A MULTIDISCIPLINARY APPROACH

TO INFORMATION SYSTEMS RESEARCH

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The development of computer-based information systems has had a dramatic impact on business during the last three decades. The government estimates that half of all U.S. workers are in the "knowledge industry"; their jobs involve significant information processing. While the study of information systems is often considered an applied field, it is more of an underlying management discipline. Managers, no matter what their specialty, process information, make decisions and take action. In a business school, finance, marketing, economics, production and most other areas all share a common bond of information processing.

UNDERLYING DISCIPLINES

The field of information systems extends across a number of areas and systems research must encompass topics ranging from organization and management to applied mathematics. NYU has based its research program on three underlying disciplines:

Behavioral Science - questions of how organizations are structured

and managed, the flow of information, individual perceptions,

decision making and the behavior of individuals, groups and organ-

izations, and the use of information and systems.

<u>Computer Science</u> - especially database design and formal systems for describing and representing knowledge; issues in the design and performance of combinations of hardware and software; the development and integration of different aspects of technology.

<u>Applied Mathematics</u> - approaches to the optimization of decision problems, particularly decisions supported by computer-based applications; also the optimization of aspects of information systems and systems development.

MULTIDISCIPLINARY RESEARCH

Given the broad nature of the information systems field and the presence of diverse areas of expertise, a natural strategy for the Center for Research on Information Systems at NYU is <u>multidisciplinary research at the leading edge of information processing</u>. The variety of faculty interests and the nature of research in the field mean that applied research projects are multidisciplinary in nature.

Database

Databases are a fundamental component of an information system. To a large extent, data structures make possible the kind of computer-based systems in use today, from decision support to transactions processing applications. The study of database systems and their technology represents a point of intersection between the information systems field and the traditional discipline of computer science.

Database applications may be found in operating systems, query processing, decision support and artificial intelligence. Each of these areas involves the processing of information and database research provides guidelines for representing the required data.

Artificial Intelligence

The artificial intelligence (AI) field provides a different way of thinking about computers and information processing. AI research is concerned with the representation and processing of knowledge as opposed to more traditional numerical processing.

Artificial intelligence techniques offer promise in three areas. First, there is significant interest in expert or rule-based systems. The knowledge and rules of thumb of an expert are represented in a computer; less expert users can draw on the knowledge in the computer to improve their decisions.

A second application concern is natural languages; a good example is the use of natural language as opposed to a restricted, structured query language to store and retrieve data from a database. As a third option, the power of artificial intelligence can be used to expand the

range of decision support systems. The user must, with current technology, specify the alternatives to be assessed. An intelligent DSS might be able to develop a small set of good alternatives and evaluate them for the decision maker.

Implementation

There is no consensus on what makes a system a success. Various criteria are used for this purpose including ROI, cost savings, extent to which original goals are met, and system use. The question of success is directly related to determining the organization's return on its investment in information processing.

Implementation research attempts to determine what factors and approaches are most likely to lead to successful systems. How should the analyst work with the user? What is the role of senior management in planning and controlling information processing?

Impact of Computers

For two decades researchers and managers have speculated about the changes that would occur in job content, working life quality and employment when computers were used extensively. While middle and upper level managers usually have the option whether or not to use a computer system, lower level workers frequently are not given this choice - the use of applications is mandated.

The impact of forced use of a system is of great interest; it is also important to encourage the use of voluntary computer applications. From the clerical worker to the professional working at home with a terminal or microcomputer, managers and the information processing

industry need to understand the impact of computers.

Related to impact research is the study of management control over information processing. How do firms take advantage of technology to gain a competitive edge? How should senior management evaluate information processing?

Summary

Figure 1 describes the relationship between disciplines and applied research projects at the Center for Information Systems Research at NYU.

EXAMPLES

Database

1. An important factor for the successful application of artificial intelligence in a business environment may be how well AI applications integrate with database systems and mathematical models. A major objective of an expert systems project at NYU is the exploration of combined use of a database management system and expert system for a business application. The large body of facts usually required in business applications can be made available to the expert system through a commercial DBMS. In addition, the DBMS itself can be used more intelligently and operated more efficiently if enhanced with expert systems technology.

NYU is investigating the technical and theoretical problems of successful cooperation between database and expert systems. A large relational database system and a mathematical logic approach to expert systems are the research tools. The inherent similarities betweeen the

UNDERLYING DISCIPLINES AND APPLIED RESEARCH

Applied Research	Behavioral Science	Computer Science	Applied Mathematics
Database		X	X
Artificial Intelligence	X	X	X
Implementation	X	X	
Impact of Computers	X	X	

FIGURE 1

relational model of data and predicate logic should ease the task of coupling systems with substantial differences in basic philosophy and orientation.

2. The Advanced Language Project, currently in its final stages, is an excellent example of a multidisciplinary study. The purpose of this research is to compare and contrast a restricted natural query language with a structured language for retrieval from databases.

The researchers developed a database application for alumni records in the Business School. The application became the focus of field and laboratory research to evaluate the two query languages, both of which process retrievals against the same relational database system. The project draws on expertise in computer science, systems analysis and design, database technology and experimental and field research.

3. One research effort involves investigation of techniques for organizing data so as to accurately reflect its semantics. That is, the meaning of the individual data items and the relationships which exist among data items are clearly specified. A related research effort involves an investigation of how to maximize the number of users that can simultaneously and safely access the same database. "Safely" implies that users do not interact with each other in such a way as to produce incorrect results. This area of research is known as concurrency theory and has applications both with centralized and distributed databases. By basing concurrency control techniques on the semantics of the data, it should be possible to further increase the number of concurrent users of a database.

4. The sense of time plays a central role in many management functions, yet it is rarely reflected in the ways computer-based information systems view these activities. A number of faculty members in the Center are currently working on developing a basis for the explicit treatment of time in computerized information systems and designing tools that address the unique temporal needs of these applications.

The current thrust of the effort aims at extensions to the generalized DBMS that will support the automatic generation of three-dimensional "data landscapes." The imaginary depth of the pictorial output corresponds to the time dimension, and retrieved events that happened earlier are shown farther "inside." This project involves new options in interfacing with databases and novel concepts for man/machine interaction like direct manipulation interfaces.

Expert Systems

The Center is currently engaged in a major project on expert systems. The study consists of two major parts; the interface of a large database management system and an artificial intelligence language, and the development of a prototype business application. As described above in the database section, various strategies for coupling the database to the AI language are under study. When the interface has been completed, a tool will exist for building expert systems. Most current AI systems do not need extensive access to large and complex data structures, yet many business problems have exactly these kinds of data requirements.

The business application is currently being evaluated, though the leading candidate is a system for custom tailoring life insurance policies. A potential insurance customer has a variety of needs and personal situations vary widely among customers. It would be prohibitively expensive to develop a custom policy for each customer using existing underwriting and actuarial personnel. However, an expert system that captured the knowledge of these professionals could develop uniquely tailored policies. Such a system needs access to a large amount of data on individuals and insurance products as well as computational capabilities for actuarial analyses.

Implementation

1. A project is underway to develop a general model of system implementation and to test that model in a specific setting. The general model attempts to synthesize the findings of a decade of research on the implementation of information systems and management science models into a unified model applicable to a wide range of systems and settings.

The system in the study supports the decisions of a large number of product planners. These individuals have access to extensive company-maintained databases; in addition, users can create private files for analysis. There are some 600 users of the system, though probably ten times that number could benefit from it. An extension of the present study will focus on nonusers to determine why they have not adopted the system.

2. One answer to the increasing backlog of requests for new applications is the use of software packages. A package includes program code that has been written and tested by the vendor; often these packages have been in use in a number of sites and are well debugged.

The implementation of a package can be a difficult task. The software frequently has to be modified and/or the organization must change its procedures. Many packages are quite complex making it difficult for users to fully understand their capabilities and limitations.

A Center project involves testing a model of the implementation process for software packages. The packages involved in the research deal with job accounting for small manufacturing firms and production planning for large firms. The results of the research should provide a better understanding of the implementation of this kind of software and guidelines for organizations contemplating the acquisition of a package.

The Impact of Computers

1. The purpose of this research is to determine how jobs are changed when they are performed using computer systems. The first question is to determine whether there are systematic differences among workers' jobs based on the extent of their computer usage. The next issue is understanding how jobs are changed. A micro-task model that relates performance and work life quality to the task environment of workers and to the form and degree of application system use explains changes in job content.

The first study of some 1500 mortgage loan servicing workers in 80 mutual savings banks indicated that workers making more intense use of computer systems had poorer jobs than workers using computers less. Job quality was related to the characteristics of the system. A second study of some 650 claims processing clerks in 30 Social Security offices showed an interrelationship between task and the application system.

A theory of software ergonomics has been developed to provide the conceptual basis for understanding how computer applications affect the task content of work. The model shows relationships between factors in system design and their likely consequences. The model leads to the identification of strategies for the division of labor between a computer application and its operators.

2. Computer equipment and communications capabilities make it possible to design new work environments. There is an increasing tendency for individuals to deviate from traditional places and time for work. Many workers who currently do not spend much time at an office do so because they have little choice but to work from their homes as they often have primary child care responsibilities. It is likely that large numbers of individuals will have the option to work at home at least some percentage of their time as the technology becomes less expensive and more pervasive.

A study at the Center seeks to evaluate the impact of work at home. What are the likely consequences for the employer? For the employee? How does the organization supervise and manage large numbers of individuals who infrequently come to a central office location? The technology should make it possible to increase productivity and include

a skilled group of workers in the economy. The challenge is to create appropriate management techniques for organizing remote work.

MANAGERIAL IMPLICATIONS

Each individual research area and study in the Center has a particular focus. One common theme in all of the research is the implications of the results for management. Managers must plan for information processsing and monitor the execution of their plans. They must provide resources and participate in key decisions about applications and technology. In most organizations, information processing is one of the least understood and most poorly managed areas of the firm.

Researchers at the NYU Center for Research on Information Systems attempt to draw conclusions from their research to help managers improve the effectiveness of information processing and to feel comfortable with their role in this activity. Through seminars, teaching programs and publications aimed at managers, the faculty presents key issues and recommendations for management in areas ranging from planning and control for information processing to systems analysis and design.

In the final analysis the action or inaction of managers will determine the kind of information processing the organization enjoys. Researchers in the area need to provide guidance for management if the potential benefits of information processing are to be achieved.

SUMMARY

Academically, information systems is still an emerging field. The dramatic reduction in hardware costs and proliferation of computers and their associated software will continue, trends which add impetus to research efforts in information processing.

Computer-based information systems represent a revolutionary change for business. Because these systems are so pervasive and have the potential to make a significant contribution to the organization, courses and research on information systems in business schools are of vital importance. Firms that manage information processing technology well in the next decade will have a major competitive advantage.

NYU has assembled a faculty with diverse interests and expertise. The nature of the field allows this group to coalesce around specific applied research projects that are highly relevant to today's organization. It is through this multidisciplinary approach to information systems research that a major contribution can be made to advancing the state-of-the-art.