Maintaining the Cutting Edge

Proceedings of the American Agricultural Economics Association Extension Workshop

July 31, 1987 - August 1, 1987

East Lansing, Michigan

Editors: Cara L. Mitchell
Kim B. Anderson

Produced at Oklahoma State University

Additional funding provided by Agriculture-Agribusiness Program, Oklahoma Cooperative Extension Service,

COOP-SIM: A DECISION SUPPORT SYSTEM FOR COOPERATIVE GRAIN ELEVATORS

David W. Park and Elton Li*

This paper describes COOP-SIM, a decision support system (DSS) for cooperative grain elevators. The concept of decision support systems and their application to the decision environment of cooperative grain elevator managers is presented, the objectives of the COOP-SIM DSS project are summarized, the COOP-SIM development process is discussed, and the benefits of the integration of expert systems into COOP-SIM are examined.

Decision support systems (DSS) represent one area in which information technology is influencing the way managerial decisions are made. Designed for use by managers, the primary objective of these computer-based information processing systems is to improve the overall effectiveness of managers in planning, organizing, directing, and controlling the activities of the firm.

COOP-SIM is a DSS designed for cooperative grain elevators and is being developed jointly by the Agricultural Cooperative Service, USDA and Oklahoma State University. The system is currently in the development stage and is scheduled to be released during the spring of 1988.

The objectives of this paper are to: 1) present the concept of decision support systems and their application to the decision environment of cooperative grain elevator managers, 2) summarize the objectives of the COOP-SIM decision support system project, 3) discuss the process followed in developing COOP-SIM, and 4) examine artificial intelligence and expert systems in relation to COOP-SIM.

Primary emphasis is placed on a discussion of the COOP-SIM DSS development process which consists of analysis, design, construction, and implementation activities. The intent is not to provide a comprehensive review of DSS literature but rather introduce the COOP-SIM project and identify an appropriate approach to developing agribusiness DSS applications.

---

*Authors are assistant professor and visiting assistant professor, Department of Agricultural Economics, Oklahoma State University.

THE DSS CONCEPT AND COOP-SIM

A DSS is defined as an interactive computer information system coupled with decision making software models that can be readily accessed by managers to enhance problem solving and analysis. A DSS does not replace but rather supports managerial judgments and is: 1) aimed at less well-structured, underspecified problems; 2) attempts to combine the use of models or analytical techniques with traditional data access and retrieval functions; 3) focuses on user-friendly, interactive features; and 4) emphasizes flexibility and adaptability to accommodate changes in the environment and decision making approach of the user (Sprague).

The primary objective of COOP-SIM is to provide a means by which managers of cooperative grain elevators may tackle a number of alternative management decisions. The following is a brief description of performance objectives, technical abilities, and underlying technology of COOP-SIM.

Performance Objectives

The principal performance objective of COOP-SIM is to assist managers of cooperative grain elevators in decision making activities. While difficult to measure, the success of the project depends on the effectiveness of the DSS in helping managers improving firm performance. Common DSS characteristics (i.e.; the combination of models or analytical techniques with traditional data access and retrieval functions; application of user-friendly, interactive features; and model flexibility and adaptability) are incorporated into COOP-SIM.

Technical Abilities

The COOP-SIM design separates data from model specifications. Specifically, users can apply the same data to alternative models and, thereby, explore a wide range of alternatives with only minor efforts on the part of the manager. Moreover, the ability to create new models quickly and easily, catalog and maintain a wide range of models, and manage the model base is characteristic of COOP-SIM.

Underlying Technology

COOP-SIM takes full advantage of hardware and software technology. COOP-SIM is developed for an IBM PC/AT (or compatible) equipped with high resolution (EGA) color graphics. The system is programmed in the C language and the user interface consists of: 1) pull-down hierarchical menus, 2) a spreadsheet format for data viewing and input, 3) special function keys to simplify common commands,

4) modeling notes attached to cells to assist in analyzing assumptions, and 5) context-sensitive help facilities.

COOP-SIM DEVELOPMENT PROCESS

The development process consists of four stages: analysis, design, construction, and implementation (Figure 1). The stages of the process are interrelated since, for example, design is based on analysis, construction is based on design, and implementation is contingent on construction. At any point in the development process, it may be necessary to return to a previous stage(s). A discussion of each stage in the COOP-SIM development process follows.

Analysis

The analysis stage focuses on the identification of user characteristics and the decision environment.

User characteristics. Based on a recent survey of cooperative grain elevators, on average, managers had 13 and 5 years experience as general manager and assistant manager or foreman, respectively. Formal management education consisted of 2 years of trade school or college. During the past 2 years, managers attended 13 days of management seminars (such programs often focused on short-term topics rather than on long-term educational concerns). In interviews, few managers indicated any significant amount of computer experience. A number of managers expressed reluctance to obtain the requisite computer skills to perform even the most elementary analyses.

Decision environment. The decision environment is characterized by uncertainty. In fact, uncertainty is often used as a justification for the lack of adequate planning. Types of analysis conducted by managers include, but are not limited to: 1) sales and profit margin analysis; 2) cost analysis and control; 3) cash flow planning; 4) operational, tactical, and strategic planning; 5) firm reorganization; 6) sales and profit forecasting; and 7) equity redemption.

Design

Drawing upon information obtained during the analysis stage, activities in the design stage include the identification of design constraints and the formulation of design specifications.

Design constraints. The design of COOP-SIM is subject to 6 constraints: hardware constraints, software constraints, simulation model attributes, the problem environment, user experience with computerized models, and technical background and expertise (Fuerst and Martin; Meador, Guyote, and Rosenfeld).

Design specifications. Based on consideration of user characteristics, the decision environment, and design constraints, COOP-SIM has the following design specifications:

1. IBM PC/AT environment. Selection of this hardware configuration for the system should facilitate adoption by the potential users due to its low cost, high performance ratio. Standardization on IBM products further enhances implementation since firms will be able to justify purchase based on multiple uses. Moreover, a number of firms have already purchased IBM equipment capable of running COOP-SIM.

2. User-friendly interface. The interface between the user and the hardware should be simple, straight-forward, interactive, and conversational. The interface should be as unobtrusive as possible to assist users in focusing on management decisions rather than on operating the program.

3. Self-documenting. As the impact of alternative scenarios or assumptions are considered, the need exists for keeping track of the factors underlying the model. In this regard, the program should provide the means of saving descriptive information pertinent to modeling activities such as reorganization and forecasting.

4. Modifiable by user. While many managers will limit the use of COOP-SIM to those templates provided with the package, it is essential to allow managers the flexibility to make some modifications to accommodate idiosyncrasies of the firm and decision environment. This capability, while not implemented within the COOP-SIM system, is available through the development of a Lotus 1-2-3 worksheet.

5. Modular. To facilitate use, a modular design which permits the user to build a number of alternative models linked to a baseline case is followed. Moreover, a consolidation feature permits users to combine the financial information of any number of disparate operations for analysis as a complete enterprise.

6. Database oriented. COOP-SIM is designed based on the concept of a database from which are extracted a number of alternative "views" such as a balance sheet, an income statement, or a sources and uses of funds statement. This approach enables the user to make changes in one view and have the requisite changes made automatically in other views.

7. Graphics oriented. High resolution color graphics are a principal design characteristic of COOP-SIM. Through the use of graphics, communication is facilitated and decision making improved (Benbasat and Dexter; Benbasat and Schroeder).

Construction

In the construction stage, a DSS development language is selected and a working prototype is produced. DSS language selection is based on: 1) end user needs assessment and problem diagnosis, 2) critical success factor identification, 3) feature analysis and capability review, 4) demonstration prototype development, 5) benchmark and simulation tests, and 6) programmer productivity and end user orientation analysis (Meador and Mezger).

One approach to DSS construction advocates the use of fast prototyping in which an initial prototype is developed quickly to elicit rapid feedback, a second prototype is developed to refine design specifications, and, finally, an operational system is developed (Kraushaar and Shirland). The benefits of this approach lie in the close user involvement throughout the development process.

In constructing COOP-SIM, the need to develop a working prototype quickly for user feedback and design refinement was deemed essential to the success of the project. Hence, an initial prototype was developed using a high level application package which provided a number of facilities which permitted rapid prototyping (i.e., Encore! by Ferox Microsystems). The major limitation of this prototype was its inability to demonstrate the user interface which was an important part of the final product. Moreover, it was not possible to develop the model structure eventually adopted due to limitations imposed by the application package environment.

The second stage of construction consisted of developing a prototype in the C programming language. While requiring greater expertise than higher level languages, C provided an environment for developing a compact, high quality software product on an IBM PC/AT. Additional benefits included software transportability and low distribution costs of the software product due to the absence of licensing costs often associated with higher level development environments.

Following field testing, an operational version is to be developed for release. Additional refinements based on user experience are to be included in subsequent versions as resources permit.

Implementation

Implementation is to be accomplished by: 1) conducting educational programs, 2) making on-site visits and presentations, 3) assisting early adopters in installing the system and assembling data files, 4) soliciting support from professional associations, and 5) developing supporting educational materials.

COOP-SIM, ARTIFICIAL INTELLIGENCE, AND EXPERT SYSTEMS

Artificial intelligence is the term applied to the application in technology aimed at simulating the interpretive processes of humans. Expert systems (ES) represent one practical application of research in artificial intelligence.

DSS differ from ES in a number of fundamental ways (Turban and Watkins). First, the objective of DSS is to assist human decision makers while the objective of ES is to replicate a human advisor and replace him/her. Second, with DSS recommendations are made by the human and/or the system. In ES, recommendations are provided by the system. Third, DSS are oriented toward decision making. In contrast, the orientation of ES is on the transfer of expertise and rendering advice. Fourth, DSS are intended to deal with problems which are complex, broad, ad-hoc, and unique. ES, on the other hand, are most applicable to problems within a narrow domain which are repetitive. Finally, and perhaps most significantly, DSS have no reasoning capability and little explanation capability while ES provide both capabilities (although somewhat limited at times).

The benefits of integrating ES components into DSS include the provision of: 1) judgmental elements to models, 2) improved sensitivity analysis, 3) a friendlier user interface, and 4) intelligent advice.

Clearly, COOP-SIM would benefit from the integration of ES components into its structure. Particularly, users would benefit the greatest from the use of artificial intelligence in improving the user interface and as a consultant in model building. Such extensions are to be included in future releases of COOP-SIM provided that adequate funding is available for development work.

SUMMARY

There are numerous potential applications of DSS technology in agribusiness firms. With support from the Agricultural Cooperative Service and Oklahoma State University, COOP-SIM is currently in the early prototyping phase of development. Many of the design issues have been addressed by the analysis of needs and constraints. The success of COOP-SIM depends not only on the development of a well-designed system, but also on careful attention to the implementation process. Experience gained through the COOP-SIM project should provide valuable insights into the development of future applications.

References

Benbasat, I. and A. S. Dexter, "An Investigation of the Effectiveness of Color and Graphical Information Presentation Under Varying Time Constraints," MIS Quarterly, Vol. 10, No. 1 (March), 1986, pp. 59-83.

Benbasat, I. and R. G. Schroeder, "An Experimental Investigation of Some MIS Design Variables," MIS Quarterly, Vol. 1, No. 1 (March), 1977, pp. 37-49.

Fuerst, W. L. and M. P. Martin, "Effective Design and Use of Computer Decision Models," MIS Quarterly, Vol. 8, No. 1 (March), 1984, pp. 17-26.

Kraushaar, J. M. and L. E. Shirland, "A Prototyping Method for Applications Development by End Users and Information Systems Specialists," MIS Quarterly, Vol. 9, No. 3 (September), 1985, pp. 189-97.

Meador, C. L. , M. J. Guyote, and W. L. Rosenfeld, "Decision Support Planning and Analysis: The Problems of Getting Large-Scale DSS Started," MIS Quarterly, Vol. 10, No. 2 (June), 1986, pp. 159-77.

Meador, C. L. and R. A. Mezger, "Selecting an End User Programming Language for DSS Development," MIS Quarterly, Vol. 8, No. 1 (March), 1984, pp. 267-80.

Porter, Michael E. and Victor E. Millar, "How Information Gives You Competitive Advantage," Harvard Business Review, July-August 1985, pp. 149-60.

Sprague, R. H., Jr., "A Framework for the Development of Decision Support Systems," MIS Quarterly, Vol. 4, No. 4 (December), 1980, pp. 1-26.

Turban, E. and P. R. Watkins, "Integrating Expert Systems and Decision Support Systems," MIS Quarterly, Vol. 10, No. 2 (June), 1986, pp. 121-36.