothing about the technology underlying production, nor of the motivations that inspire the decisions of managers and

employees or the process that leads to "optimal decisions." The theory is not concerned with how those involved acquire the necessary information, how they perform their calculations, or more importantly still whether they are capable of correctly evaluating the consequences of each decision as postulated by the maximization of utility.

A key consequence of Simon's observations and ideas is that decisions and the actions that follow them cannot easily be distinguished. Thus, decision support systems should primarily be geared as models for action, but action in an organization is a cascade at intertwined subactions and consequently DSS design must accommodate human reasoning at a variety of levels, from the strategic level to the lowest level of granularity of action decided by managers. However, we believe that this has not been applied in the practice of DSS development, and that DSSs have focused on high level decision making (strategic decision) but using low levels of representation (data, equation, etc.) because (1) the notion of representation level has not been sufficiently studied and (2) high level decisions are more appealing than low level decisions (Humphreys & Berkeley, 1985; Pomerol & Adam, 2003b).

THE DECISION PROCESS

To deal scientifically with decision, Simon knew that distinguishing between facts and values (1947, 1997) was of utmost importance. Facts are what can be verified or falsified, whereas values are the objectives of the decision maker and, beyond this, his wishes. Thus, we can only evaluate a decision if we know the objectives of the decision maker. This notion, reminiscent of the idea of aspiration level introduced by Dembo (Lewin, Dembo, Festinger, & Sears, 1944), was adopted by Simon and became an important feature of his "heuristic" search. Many interactive methods in decision making rely on the notion of local adjustments according to the level of satisfaction reached at every given step. This is a basic tenet of "bounded rationality" (Selten, 2002) and, to evaluate the quality of a decision, researchers must know the utility of the decision maker and understand what he or she expects in terms of the probabilities of future events.

Towards a Model of the Decision Making Process

Simon observed that the problems that trigger decisions are not factual data but constructs. In his own words, "problems do not come to the administrators carefully wrapped in bundles with the value elements and the factual elements neatly sorted" (Simon, 1997, p.77). Second, he observed that decision "is a matter of compromise" (Simon, 1997, p.77) as all decision makers have contradictory objectives in mind. This is an early introduction of the multicriterion aspect of decision making in the discipline.

Based on these observations, Simon (1997, p. 77) laid the foundations for his seminal model of decision making, which breaks down decision making as follows: identify all the possible alternatives, determine all the possible consequences of these alternatives, and evaluate all the possible consequences. Simon was clearly interested in the mechanics of the decision making process, in particular how a decision maker evaluates all the consequences and compares them with each other. This is a central problem in any decision process in that evaluating consequences requires that managers have a complete knowledge of all future events and their probabilities.

In his discussion of the model, Simon emphasises *attention*, *information,* and *stress*. Given the limited cognitive capacity of humans, attention is a resource which plays an important part in decision making. Cognitive limitations also play a substantial role in the concept of bounded rationality in that, as Simon stressed, they preclude the exhaustive study of all of alternatives and their consequences. This led Simon to present his famous four phases (Simon, 1977): intelligence, design, choice, review.

The role of information and attention is particularly fundamental in the first two phases of decision making because managers can only choose between alternatives that they know about and that they are able to document. As Simon pointed out, information acts as a constraint on decision. This role of information is often a source of weakness in DSSs, because many designers emphasize the models they build into their systems rather than the significance of the information fed into them.

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