

PROFESSIONAL ETHICS and SIMULATION

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The increasing use of simulation studies as adjuncts to decision-making imposes an increasing responsibility on the part of modelers and analysts to determine and disclose to the decision-maker the extent to which information derived from the studies is valid and applicable to the decision of interest. This raises ethical problems concerning the selection of input data and the professional judgment of the modeler and analyst as well. These problems involve the selection of data, the modeler's interpretation of the dynamics of the system modeled, and his or the analyst's interpretation of the results. Such situations put a severe strain on the professional ethics of all involved. This paper discusses the problem and offers suggestions as to how it might be alleviated.

Throughout my professional career I have been concerned with improving communications, first among my engineering colleagues in the aerospace industry by founding the Simulation Council (now the Society for Computer Simulation) and, with the help of my wife Suzette, publishing a newsletter for the benefit of those unable to attend the Council meetings.

Early in my simulation experience I came to realize the difficulties of interdisciplinary communication; I found that not only were many words and terms used by people in other disciplines unfamiliar, but -- more disconcerting -- some had different meanings. Thus certain assumptions taken for granted by the engineer were not necessarily accepted by people trained in other disciplines. It also became apparent that in some fields, especially those relating to the problems of society, there were times when no one knew for certain what was going on in the real world.

Therefore the modeling of many systems has proved more difficult than modeling the guided missile systems with which I originally worked. The characteristics of missile components are known, or can be ascertained. In physiological, sociological, and many other systems the investigator is forced to deal with "soft data."

In 1969 I published (Simulation, July 1969) a "Statement of Personal Beliefs" in which I expressed my growing concern for the future of mankind and my intention of applying the techno-

logy of simulation to help alleviate the problems of society.

It hasn't been easy. Among other things I have felt grave concern over the lack of acceptance of the results of modeling and simulation. In a time of increasing complexity of life, when decision-makers need all the help they can get, the very powerful tool of modeling is sometimes not used, or is misused, or the results of modeling, once obtained, are not acted upon. In an effort to clarify and improve the situation a colleague and I co-organized a Workshop on Model Acceptance of some 30 skilled practitioners in the field.

The results of the Workshop, together with related opinions of others who were unable to attend, were reported in my book Computer Modeling and Simulation: Principles of Good Practice (Society for Computer Simulation, 1982). Among the major problem areas identified were soft data and conflicting standards of ethical behavior. The subject of ethics was brought up again and again, but was always dropped because, by common agreement, it was too big, too important, and too complicated to be dealt with at the Workshop. Now, however, I have a National Science Foundation/National Endowment for the Humanities-funded project designed to study and, I hope, alleviate the ethical problem.

In the broadest sense the ethical problem of concern is the basing of decisions on questionable information. However, as this is such an all-pervading question it can best be studied in

a more limited context. The area of primary interest to me, and the focus of my study under the grant, is the use of "soft" data in the development of computer models, especially if they are to be used as tools for decision-making. This, of course, is considered of particular importance in the political arena because such decisions can profoundly affect our future.

In my study "soft data" will be taken to mean any information bearing on a decision that is, for example: difficult to quantify; obtained from questionable sources; generated by other than rigorous procedures; or that has significantly different values when obtained from different sources; changes with time in unpredictable ways; is not applicable to the ethnic group targeted; may be skewed by the paradigm of the collector or user.

Computer modeling, as defined in my book, is the programming of a computer to behave dynamically in a way analogous to a real or postulated system of interest. Simulation is the use of a model to study and perform experiments which, by inference, will predict the behavior of the system modeled -- the simuland -- under similar conditions. All of the thirteen steps listed in the book as required for competent modeling, and the five listed for simulation, involve choices, and these choices will be based on human value systems. Thus the process is rife with questions that must be answered, and should be answered ethically.

Leo Kadanoff in "An Examination of Forrester's 'Urban Dynamics'" (*Simulation*, June 1971) makes the point that an alternative method of evaluating the results of the Urban Dynamics model's output "leads to quite different conclusions from those reached by Forrester." If the method of evaluating the results of a study can change the conclusions, then surely the choices involved in modeling and simulation, who makes them, and under what influences, raises important ethical questions.

Modelers choose data and make assumptions. Simulationists design experiments and analysts interpret the results. Politicians, industrialists and others use the end product as an aid to the making of decisions that shape our lives. And all are influenced by their own sense of values and the ethics of applying them. Small shadings of facts at any step can make large differences in the final decisions.

This is brought out repeatedly in *Models of Doom* (H.S.D. Cole, et al., New York: Universe Books, 1973), a critique by a University of Sussex group of World 3, the model upon which the controversial book *The Limits to Growth* was based. "It is essential to look at the political bias and the values implicitly or explicitly present in any study of social systems. The apparent detached neutrality of a computer model is as illusory as it is persuasive. Any model of any social system necessarily involves assumptions about the workings of that system, and these assumptions are necessarily coloured by the attitudes and values of the individual or groups concerned." "If the sum of the annual rates of increase of resource discovery, or recycling, and of economy of use in industry add up to more than around 2%,

then the resource mode of collapse in World 3 will be avoided." "The assumptions about the physical limits of the critical variables in the agricultural sub-system of World 3 are pessimistic. By making more optimistic but, on the basis of available information, equally plausible assumptions about them, any physical limits to agricultural production recede beyond the time horizon of the model." "World 3 as a whole is very sensitive to relatively small changes in the industrial output/capital ratio and other economic relationships which are assumed, with very little empirical justification, to be constants. Relatively small changes to this ratio can prevent any economic growth occurring or, at the other extreme, lead to collapse . . ." "Relationships which are unimportant in some circumstances may become critical in others."

The problem of ethics in the use of soft data and the interpretation of the results is certainly not confined to the modeling of social or any other particular kind of system. Politicians have commissioned simulation studies, then refused to accept results other than those they wanted to hear; and environmental factions have used models to support opposing points of view.

There are two important facets to the problem of obtaining more dependable results from computer-based simulations of real-world systems or situations which involve soft data. Obviously one is to develop and use techniques for "firming up" the soft data; the other is to adhere to ethical guidelines when the firming-up process is inadequate and soft data must be used.

Project MAC (Methodology, Acceptance, and Credibility), an SCS project of which I am director, is giving attention to the first facet of the problem, that of data improvement. My work under the NSF/NEH grant will, therefore, be concerned solely with the problem of the ethical use of data known to be questionable.

I believe that in this connection, adherence to ethical guidelines is an important factor. But computer modeling and simulation constitute a relatively new field, and no ethical parameters formulated especially for their practice have yet been established. The objective of the NSF/NEH project will be to develop, disseminate, and promote the use of guidelines covering, but not limited to, the use of soft data in computer modeling, simulation, and decision-making.

Formally setting forth such principles of ethical practice is necessary to improve respect for the profession of modeling and simulation; professional societies cannot argue convincingly for individual responsibility if their members do not have training, knowledge, and concern about ethical issues. I am familiar with rules of good practice, which involve ethics, in the fields of science and engineering, e.g. the Canons of Ethics for Engineers and Rules of Professional Conduct. However, these are not directly applicable to the ethical problems with which I am currently concerned.

The central objective of my work will be the formulation of guidelines for the ethical development and use of models and simulation, and of the results of simulation studies. And these

guidelines must be developed for use by people. For people will always be involved, either as components of the simuland, or as those who will use the results of a simulation study as aids to decision-making -- and those who may be influenced by the decisions.

In the last analysis, people are the beneficiaries -- or otherwise -- of all simulation studies. Ethics dictates the relationships among people. One need not be a philosopher to realize this, but a knowledge of the principles of philosophy and metaphysics, formal or otherwise, underlies our formation and application of ethical principles.

I hope that a primary result of my work will be an infusion of ideas and values from the humanities into the procedures and practices related to the development and use of computer modeling and simulation. This I consider to be extremely important where the results of such work are to be used as inputs for decision-making in all fields, and especially in societal areas where the outcome can influence our global future.

It would be premature for me to offer here any of the incomplete results of my study to date; the foregoing is only a statement of the problem. It is presented in the hope that others can and will help me to press for solutions by offering suggestions and/or anecdotes, based on their own experience. These inputs, together with others developed during my study, will allow me to complete my project by the end of July '84, and prepare a final report which I hope to present at the Winter Simulation Conference '84.

Please send comments to

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