RESEARCH PROGRESS IN MIS:
THE CENTER FOR RESEARCH ON INFORMATION SYSTEMS
NEW YORK UNIVERSITY

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1.   INTRODUCTION

Every academic department has different goals and different strengths and weaknesses which collectively determine the educational and research strategies that it should follow. Having a research center associated with the department can impact, not only the attainment of collective goals, but also the lives and careers of the faculty members concerned. In this paper, we review some of the issues involved in establishing a center and defining its goals viz-a-viz individual faculty goals. We then describe the organization and activities of the Center for Research in Information Systems (CRIS) at New York University. With this background, we describe some of the research that has been conducted at CRIS, and outline current projects and future research directions.

2.   RESEARCH CENTER ISSUES

In this section we outline some of the alternatives with respect

to center mission, constituents served by the research, and the role of the center administration in the execution of projects.

a. <u>Research mission</u>: A research center may have a strong focus or theme under which it was established and which dictates the types of projects which fit under its umbrella. For instance, NYU's Center for Entrepreneurial Studies only funds projects related in some way to "entrepreneurism." At the other extreme, a Center may have a broad base with no particular focus except "Research on Information Systems."

b. <u>Constituents</u>: A research center may have one or multiple client bases which benefit from the outputs of its research projects. At one extreme, a center may be client-based, doing projects based on specific client requests and funded by the same sources. "Proprietary research" falls in this category; there is a fine line between client-based proprietary research and consulting. At the other extreme, research projects may be purely dictated by faculty interest; the job of the center is then to find external parties that are sufficiently interested in the project to fund it.

Some centers may do both kinds of projects, and do research based on client requests that is not proprietary. Centers such as MIT's CISR and NYU's CRIS have Affiliates' Programs associated with them, and may do a certain amount of client-based research to serve Affiliates' requests.

c. <u>Project administration</u>: This dimension refers to the role of the center and, in particular, the center director, in assigning projects and administering them. At one extreme, the center staff handles all project administration and assigns work roles, particularly in projects with large numbers of participants and large multiple-year contracts. At the other extreme, the center takes a more "laissez-faire" attitude toward projects, which are basically administered by individual project team members. The center director acts more as a facilitator in obtaining needed resources and providing information sources.

The three dimensions are not exclusive, but are sufficiently independent that different centers can be described differently based on them. The dimensions are summarized in Figure 1:

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Applied<--------------Research Style-------->Theoretical

Single focus<---------Research Mission------>Multiple themes

Client base <---------Constituents---------->Faculty
interest

Planned      <---------Administration-------->Laissez faire
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Figure 1

DIMENSIONS THAT DIFFERENTIATE CENTERS

For a given research center, the activities that collectively must be performed are as follows:

(1) Assimilate knowledge.

(2) Sense research opportunities.

(3) Develop research ideas.

(4) Plan a research program.

(5) Find resources.

(6) Execute research activities.

(7) Disseminate research results.

(8) Evaluate performance.

All centers will perform the above functions. But there are choices on how each is performed, and the chosen mixture should be consistent with the role of the center relative to mission, constituents, and administration. For example, the sensing activity can be performed by faculty and research assistant reviewing relevant literature, by the center director and staff scanning requests for proposals and actively soliciting funding agencies, or by developing research contacts with business. As another example, the search for resources might concentrate on supporting individual faculty projects or might attempt to develop a shared resource for research such as a behavioral decision laboratory.

There is also a range of choices with respect to the relationships that are built up both within and outside the center. Some of the significant individuals and organizations with which centers
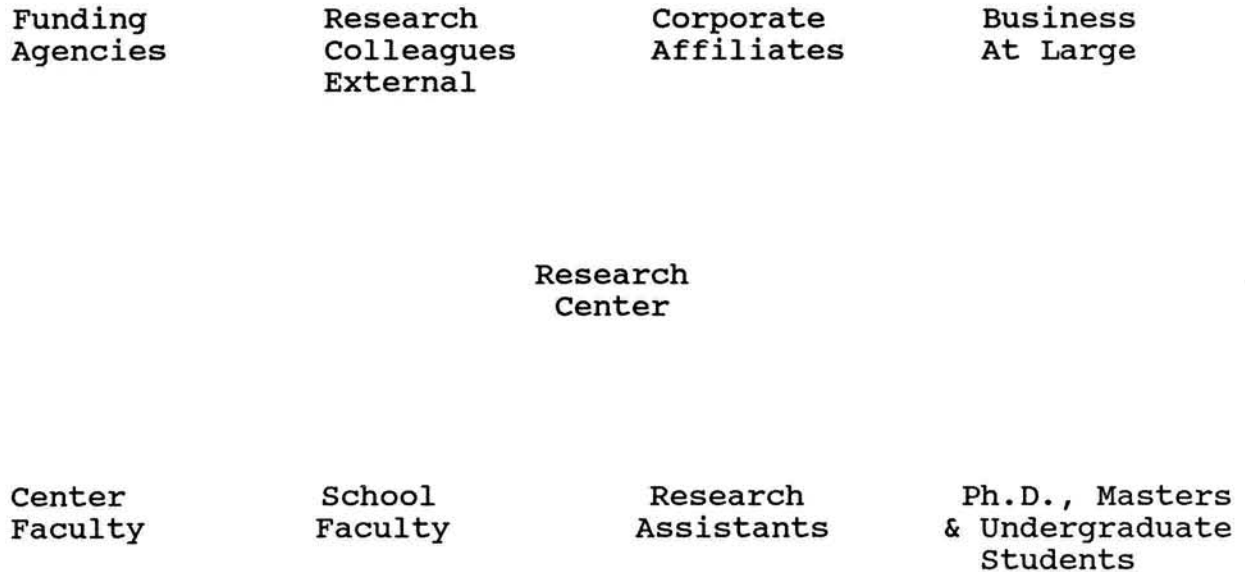
interact are shown in Figure 2.

Funding Agencies	Research Colleagues External	Corporate Affiliates	Business At Large

Research
Center

Center Faculty	School Faculty	Research Assistants	Ph.D., Masters & Undergraduate Students

Figure 2

ENVIRONMENT FOR FACULTY RESEARCH

Again, the relationships that are emphasized will depend on the mission and constituents of the center. For example, a center with a highly theoretical/conceptual orientation might focus attention on federal funding agencies willing to support more fundamental, long-term research. A center which strives for relevance in the business community may look more toward building and serving a client base, as with a corporate Affiliates Program.

Finally, there is a range of alternatives for center governance and responsibilities. With respect to faculty participation, the

Center may be open to all members of the department or only to a smaller group of interested, research-oriented faculty. Perhaps, more important, is the extent to which the existence of the center modifies the research directions adopted by the faculty. This can be characterized along a planned versus laissez faire dimension.

Centers taking a planned approach to research will probably influence faculty to work on funded projects through dictate or through benefits in the way of equipment and enhanced travel and research assistant budgets. Large, planned projects may involve significant efforts from junior faculty and Ph.D. students, but may help them to focus on significant research areas and to develop their own research skills through work with more senior faculty. Finally, many of the important issues facing the IS field today require multi-disciplinary research teams with significant resources; a good example is the work in GDSS that is being conducted in parallel at a number of universities. Since the administration of multiple-site projects is extremely complex, a "planned" administrative center to take on the responsibility is essential.

On the other hand, Centers adopting a laissez faire approach will encourage individual faculty members to pursue their own lines of research. While individuals and small groups of faculty will pursue funding opportunities on a small scale, a probable consequence of the multiple-mission, laissez faire approach is a

reduced ability on the part of the center to obtain large grants that can generate significant income in the form of overheads to both the university and the center.

3. CRIS ORGANIZATION AND OBJECTIVES

Having outlined the major organizational choices, we turn now to CRIS and the way in which our own particular aspirations and faculty backgrounds have dictated the shape of our center. CRIS was established in 1979 through a grant from the IBM Corporation. All IS faculty are also members of the Center.

The IS Area at NYU is one of the largest IS departments in the country. Currently, we have 17 full-time faculty with backgrounds in diverse areas including computer science, management science, behavioral science, organization theory and sociology. Discussions of goals and objectives amongst the faculty have surfaced three dominant goals:

    (1) Perform our teaching mission

    (2) Enhance individual faculty careers.

    (3) Encourage applied multidisciplinary research.

The strong research orientation of our faculty and the different areas of academic interest combined with objective (2), have caused us to gravitate towards the right end of the spectrum on all three dimensions:

a. <u>Research mission</u>:   CRIS has no single focus or "theme" to justify its existence. It is a vehicle for serving the faculty on a broad spectrum of research projects, which are demonstrated in the remainder of this paper. Furthermore, every member of the IS department is de facto a member of CRIS.

b. <u>Constituents</u>:   The role of CRIS in faculty research is to support faculty interest rather than to dictate what they should work on. In general, this means that faculty for the most part raise their own funds for research and CRIS facilitates this process through its bureaucratic devices. On the other hand, CRIS maintains an active Affiliates Program and attempts to meet their research interests as best it can. There is in fact a constant tension: trying to support faculty interests and also meet "client" requests. When we are lucky there is a match. Other centers resolve this tension through a separate research staff to meet Affiliates needs;   CRIS has a minimal staff and strives to retain its small size.

c. <u>Administration</u>: CRIS's philosophy about administering research projects is strictly "laissez faire". CRIS facilitates, where possible, getting through the bureaucratic maze of project funding. In particular, industrial contacts prefer to fund projects through an institution such as a center rather than individual faculty members; this also makes it easier to fund small groups of faculty.

However, CRIS does not provide staff for project administration; this is done by individual faculty members running their own projects. Faculty also manage their own project budgets.

Because of our size, we have been able to develop relatively strong ties with all of the external entities shown in Figure 2. With one exception, this has been achieved for the most part, by individual faculty efforts rather than through an organized approach. For example, the center director spends relatively little time searching for funded research opportunities. The one area in which we have taken an organized approach is in the development of a strong affiliates program. We see this as a key component in achieving our educational mission and also in improving the practical relevance of our research. Broadly stated, the mission of the Affiliates Program is to forge strong links between the academic research of our faculty and the real problems faced by organizations by (1) providing industry with direct access to University research and teaching programs; (2) developing opportunities for collaborative research; and (3) establishing a channel of access between students and prospective employers for part-time, summer, and full-time employment. Major activities within the Affiliates program are a seminar series for representatives of Affiliate companies, a research seminar series and an annual two or three day symposium.

In summary, our general goal has been to maintain a low-profile Center which does not interfere with individual faculty research

agendas but, at the same time, facilitates faculty/industry interaction.

3.   **OVERVIEW OF RESEARCH AT CRIS**

The faculty and Ph.D. candidates affiliated with the Center pursue applied research, much of it in cooperation with Affiliate member firms. Since the inception of the CRIS working paper series in 1980, IS faculty have written almost 200 working papers. In two separate studies (Vogel and Wetherbe [1984] and Shim and English [1987]), the IS Department has ranked first in research amongst leading business schools.

In the space available, we can only give a brief overview of the topic areas on which we have worked, together with brief overviews of some of the research projects which have most influenced our development. Figure 3 shows the topic areas in which faculty members have worked over the last four years. In most cases, each topic area is associated with more than one subproject and more than one faculty member. The table is based on the subheadings contained in the annual reports issued by CRIS since 1984. The major topic areas - from artificial intelligence through organizational impacts of information systems - reflect the backgrounds of the faculty.

Artificial Intelligence and Expert Systems

The Expert System/Database Interface.
A Planner's Assistant.
An Auditor's Assistant.
A Modeling Environment to Support Constraint-Based Reasoning.
Uncertainty and Belief in Expert Systems.

Database Management Systems

Evaluation of a Natural Language Query System.
Time and Databases.
Natural Language Database Access.
Concurrent Database Usage.

Telecommunications

The Design of Wide Area Computer Networks.

Decision Support Systems

Implementation of Decision Support Systems.
DSS for Group Decisions.
Automated Support for Formulating Mathematical Models.

System Design and Implementation

Modeling Information Processing.
Modeling the System Design Process.
Human-Computer Interaction.

Management of the Information Systems Function

Information Systems Implementation.
Power and Information Services.
Implementation of Decision Support Systems.
Managing Data Processing Personnel.
User Information Satisfaction.
Work Redesign.
Telecommuting as an Organizational Work Option.

Impact of Information Systems on Organizations

Quality of Information Systems in the Criminal Justice Area.
Computers and Society.

Figure 3

RECENT RESEARCH AREAS

Historically, the earliest research topics addressed at NYU were in the area which we now call the management of information systems. Shortly thereafter, we hired faculty interested in the application of database technology in organizations. This set the stage for a multidisciplinary approach to research which has been a major direction for the center over the last eight years. We have sought to maintain a balance of faculty in each of the underlying disciplinary areas of management science, behavioral/organizational theory and computer science. As artificial intelligence, human factors and telecommunications became important, we were able to hire faculty with interests in these topics.

Looking back, one can identify eight research areas/projects that have had a major influence on the development of the Center. These are:

(1) The early work by Hank Lucas on the implementation of information systems and the determinants of success and failure (Lucas [1975] and [1981]).

(2) The work by Baroudi, Ives and Olson on user satisfaction measures (Baroudi et al. [1986]).

(3) The Advanced Language Project,[1] in which a multidisciplinary team of five IS faculty worked to evaluate a natural language query system (Jarke et al. [1985]).

(4) The Expert Systems Project,[1] in which teams of faculty worked on issues arising in interfacing expert systems to commercial database systems and on the development of business expert systems (Jarke et al. [1985], Murphy and Stohr [1986]).

(5) The series of projects led by Ken Laudon on computers and privacy, due process, equity, freedom of information and federalism (Laudon) [1986]).

(6) The ongoing research by Jon Turner on models of computer-mediated work and their use in explaining the factors that contribute to employee stress (Turner [1984]).

(7) The separate, but related, research projects by Clifford, Ariav and Croker on the representation of time in databases and the subsequent generalization of this work as an extension to relational database theory (Ariav [1986], Clifford and Warren [1985]).

(8) The work by Dhar and later by Jarke and Croker on

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[1]Joint Studies with the IBM Corporation.

artificial intelligence in business applications such as modeling and systems development (Dhar [1987], Dhar and Croker [1988]).

All eight of these research areas have received significant external funding and/or attracted sustained attention by more than one faculty member and Ph.D. student over extended periods of time. Many other topics have been investigated that are not mentioned in the above list or in Figure 3. Examples are group decision support systems, end user computing, working at home, and office automation.

Our experiences to date have reinforced our desire to perform multidisciplinary research and confirmed that faculty with widely different interests can effectively work together. Rightly or wrongly, we have also come to the conclusion that we are more effective, in terms of research output per unit of faculty time, if we work together in small teams of two or three people on projects of mutual interest.

4. RESEARCH WORK IN PROGRESS

To be more informative about our current and future work, we now describe some of our current projects in more detail.

Artificial Intelligence Applications in Business

Application of artificial intelligence to problems in business

constitute a continuing CRIS research project. Despite the flurry of interest in business applications, few successful expert systems have been developed in the business domain. A major characteristic of business is the need for cooperative, interacting agents that bring disparate types of knowledge to bear on a problem. One current topic is the application of the center's historical database work, coupled with a temporal reasoning component based on expert system technology, to a problem in financial analysis. Another project concerns constraint-based reasoning to support generic business problems such as long-range project planning and resource allocation.

In another study, a research team is developing a system for a specialist at the American Stock Exchange. The system, called AESOP (An Expert for Stock Options Pricing), will assist the specialist in moving from the theoretical option price based on a well-known financial model to the actual bid and ask price posted on the exchange floor. The system will apply the specialist's rules which necessitate a deviation from the model's theoretical recommendations, rules from such sources as the requirements imposed by the limit order book, spread orders and the specialist's own position in the option and stock.

Database Management Systems

Work on extending today's database management systems to handle data over time is of ongoing research interest. Among the

questions addressed are criteria for assessing the completeness of extensions proposed both by CRIS researchers and others. We are also exploring a generalization of our model for the time dimension to allow for the handling of data with multiple points of view. Among the kinds of information our model will handle are opinions, expectations, judgments, personal observations, histories, predictions, expert advice, hypothesized scenarios, design versions, simulations.

Another ongoing project investigates using the relational data model to manipulate non-record oriented types of data.

Modeling Information Processing

Research is in progress aimed at developing a methodology and defining broad, useful, and reliable coding schemes for the classification of information-processing activity. Simulation models are being used to help validate the methodology.

Complementing this theoretical work is a series of empirical studies that compare the conceptual models with actual information-processing activity in organizations. The first of these, a case study of a leasing firm, proposes a hierarchy of levels of information-processing success, ranging from "maintains a physical environment in which hardware will operate," to high levels such as "anticipates the business plan in order that enabling information systems will be in place when required." It is

predicted that higher levels of success presuppose that the lower levels have already been satisfied.

Decision Support Systems

Research extending earlier work on decision support systems is supported by the National Science Foundation and examines how potential users of a decision support system choose between alternative information sources. This research should result in guidelines for the design and implementation of decision support systems. The research should also provide a better understanding of how decision makers choose their sources of information.

A related project examines the organizational and environmental factors that affect successful implementation of software packages and will identify the best tools to facilitate successful implementation. The setting of the study is a group of manufacturing firms that all use a particular computer vendor's production planning and control package. Data are being collected from the vendor's marketing representatives and from several employees of each firm.

Another project looks at methods for DSS analysis and design to develop guidelines for matching methodologies and decision situations. Typically, efforts in this domain have dealt with a single methodology for DSS development, under the implicit premise that there is only one DSS development methodology. Our approach

recognizes that different decision situations call for different approaches to DSS analysis and design. A DSS developer has to select an appropriate methodology from the pool of available DSS development methodologies, and the primary basis for this selection should be the salient characteristics of the decision situation under study. The research constructs a typology of design methodologies for DSSs, and develops a program to identify experimentally the nature of the decision situations where a given methodology could be effective.

Systems Analysis and Design

The objective of this research is to improve understanding of the nature of the information systems design process. A great deal has been written about how information systems should be developed, but relatively little empirical research has shown which techniques do, in fact, reduce the cost and/or improve the quality of the resulting information system. This research seeks to capture descriptions of systems designers in action, and to identify the alternative patterns of design activity which they apply. If these patterns vary systematically with the designers' expertise, we can use these findings to improve both educational techniques and practice in information systems design.

Another current project focuses on the design of conceptual models of dialogs. The conceptual design of user interfaces focuses on the specification of the structure of the dialog, independent of

any particular implementation approach. While it is commonly agreed that this activity is important, there are no adequate methods to support it. Dialog charts, which were developed and tested at CRIS, support the conceptual design of dialog control structures. The dialog charts combine visual modeling (i.e., diagramming) with widely accepted design principles and an explicit model of dialog structures. The project focuses on developing methods of assessment, both theoretically by contrasting them with representative alternative design tools, and experimentally by observing teams of designers at work with dialog charts.

Impact of Information Technology on the Organization

A major project funded by the National Science Foundation involves a thirty-year retrospective study of information technology management and utilization at three of the largest domestic policy federal agencies: Social Security administration, Internal Revenue Service, and Federal Bureau of Investigation. The variables in the study are: changing occupational composition of the labor force, productivity changes, investments in information technology, political and policy environment changes, internal politics, and bureaucratization.

Technological Support for Collaborative Work Groups

Several ongoing projects consider how people work together and the ways in which technology might support collaboration. One project focuses on group decision-making, particularly when work group

members are not in the same place or cannot meet at the same time. A system must allow for communication among group members (e.g., computerized conferencing and electronic mail), and should support both individual members and the group as a whole. A prototype system has been constructed on a personal computer network. Extensions of the project involve development of models to support multiple-criterion decision making and negotiation when noncooperation among participants is the norm.

A second project involves observation over time of members of a research and development laboratory who are building tools to support work group collaboration. The group, which is physically split into two geographically separate locations, is concerned with supporting remote collaboration. The research involves observation of how organizational culture is transmitted over time and space.

A third project involves a longitudinal case study of management-level planning team in a major computer vendor. The purpose of the project is to understand coordination needs (both intra-unit and inter-unit) of an "entrepreneurial" management team, in order to design management support tools that meet their coordination requirements.

Computer-assisted Instruction: The Living Case
The Living Case is a computer-aided system that is an alternative to traditional methods of case instruction. Rather than reading

a case, a student interacts with a computer system during information gathering, problem identification, and action planning phases of case analysis and thus learns through exploration. Not only does this create a potentially more interesting learning environment, but it also permits gathering data on student behavior during case analysis that may lead to insights in the process of learning.

5. CONCLUSIONS AND FUTURE RESEARCH

The Center for Research on Information Systems at NYU has adopted a "rightist" approach on the three dimensions depicted in Figure 1. Our research mission is eclectic rather than focused on one or a few major themes; our main constituents are our own faculty rather than outside clients; our administrative approach is laissez faire rather than planned. Our goal is to have a low-profile Center which facilitates the research activities of individual faculty members while at the same time developing strong ties to industry and strengthening our educational programs.

Our research agendas in the near future will continue in the directions indicated in the previous section. In the longer term, we intend to continue our work in organizational and societal impacts of computers and advances in database theory. We believe that some of the relatively new areas for research such as collaborative computing, telecommunications and applications of

artificial intelligence will grow in importance. Finally, we believe that the uses of computers in education and the study of the information systems area as an academic discipline will be of major importance.

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