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## INTRODUCTION

An effective and successful multi-purpose classroom experience was developed using an intentionally mis-designed simulation model.

Our design philosophy, of intentionally misrepresenting reality with a simulation model, was completely counter to the maxims and precepts to be found in standard reference texts:<sup>1,2</sup> make the model as analogous as possible to reality, within time and money constraints, and with regard to the need for parsimony. Our motives in misdesigning the model were to educate a class of managers: the potential usefulness of simulation models, how to detect inadequate simulation models, and effective ways of using consultants.

## STRUCTURE OF THE PEDAGOGICAL SITUATION

The class was comprised of a group of 25 middle managers from a single company participating in an executive development seminar which covered a wide range of topics related to contemporary management. During the early sessions of the operations research part of the seminar, the class was introduced to some techniques of operations research (P.E.R.T., Linear Programming, etc.). After this initial preparation, the instructor<sup>3</sup> for the operations research sessions distributed the Sterling Paper Bag Company Case<sup>4</sup> (SPBC) to the class. He instructed the class to assume the role of the firm's executives to be responsible for the resolution of apparent problems associated with the case. He indicated that, at the next session, a pair of operations research consultants (the authors) would make a proposal to the firm for analysis and resolution of the firm's problems.

Prior to our introduction as the operations research consultants, the authors of this paper had no contacts with the class. The first session with the class (firm) was devoted to our presentation of a proposed methodology for analysis of the firm's problem areas, a methodology centered about a deterministic simulation model which would be constructed for the firm. An agreement was reached as to the scope of the consultants' tasks and responsibilities. Two subsequent sessions with the firm consisted of presentations of the work agreed upon, and interaction between

the consultants and the firm over the status of current work and potential modifications of the agreement. The last of these sessions involved a final presentation of our work and a post hoc analysis of the interaction between the consultants and the firm.

## STRUCTURING THE SIMULATION MODEL

During the initial session with the class (firm) the short range and long range problems of the firm were presented, as seen by the consultants. From this presentation it was agreed that the consultants would be employed to consider the short range problems only. Using a simulation model as a vehicle, the consultants were to consider five alternative policies for the firm over a ten year horizon.

The simulation model was developed by the consultants for the class (firm). It was a deterministic cash flows simulation of SPBC.

## THE CLASS INTERACTION PROCESS

The simulation model building process was a vicarious experience for the class. The consultants performed the model building and presented the resulting model to the class. The assumptions associated with this model were carefully and explicitly detailed for the class.

Following the presentation of the model, the preliminary results of the simulation for some of the alternative course of action were presented and discussed. Specific errors had been intentionally made in the operational version of the simulation model. In particular, the increases in costs, prices, and demand over the horizon were computed in a compounded fashion instead of the intended simple linear manner. Also, the fixed costs of manufacturing were improperly computed for certain alternatives. During the discussion of the results, the class became aware of the errors and were unwilling to accept the consultants' opinion that the errors were minor and did not dramatically affect the results. The class demanded that the consultants correct these errors to allow for accurate comparison of the alternatives. It is virtually certain that these managers will encounter later in their careers

an unintentionally misdesigned simulation. If they are not wary, experienced, and appropriately skeptical, they may regard these nonanalogous models as adequate for their decision making purposes.

The final meeting between the class and the consultants was segmented into two parts. The first part dealt with the substantive issues of the best alternative course of action for SPBC and the results of the simulation experiments, including an agreed upon sensitivity analysis. For the remaining portion of this session the consultants stepped out of their roles as consultants to discuss with the class the interaction process that had occurred between the class and the consultants. This discussion dealt with the successes and failures of both parties during the sessions and arrived at recommended procedures for subsequent interaction on the part of the managers with any consulting group.

#### THE VALUES OF THE INTENTIONALLY MIS-DESIGNED SIMULATION

The introduction of simulation modeling and its attendant problems in the artificial consultant-firm environment provided a convenient vehicle for participative learning. The intent was not to develop the model building skills of the class. Rather, the intent was to develop awareness of the uses of simulation and a healthy skepticism, appropriate for managers, toward the issues of verification and validation.

The issues of verification and validation of a simulation model were brought into sharp focus through the consultant-firm environment. By reviewing the calculation and the assumptions of the model with the errors obviously present, the consultants forced the class to point out the errors and demand their correction.

The problem of validation of the simulation was initiated by the consultants' concern with the critical assumptions incorporated in the model, indicated in the previous section. The class agreed with the existence of the problem. Once again healthy skepticism about the absolute usefulness of the results was developed. It is noteworthy that this skepticism was appropriately directed toward simulation methodology and not toward the consultants.

The second major benefit of the experience was the interaction of the class with the consultants in a managerial setting. During the sessions there were several occasions when the consultants were successful at inappropriately exerting power over the class (firm).

#### SUCCESS OF THE APPROACH

The success of this mis-designed simulation model approach can be measured in two ways:

- 1) The pedagogical effectiveness of the actual learning experience.
- 2) The retention and use by the members of the class of the concepts presented during the experience.

The pedagogical effectiveness was demonstrated by a follow-up evaluation of all instructors in the seminar series by the participants. Each of the nine segments of the series were rated as to subject matter and instructor(s) effectiveness on a ten point scale. In both categories the operations research segment was rated the highest.

This result corroborates the information obtained by the authors immediately after the close of the series where several of the participants reported to us that the "experience was 'eye opening'"; "had great shock value"; "should influence the manner in which I deal with consultants subsequently."

It would be pleasant to report that a significant beneficial change in behavior occurred in each of the participants as a result of this approach. Unfortunately, it was impossible to follow-up on each person's retention and use of the concepts. In one case, however, a subsequent professional contact, by one of the authors, did demonstrate useful change. This participant indicated that he was effectively employing the client-consultant rules developed during the experience with consultants who were external to his firm and with consultants from other divisions of his firm (in particular the operations research group).

From these data we conclude that this approach, of intentionally mis-designing a computer simulation model, was successful.

#### BIBLIOGRAPHY

1. Emshoff, James R. and Sisson, Roger L., Design and Use of Computer Simulation Models, Macmillan, 1970.
2. Naylor, Thomas H., Balintfy, Joseph L., Burdick, Donald S. and Chu, Kong, Computer Simulation Techniques, Wiley, 1966.
3. Professor Lawrence A. Sherr, School of Business, University of Kansas.
4. "Sterling Paper Bag Company (A)," ICH 13C133, Intercollegiate Case Clearing House, Harvard Business School, Boston, 1966.