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THE MIS LABORATORY CONCEPT: The Integration of MIS and Management Education

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INTRODUCTION

The MIS Laboratory Concept combines three methodologies: 1) the case study approach, 2) the quantitative approach and 3) the hands-on approach. The objective of the Laboratory Concept is to establish an environment that will allow MIS students to apply their academic knowledge and skills to the types of experiences that they will encounter in the real world of MIS problems. The implementation includes the use of a data base of case information with a query facility for selective retrieval of information by the student.

MIS departments must take the lead for application of computer education in the functional areas of business; computerized cases are just now being developed by faculty in the functional areas, and they make poor use of the computing resource. The computer is used in most areas of management as a research tool, not as a pedagogical teaching aid. MIS has an opportunity to take the lead in this development, as the functional areas have not been effectively involved.

This involvement can be accomplished using the MIS Laboratory Concept to simulate real environments. This article discusses the skill and knowledge requirements addressed in the application of the concept to MIS education, the nature of that implementation, and the application of the MIS Laboratory Concept in related functional areas (e.g., accounting, marketing, etc.).

LABORATORY APPROACH TO MIS EDUCATION

The MIS system laboratory can be used to increase students' awareness of the problems involved in collection and organization of information in an information system design effort. A data base of case facts concerning specification of requirements in design of an information system along with a query facility are utilized to simulate some of the behavioral and technical problems the analyst will encounter. Role play, documentation and tool procedures, partially protected data in data bases,and controlled inconsistencies also play a part in the pedagogical exercise.

The objective of systems analysis is the determination, statement, and design reorganization of the information system requirements of the organization. The query facility enables the student to ask questions of the requirements data base. In this way, the student develops questioning procedures necessary in determining a complete and consistent statement of the design problem. Other system usages include the comparison of alternative analysis and design tools and the evaluation of design metholologies.

The system is being developed as a tool in the Information Systems curriculum at the University of Arizona. It is expected that this tool will provide valuable experience in preparation for real-world design problems while facilitating the monitoring of student development.

Information systems are a complex of man, material, and machines that create and manipulate information that is necessary and useful in the operation of an organization. The complexity of the interactions and the variety of necessary system interfaces serve to make the analyst's task a complex undertaking. Simple documentation of a system is often impossible due to the degree of effort necessary to effectively document the requirements and the volatility and impact of change.

Nevertheless, computer-based information systems are not only here to stay, but the demand for qualified analysts is ever increasing. To meet this need, the education process for future analysts must be formalized. The analysts must be trained not only to serve industry's present needs, but must also be prepared to enter a field whose growth in the next 10-20 years will match or surpass that of computer hardware in the past decade. This situation is the result of the tremendous demand for application systems and the ever rising costs and complexity in their development.

Analysts charateristically have little formal training for their role. Most analysts evolve from a programming background, with most of the training being done on the job.

It is obviously too expensive to allow future analysts to gain their experience in managing real-world projects at the expense of our real-world efforts. With little formal methodology used in practice, the analyst develops his or her, good or bad habits through experience alone. Thus, the analyst learns by participating at lower levels and gradually gains more and more responsibility.

The primary tool being developed in the MIS Department is a laboratory for training analysts. The laboratory consists of several specially designed case studies and necessary material for performing systems design according to alternative methodologies. The facility provides an environment for the beginning analyst to explore differing methodologies and compare alternative decisions. It also provides a means of monitoring and evaluating the analysts progress.

The case study, in such an environment, must be designed according to some of the following specifications.

The case study must represent typical real-world problems. The complexity must be representative, yet the effort involved in the design must not be too excessive as to make the design effort the end rather than the learning experience. The case must be logically complete so that sufficient information is available for the design process. One must be able to apply many of the developing methodologies to the case design. The case must be modifiable or extendable in order to evaluate the impact of change.

The laboratory allows the student analyst to formalize the duties of the analyst and evaluate alternative procedures. The analyst is able to experience the differing roles of the user, analyst, and programmer and in this way identify responsibilities. The student gains experience with differing techniques and is able to evaluate the work of others in the context of the design that the student generates. Further, the experience of differing team organizations and role playing are a major part of the experience.

The laboratory can be a center for evaluation of alternative tools. The benefit of and conditions under which certain tools prove useful can be determined. The utility of such diverse tools as simulation, data dictionaries, program development monitors, PERT/CPM, and decision table processors might be used.

The evaluation of proposed methodologies can be explored using the laboratory system. Methodologies such as those proposed by ARDI, ISDOS, SOP, and HOSKYNS can be compared and appropriate conclusions drawn for modification or evolution of a new approach. The laboratory provides a basis of comparison as well as a means of communicating as the different approaches have differing formal definitions of terms used.

LABORATORY APPROACH TO MANAGEMENT COURSES

Next, we deal with the application of the laboratory idea to the functional areas in business schools. The common body of knowledge described below is intended to satisfy the AACSB requirements and to present a new approach to MIS and management education. The management courses to which we apply the laboratory concept approach include accounting, economics, finance, marketing, and management. The objective is to introduce the MIS student to the management and business courses in a way that will be consistent with the business world that he or she will work in upon graduation. This section describes how the Common Body of Knowledge courses can be taught from an MIS perspective. In the MIS laboratory approach, the student is exposed to the use of computers in the various management disciplines. In addition, the use of computer and information systems knowledge and skills in other courses will reinforce and build expertise in information systems. The descriptions of the Common Body of Knowledge courses stress the application of information systems and do not attempt to describe the content of the various courses.

ACCOUNTING

The effectiveness of teaching and research programs in financial reporting and performance evaluation can benefit from the greater breadth of knowledge provided by contact with actual business settings. Systems design and auditing likewise benefit from such contact and, in addition, these two areas particularly benefit from increased integration of the computer into the curriculum.

In financial reporting, the choice of a new accounting principle or a new disclosure requirement can be partly determined by analytical reasoning best taught in traditional classroom settings.

However, political considerations, the susceptibility of the accounting principle to manipulation by management and the implementation cost of the accounting principle are important considerations that can be taught by bringing the student into contact with actual or simulated business settings. The Federal Trade Commission's recent efforts to require line of business reporting of most large businesses clearly illustrates how political considerations and implementation costs play a role in a decision to implement a disclosure requirement.

Students can best make sense of the existing body of accounting theory, and accounting researchers can do research that influences practice only if they interface with the business or governmental settings and obtain an appreciation of those factors that influence the evolution of accounting theory.

Similarly, systems design in general and specifically the subject of internal reporting for control and performance evaluation are difficult to teach and study in a traditional classroom setting. The benefits of good internal reporting are intangible, the strong behavioral reactions of employees are hard to describe, and the difficulties of implementing an effective evaluation system are hard to appreciate.

Here, again, the laboratory setting is ideal for providing something very close to first hand experience. In addition, the cost of a system and the timeliness of its reports are influenced greatly by the availability of the computer. The design of evaluation systems particularly requires awareness of the power of the computer.

The conduct of an audit requires, among other things, the evaluation of a company's system of internal controls and the use of statistical sampling procedures. Contemporary accounting systems are frequently computerized and, as a result, most evaluations of the system of internal control require an evaluation of computer controls. At present, auditing firms and internal audit staffs of business and government are having great difficulty finding accounting graduates capable of working with computerized systems. Extensive integration of the computer into systems, cost, and auditing courses provide students with a rare and highly valued combination of accounting, auditing, and computer skills. In fact, an educational program of this type can have great visibility in the business community.

On the auditing research side, the appropriate statistical sampling procedure is dependent on the nature of the errors in the accounting data base. Access to actual and simulated accounting systems permits accounting researchers to make substantial progress in the development of sampling procedures.

ECONOMICS

A major factor that is missing from the teaching of economics across the country today is an intensive interaction of theory, method, and application in the teaching of econometrics beyond basic theory. Students should be expected to work through a series of problems which have been carefully constructed to illustrate and simulate the complications typically encountered in applying econometric techniques. These problems -- which may deal with national economic forecasts or market analysis -- may have targeted answers and students are expected to come up with these answers. The instructor would be on hand to answer questions as they arose, provide guidance to the literature, and to present the theory and philosophy underlying the techniques and concepts being illustrated in the problems. All data and programs required to solve a problem are available to the student through a Data Base Management System.

In addition to a wide variety of statistical programs, the program library in the economic area must involve a manipulative language which, among other things, enables the student to access data, transform them if necessary, and then select the statistical program (or programs) required. Such a system has been developed in our information system environment.

Modern econometric research is being ever more hungry for data and statistical programs, and there now exist at least two firms (Data Resources, Inc., and Chase Econometric Associates) which provide time-shared access to large banks of economic data and a wide range of statistical progrms, as well as to several well-known econometric models of the U.S. economy. It is possible that a working relationship with one of these services can be developed such that students could gain access to the data and programs, as if they were employees of a corporate subscriber to the economic services. This "hands on" experience would provide an outstanding opportunity for students.

Another area that is being explored in economics is the performance and efficiency characteristics of computerized competitive markets for the exchange of ecurities, commodities, or any similar

item of value. The idea is to combine the teaching of principles and theory with the study of experimental results and to give students operating experience in the various kinds of competitive market situations to which the principles and theory apply.

Students in aggregate economic analysis devise and estimate economic models capable of forecasting gross national product (GNP). To complete this task successfully, students must learn to apply their knowledge of macroeconomic models, data, and statistical methods to the recurring business problem of forecasting.

Access to data bases such as those provided by Data Resources Incorporated (DRI) and Wharton Econometric Forecasting Associates frees students from the time-consuming tasks of collecting data and putting data into machine readable form, tasks which are outdated at most large firms. On-line access to DRI and Wharton forecasts provide students with alternative forecasts to be used in evaluating the results of their own models. In addition, both the DRI and Wharton forecasts provide students with systems that permit users to devise their own forecasting experiments (such as the effect of a tax cut or an increase in the price of crude oil) which are then simulated using the DRI and Wharton models. Access to this resource greatly enhances the policy portion of the macroeconomics course.

Both the DRI and Wharton systems permit users to simulate the impact of aggregate business activity on individual industries. Such results provide a natural starting place for discussion of firm investment and financing strategies, topics which are treated in detail in the finance course.

FINANCE

The Department of Finance at the University of Arizona has taken steps in the direction of developing an MIS laboratory through use of computerized data files (e.g., COMPUSTAT) and time-shared programs (e.g., FATS). Students currently have access to hundreds of publicly held corporations' reported financial data, which they can analyze using standard financial ratios or advanced statistical analyses.

Another possible application of the MIS laboratory approach is the integration of financial courses and projects with related courses in economics, accounting, and statistics. Courses in business forecasting or demand analysis, for example, are closely tied to problems associated with financial planning. Achieving such integration requires substantial faculty coordination, but could result in students' appreciation of all aspects of the business environment and how information concerning these aspects is communicated, evaluated and used by management.

MARKETING

The objective of the laboratory in the marketing area is to understand the basic issues of marketing communication. One such area of marketing communication that could be studied in the laboratory setting is message evaluation. There currently is great interest in improving advertising copy testing systems. Copy testing systems such as those of Burke, Audience Studies, Starch, and others have not been eager to provide evidence of the readibility or validity of their measurements. It has only been recently that researchers in advertising agencies as well as the academic world have gathered sufficient data to draw rather questioning conclusions as to how well these commercial services have performed. Given the importance of message as an element in communications strategy, it is important that research be done on the accuracy and worth of both existing and proposed copy testing systems that cover one or more of the important media.

Only a limited amount of research has been conducted on the relative effectiveness of alternative mass advertising media. Most such research has been sponsored by a given advertising outlet such as Time or a trade association such as Magazine Publishers Association. This type of research has sought to establish the relative worth of the medium represented by the sponsor. Even less research has sought to consider the relative impact of combining two or more media and contrasting such a combination to one or other combinations. With most advertising media plans incorporating two or more basic media, such research is overdue.

Advertising weight tests have been attempted by advertisers, although many of them have been poorly conceived and most of the findings have remained confidential. In most instances, the research has focused on one brand or product category at a time, this limiting the prospects for drawing general conclusions about appropriate spending rates. Even less research has been done on the relative worth of transferring money to or from advertising and field sales force or other promotional budgets.

One possibility of a "laboratory case with real data" would be to focus on a particular industry undergoing substantial change (as in the airline industry now). Data on the industry and key companies within it can be gathered and made available for students to analyze, developing marketing plans for the various companies. The students would work with the data, conduct related inquiries, develop plans, make presentations, and get feedback.

In this environment, the student is allowed to explore these timely issues and is able to make judgments and participate in discussions of these real-world problems. The dove-tailing of the research and pedagogical efforts enhances both aspects.

ORGANIZATIONAL BEHAVIOR AND STRUCTURE

The management course that exists is currently concerned with computer center management and information systems management. Case studies involving computing center problems such as programmer productivity, organization structure, organization behavior, and issues of centralization vs. decentralization will be presented. The course is currently centered around the behavioral aspects of computing, as the technical aspects are emphasised in other courses.

SKILL AND KNOWLEDGE IN THE LABORATORY APPROACH

There exist three basic categories of topic areas essential in the education of an "MIS Specialist." An integrated approach to management information systems education should be designed to cover the three areas:

1. Information Systems Technology: Computer and Communication Systems
2. Systems Analysis and Design, Development and Maintenance
3. Management: Business Functions and Organization theory and structure

Each area makes a significant contribution toward a successful system development and operation effort. It is important that a practicing individual have a basis in all three areas.

The following topics represent a minimum set of skill and knowledge requirements to be addressed in the curriculum:

1.0 Information Systems Technology

Logic Specification Skills - Algorithms, flowcharting, and other logic specification tools. Languages, syntax, evolution of languages. Programming style and approaches, structured programming, programming documentation, and programmer organization techniques. Debugging and verification - test deck generation, error detection and recovery.

Software Systems Organization - Basic computer structure and configuration. Data representation (bits to DBMS). Encoding, access methods, and storage mechanisms, memory management.

Hardware Organization - Basic computer operation. Computer sizes and capacities. Computer system and configurations, channels, networks, terminals, front-end processors, etc.

Data Structure and File Processing - a Data structures, arrays, strings, stacks, queues, linked lists, etc. Complexity of algorithms for manipulation of data. File organization, records, files, data bases, buffering, and access method characteristics. Logical data base design, schemas, etc.

System Programs - Job control languages. Operating system concepts, deadlock, synchronization, scheduling, network control, memory management, and monitor and recovery capabilities. Utilities, compilers, assemblers, report generators, etc.

Data Communications and Distributed Processing - Transmission fundamentals, protocols, network architectures, communications hardware and software, value-added networks, common carriers, distributed software, data and directories.

2.0 Systems Analysis and Design

Systems Concepts - General systems theory. System structure, components, boundaries, operating environment. Characteristics of systems.

Role of Systems Analyst - Interface with management, users, analysts, and programmers. Organization and conduct of systems analysis effort. Selling and coordination of a system effort. Technical skills required.

System Life Cycle - Logical progression. Recognizing steps or phases. Life cycle management. Productivity. Prototyping and requirements simulation.

Project Management - Organization and planning. Personnel (assignment, sequencing activities, balancing resource utilization, cost and time estimating). Management tools (tables, Gantt charts, PERT/CPM, etc.).

Documentation - Need for documentation, specification of requirements, design, and operations. Use in project control. Library organization. Documentation of design decisions.

Information Requirements Analysis - Capturing requirements, interviewing techniques, goal analysis, tools for requirements specification (PSL, ADS, SOP, Grid charting, etc.), and data dictionaries.

Systems Analysis and Design - Logical and physical systems design. Cost/benefit analysis. Feasibility analysis and organizational impact analysis. Generating alternative designs. Deriving functional specifications, incorporation of controls and security. Hardware selection. Data and software design. Testing and Implementation.

3.0 Management: Business Functions and Organizational Theory

Accounting - Cost, managerial, etc. Auditing, internal control, etc. Accounting information systems (payroll, accounts receivable, etc.).

Economics - Micro, macro, etc. Cost/benefit analysis, cost allocation.

Marketing - Marketing decisions. Buyer behavior, promotion, pricing, channel decisions.

Organizational theory and structure - Structure of organizations, concept of organizational structure. Line of authority and alternative organizational hierarchies. Strategic, tactical, supervisory, and operational decision levels. The decision process, internal and external organization environments.

Organizational Interaction - Group theory, work relations, dependencies, communication skills, job performnce and satisfaction, and organization behavior. Managing technological and organizational change.

Group dynamics - Group organizations, role play, participation, group decision making, tools (brain-storming, delphi, etc.).

CONCLUSIONS

The laboratory environment provides valuable experience for real-world design environment. Experienced, up-to-date analysts can be produced and the state of the art advanced. In addition, the progress of each student is monitored and evaluated.