User Information Satisfaction (UIS) and User Productivity: An Empirical Examination

by

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(ABSTRACT)

In this research the relationships between user information satisfaction (UIS) and user productivity were examined. Two users groups were used to test the following hypotheses:

H_{1A}:   There is no relationship between UIS and perceptions of decision-making quality for academic department heads.

H_{1B}:   There is no relationship between UIS and perceptions of decision-making quality for managers within the controller's office.

H_2:   There is no relationship between UIS and objectively measured productivity for managers within the controller's office.

H_3:   There is no relationship between UIS and a user's length of experience with a system.

H_{4A}:   There is no relationship between UIS and a user's age.

H_{4B}:   There is no relationship between UIS and a user's sex.

H_{4C}:   There is no relationship between UIS and a user's level of education.

Data utilized in testing the hypotheses were collected with a packet of six questionnaires mailed to the controllers of 100 universities. Usable responses were obtained from 107 of 300 controller's office managers and 77 of 300 academic users. H_{1A}, H_{1B} and H_2 were tested with canonical correlation analysis. H_3, H_{4A}, H_{4B} and H_{4C} were tested with multiple regression.

The findings can be summarized as follows:

1. Satisfaction with computer processing was correlated with making better operating budget decisions for both groups and helping academic users track activities in research, grant and designated gift accounts.

2. Satisfaction with system related problem finding was correlated with elimination of steps and making jobs easier for managers, and with helping academic users track activity in research accounts, and to feel they have benefited overall from FRS.

3. Satisfaction with the linear combination of inputs and problem finding was correlated with financial transactions per full time employee equivalents (FTE), late internal reports per total internal reports and number of ledger accounts per FTE.

4. More frequent users of FRS were more satisfied. Additionally, UIS and mandatory system usage were positively correlated.

5. UIS and sex were moderately correlated. Specifically, males within the academic group were less satisfied with FRS than the females surveyed.

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Chapter 1

Introduction

The purpose of this chapter is to present the problem, its implications, the definition of terms used, the objectives of the research, the hypotheses to be tested, the research scope and limitations, and the importance of the research.

Statement of the Problem

User satisfaction with an information system or the information system product has often been proposed as a surrogate measure for overall information system or information function success. Research in this area has led to the development of instruments which measure users' attitudes toward the MIS function and the information system product with satisfactory test reliability and validity. However, the validity of using measures of satisfaction as a surrogate for overall information system or information function success is still unclear.

Using UIS as a surrogate measure is problematic because assumptions must be made. It must be assumed that if the users are satisfied, then they will be more productive, and if they are more productive, this will yield a positive value to the organization. Therefore, the information system is successful in providing a positive value to the organization. For example, Bailey and Pearson[1] state, "measuring and analyzing computer user satisfaction is motivated by management's desire to improve the productivity of information systems" (pg. 530). While this assumption is intuitively appealing, further research is needed to support it.

The focal point of this research is the underlying premise that satisfied information system users are productive information system users. Researchers involved in a recent conference discussion concurred that ways to measure information system success have shifted from economic analysis to user effectiveness, more specifically, user perceived effectiveness and MIS usage.[2] However, research concerning the theoretical basis for measuring user satisfaction is still in its infancy. Are satisfied users in fact more productive than dissatisfied information system users? Does a user's satisfaction with an information system have an impact on his or her decision-making effectiveness? Does a user's satisfaction have an impact on objectively measured productivity within an organiza-

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[1] James Bailey and Sammy Pearson, "Development of a Tool for Measuring and Analyzing Computer User Satisfaction" *Management Science*, May 1983.

[2] A. Srinivasan, "Alternative Measures of System Effectiveness: Association and Involvement" *MIS Quarterly*, September 1985

tional setting? These and other questions addressed in this study are relevant to two major problems which must be addressed:

1. Several user satisfaction questionnaires have been advocated and have already been used in academia and in practice to surrogate for productivity (e.g. Bailey and Pearson, Ives, Olson and Baroudi, and Jenkins and Ricketts). Such practices are inappropriate until the theoretical bases for surrogation are more thoroughly investigated.

2. Continued efforts to refine the measurement of user satisfaction must rest on the purpose for measuring it. To measure user satisfaction for its own sake is one thing, but to use it as a surrogate measure for productivity requires an understanding of the relationship between satisfaction and productivity. This has not been the approach taken in most current research. Rather, it has been to identify all factors affecting satisfaction, and then to assume that satisfaction leads to productivity.

Critics of UIS often refer to prevalent research in organizational behavior such as Brayfield and Crockett, 1955 and Vroom, 1964 to make the point that no strong or consistent correlations between *job* satisfaction and productivity have been found. However, it should be noted that this study is different from studies examining the relationships between job satisfaction and productivity. Job satisfaction is a much more complex concept than user information satisfaction. Job satisfaction is affected by many more and different variables than user

information satisfaction which, according to surrogation advocates, deals only with the user's satisfaction with the MIS or the MIS function. Also, organizational researchers are typically concerned with an individual's overall productivity, while productivity in this study will be confined to variables affected by use of the information system.

Definitions

For the purpose of this research the following definitions are established.

1. *User information satisfaction* - In general, user information satisfaction refers to the satisfaction of an information system user with that system. The term 'user information satisfaction' is synonymous with 'user satisfaction'. Specifically, UIS literature can be divided into the measurement of:[3]

   a. Attitudes toward the MIS and\or MIS function

   b. Satisfaction with information quality

   c. Satisfaction in terms of perceived MIS effectiveness

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[3] Kyu K. Kim, "User Satisfaction: A Synthesis of Three Different Perspectives" Unpublished Working Paper, Pennsylvania State University, July 1988.

2. *User productivity* - Individuals who are employed to do something other than manual labor are often referred to as white-collar workers. White-collar workers include managers, engineers, technicians, clerks, secretaries, civil servants, professionals, and money managers. They earn their living by creating, processing, using and exchanging information instead of producing tangible goods. Hence, they have been described as knowledge workers.[4] Experts suggest that at least 60 percent of today's workers are knowledge workers.[5] Much has been written, particularly in management accounting journals, about the difficulty in measuring the productivity of such individuals (e.g. Gass, Bentson and McMakin (1987), Roach (1987), Schroeder, Anderson and Scudder (1986), Steedle (1988), and Boyd and Fleming (1987)). User productivity will be measured in this study with objective measures, and by examining perceptions of decision-making quality.

   a. *Objectively measured productivity* - Several ratios and other measures developed by the American Productivity Center (APC) will be employed to measure how effectively users employ the information system. It should be noted here that the APC uses the term 'effectiveness' instead of 'efficiency' to describe their measurement efforts. The APC points out that the traditional 'efficiency only' approach to measuring productivity served the purpose of cutting costs and reducing overhead. Their 'effectiveness'

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[4] Jeffrey L. Whitten, Lonnie D. Bentley, Thomas I.M. Ho, **Systems Analysis and Design Methods** Times Mirror/Mosby College Publishing, St. Louis 1986, pg.40-41.

[5] Ibid

approach to measuring productivity includes measures of efficiency, but also stresses improvement in the quality and timeliness of white collar activities and ensures they stay in line with the overall organizational objectives. This service orientation and focus on effectiveness avoids many of the pitfalls of traditional approaches. This approach also focuses on individual capabilities and their contribution to the functional unit with regard to both efficiency and effectiveness.[6] These measures are discussed in greater detail in Chapters 2 and 3.

b. *Decision-making quality* - Users will be asked to complete a section of a questionnaire which measures how they feel the use of the information system has affected the quality of related decisions they must make.

3. *Information system effectiveness* - IS effectiveness is typically measured either through the comparison of performance to some predefined goal, or by attempting to assess the quality of system resources, such as MIS personnel or technological sophistication.[7]. The research being conducted here involves the assessment of system resources at a particular point in time. The relationship between user satisfaction, perceptions of decision-making quality, and objective measures of user productivity will be investigated.

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[6] G. L. Gass, R. Bentson and G. McMakin, "White Collar Productivity", *Management Accounting*, Sept. 1987, pg. 34.

[7] Scott Hamilton and Norman L. Chervany, "Evaluating Information System Effectiveness - Part II: Comparing Evaluator Viewpoints" **MIS Quarterly**, December 1981, pp. 79-86.

4. *MIS* - The MIS is the management information system employed. Specifically, in this study the MIS involved is the Financial Reporting System (FRS). The Financial Reporting System is an online system which was developed by Information Associates, Inc. FRS contains purchasing, financial accounting and accounts payable applications, and is intended to support financial decisions made by all users within an academic community.

5. *MIS function* - The MIS function refers to the information system plus everything and everyone associated with the development and maintenance of the MIS. Some questionnaires attempt to measure user satisfaction with the entire MIS function (e.g. Bailey and Pearson).

6. *Information product* - The information product refers to the data and reports generated from an information system. The Jenkins and Ricketts questionnaire is an example of a survey which measures satisfaction with the information product.

7. *User group* - A user group pertains to a homogeneous group of information system users. In this study, there are two user groups: users in the controller's office and academic department heads.

Objectives of the Research

The objectives of this research study are to empirically examine the relation-ship between user information satisfaction (UIS) and user productivity, and to provide evidence related to the following questions, based on data gathered through a mailed questionnaire:

1. Is there a relationship between user satisfaction and the quality of decisions made by academic department heads?

2. Is there a relationship between user satisfaction and the quality of decisions made by managers within the controller's office?

3. Is there a relationship between the user satisfaction of managers and objec-tively measured productivity for departments within the controller's office?

4. Is there a relationship between a user's length of experience with an infor-mation system and their satisfaction with that system?

5. Is there a relationship between a user's age, sex, or level of education and their satisfaction with an information system?

Statement of the Hypotheses

To direct the research toward accomplishment of its objectives the following null hypotheses are established and tested in this research:

Hypothesis 1A (Objective 1A)

There is no relationship between user satisfaction and perceptions of decision-making quality for academic department heads.

Hypothesis 1B (Objective 1B)

There is no relationship between user satisfaction and perceptions of decision-making quality for managers within the controller's office.

Hypothesis 2 (Objective 2)

There is no relationship between user satisfaction and objectively measured productivity for managers within the controller's office.

Hypothesis 3 (Objective 3)

There is no relationship between a user's length of experience with an information system and a user's satisfaction with a system.

Hypothesis 4A (Objective 4A)

There is no relationship between a user's age and a user's satisfaction with an information system.

Hypothesis 4B (Objective 4B)

There is no relationship between a user's sex and a user's satisfaction with an information system.

Hypothesis 4C (Objective 4C)

There is no relationship between a user's level of education and a user's satisfaction with an information system.

Scope and Limitations

The basic orientation of this research is toward the general relationships between UIS and user productivity. Accordingly, this research does not attempt to provide a detailed examination of the underlying constructs of UIS, nor does it attempt to improve measurement of UIS. While the satisfaction questionnaire used in this study has the most acceptable test reliability and validity of any of the UIS questionnaires, repeated testing is desirable to further examine test reli-

ability. However, if the purpose of refining the measurement of UIS is to use it as a surrogate for productivity, it is important to begin testing that relationship.

A user's assessment of UIS can be expected to change through time, varying with experience and other work related variables. No attempt is made to assess changes in individual satisfaction in this study. However, the general relationship between satisfaction and experience with the system is analyzed in this study. Changes in a user's assessment of UIS should be regarded as a natural phenomenon and should not be interpreted as any indication of insufficient reliability on the part of the UIS measure[8]

The exploratory nature of white collar worker productivity measurement is another potential limitation. This is a relatively new concept and therefore, the measurements used in this study lack the years of testing which otherwise would be desirable. Therefore, there are potentially better measures of productivity for white collar workers which have not yet been developed. However, the empirical work which has been done, particularly by the American Productivity Center, suggest that the measures chosen here are quite effective.[9]

Another limitation of this study is that subjects are from government supported organizations, and it may be inappropriate to generalize the results of this

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[8] A. Srinivasan, "Alternative Measures of System Effectiveness: Association and Involvement" *MIS Quarterly*, September 1985.

[9] Grover McMakin, the Quality Management Analyst at the American Productivity Center sent upon request summary information pertaining to general activities of the APC along with a list of companies that have successfully measured white collar productivity using the APC's measures and methodology. These companies include ARCO, AT&T, Bank of America, BEA Associates, Inc., Chemical Financial Services Corp., the Continental Insurance Companies, Exxon, Honeywell, Inc., Memorial Hospital, Norwest Bank, IBM, Westinghouse, Paul Revere Life Insurance Companies, Shell Oil Co., TRW, and Texas American Bancshares.

study to profit motivated organizations. However, it would be difficult to identify and access another information system which has been implemented and used in as many homogeneous profit seeking institutions within the past few years. The circumstances in this study provide a much more controlled environment for examining the relationship between UIS and user productivity, as well as for examining further the test reliability and validity of the Jenkins and Ricketts questionnaire.

The fact that there could be an inherent tendency for subjects who are satisfied with the system to perceive that their decision-making quality has improved is another potential limitation. However, specific relationships between elements of satisfaction and decision-making quality were found. Also, one question pertaining to overall decision-making quality was not related to any of the elements of satisfaction. These findings indicate that there is little evidence of such a bias.

Finally, the moderately low response rate from academic users (25.6 percent) could be seen as a potential limitation. However, every effort was made to obtain as many responses as possible, and there was no evidence of a nonresponse bias (Chapter 3). In addition, an adequate number of usable responses were obtained from this user group to perform the statistical analyses in this study.

Importance of the Research

Information systems and information technology have become an integral part of our society. Due to the large amounts of capital needed to invest in information technology, finding competent methods of measuring the effectiveness of information systems has become critical. A researcher whose intent is to use information system effectiveness as a dependent variable in a study, or a practitioner who wants to evaluate alternative information systems is faced with a multitude of measurement techniques. Approaches that have been advocated vary from very complex economic analyses such as information economics, to behavioral techniques such as estimation of system usage, to attitudinal measures including user satisfaction. While researchers involved in a recent conference discussion acknowledged the importance of economic analyses of MIS value, they concurred that the emphasis in research is shifting from efficiency to user effectiveness, and that the focus has been on either MIS usage or user perceived effectiveness[10]

The focus of this research is on a type of user perceived effectiveness measurement known as user information satisfaction. User satisfaction has received both positive and negative attention in the recent information technology literature. Proponents of UIS suggest that increased user satisfaction will lead to in-

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[10] A. Srinivasan, "Alternative Measures of System Effectiveness: Association and Involvement" *MIS Quarterly*, September 1985.

creased user productivity, which is the ultimate goal[11]. Opponents to the concept suggest that there has not yet been a sound theoretical basis established for employing UIS as a surrogate for system effectiveness[12].

The primary objective of this research is to identify the type of relationship that exists between user satisfaction and user productivity. If there is a positive relationship between UIS and productivity, then the use of UIS as a surrogate measure for productivity, and thus system effectiveness is strengthened. If there is no relationship, or even a negative relationship, then the case for surrogation is weakened. Either way, the results of the study will be useful for determining the direction of future UIS research.

The Purpose of Two User Groups

As mentioned above, there are two different user groups participating in this study. The reason for this is that UIS surrogation advocates have not distinguished any particular type of user as being appropriate for their studies. The two user groups involved in this study have very different uses for the system employed.

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[11] James Bailey and Sammy Pearson, "Development of a Tool for Measuring and Analyzing Computer User Satisfaction" *Management Science*, May 1983, pp. 530-545.

[12] W. G. Chismar, C. H. Kriebel and N. P. Melone, "Criticism of Information Research Employing 'User Satisfaction'" Graduate School of Industrial Administration, Carnegie-Mellon University, WP 24-85-86, October 1985.

Academic department heads use reports and data generated by the information system, FRS, to support expenditure, budgetary and other types of administrative decisions. These users are typically not involved with any direct input to the system. Since these users only use outputs from the system to support administrative decisions, then the primary effect that FRS could have on their productivity is to influence the quality of the related decisions that are made. For this reason, this user group will be asked to complete a section of a questionnaire which measures how they feel the use of FRS has affected the quality of the related decisions they must make.

Accounting managers within the controller's office are involved in using outputs for decision making, but they are also involved with input to the system and all the other activities required to maintain the system. For this reason, these users were asked to complete the section of the questionnaire pertaining to decision making effectiveness, but were also asked to supply data which could be used to calculate productivity ratios related to non-decision-making productivity effects of the system. They are based on those measures developed by the American Productivity Center. These measures include such things as number of transactions per full time employee equivalents, and number of monthly report due dates missed per total number of monthly due dates.

The two user groups are evaluated separately since different variables are used in the analysis of the two groups. If a positive relationship exists between satisfaction and productivity for both user groups, then the use of UIS as a surrogate for productivity for diverse user groups is strengthened. If no or a negative

relationship exists for one user group and a positive relationship for the other group, then the implication may be that surrogation is only appropriate for particular types of users.

The Role of Experience

Questions about how long the respondent has used FRS or a similar application system, as well as how frequently FRS is used have been included to investigate the possibility of a 'satisfaction curve'. In other words, these questions were included to investigate whether individuals become more or less satisfied with a system as they gain experience with the system.

Examining the Effects of Demographic Variables on User Satisfaction

Personal demographic questions were also included in the questionnaire based on a review of research conducted by Zmud[13]. Zmud found that several variables such as sex, age and education may have an impact on MIS success. Specifically, it has been found in the literature that males, older individuals, and less educated individuals tend to exhibit less positive attitudes toward MIS.

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[13] Robert Zmud, "Individual Differences and MIS Success: A Review of the Empirical Literature," *Management Science*, Vol. 25, No. 19, 1979.

Chapter Summary

The purpose of this study is to test the assumption that increased UIS leads to increased productivity by looking at the relationship between satisfaction and productivity or decision making effectiveness related to the information system. Measures of UIS and productivity have been taken for two different user groups of an information system used at several universities. One group of users is primarily involved with input to the system, while the other group uses outputs from the system for decision making. If this study finds evidence that a positive relationship does exist between system related productivity and UIS for either or both groups, then the validity of using UIS as a surrogate measure for information system success is strengthened. If no relationship exists, then the validity of surrogation is questioned. However, it must be stressed that an extensive literature review has revealed no studies examining these relationships, and many more studies need to be done to clarify the relationships and to check for spuriousness among the relationships.

Chapter 2

Literature Review

The literature and research on measuring information system effectiveness is quite extensive and covers a broad range of topics. Practitioners and academics have both been interested in developing adequate measures of information system success. In this chapter, the general concept of information systems effectiveness will be discussed first, followed by how the concept will be employed in this study.

General Views of Information System Effectiveness

Hamilton and Chervany[14] offer two general views that can be taken concerning what system effectiveness means and how it should be measured: the goal-centered view and the systems-resource view. In the goal-centered view, the way to assess system effectiveness is first to determine the task objectives of the sys-

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[14] Scott Hamilton and Norman Chervany, "Evaluation Information System Effectiveness - Part I: Comparing Evaluation Approaches" *MIS Quarterly*, September 1981, pp. 55-69.

tem, or of the organizational units utilizing the system, and then to develop criterion measures to assess how well the objectives are being achieved. Effectiveness is determined by comparing performance to objectives. An example of such a technique would be comparison of actual costs and benefits to budgeted costs and benefits.

In the system-resource view, system effectiveness is determined by attainment of 'good' practices. Effectiveness is conceptualized in terms of resource quality rather than in terms of specific task objectives. For example, system effectiveness in terms of human resources might be indicated by the nature of communication and conflict between MIS and user personnel, user participation in system development, or user satisfaction.

The distinction between the two views is similar to the distinction drawn between 'summative' and 'formative' evaluation approaches in the evaluation research literature.[15] Summative evaluation determines whether the system has accomplished objectives. Formative evaluation assesses the quality of the system and related support. The distinction between summative and formative evaluation approaches is analogous to the evaluation of ends versus means, or outcomes versus process.[16]

Hamilton and Chervany discuss these classifications of system effectiveness measures primarily within the context of information systems development.

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[15] M. Schriven, "The Methodology of Evaluation: Formative and Summative Evaluation," *Evaluating Action Programs*, C. H. Weiss, ed., Allyn and Bacon, Boston, MA, 1972.

[16] Scott Hamilton and Norman Chervany, "Evaluating Information System Effectiveness - Part I: Comparing Evaluation Approaches" *MIS Quarterly*, September 1981, pp. 55-69.

However, they could also be applied to effectiveness measures used on existing information systems. For example, a comparison of actual utilization to expected utilization of the system would be an application of the goal-centered view. On the otherhand, an attempt to measure user satisfaction at some point in time would be an application of the system-resource view. The research being conducted here involves evaluating primarily two kinds of relationships. First, the relationship between user satisfaction and perceptions of decision-making quality, both of which are systems-resources, will be evaluated. Secondly, the relationships between user satisfaction, a system-resource, and objective measures of user productivity, which are goal-centered measures, will be investigated.

Specific Approaches to Measuring IS Effectiveness/Productivity

Srinivasan[17] reports on a roundtable discussion at the 1985 International Conference on Information Systems entitled "Measuring and Improving Information System Effectiveness/Productivity." Approaches which were advocated for measuring IS effectiveness include MIS usage estimation, user satisfaction, incremental performance in decision making effectiveness, cost-benefit analysis, information economics, utility analysis, the analytic hierarchy approach, and information attribute examination. While researchers involved in the conference discussion acknowledged the importance of economic analyses of MIS value, they

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[17] A. Srinivasan, "Alternative Measures of System Effectiveness: Association and Involvement" *MIS Quarterly*, September 1985.

concurred that the emphasis in research is shifting from efficiency to user effectiveness, and that the focus has been on either MIS usage or user perceived effectiveness.

The MIS usage approach employs usage indicators as surrogates for MIS effectiveness. Examples of such indicators are the number of reports generated, the number of changes made to a file, and connect time. The perceived effectiveness approach uses measures of effectiveness as perceived by users of the system. Examples of such measures include user satisfaction and perceived system quality. In this study, the validity of user satisfaction as a surrogate for white collar productivity, and thus IS success is investigated.

User Information Satisfaction

The literature and research on User Information Satisfaction (UIS) may be classified into two areas: (1) that which pertains to the development of the UIS concept and its measurement, and (2) that which deals with identifying the proper role of UIS in research. This research pertains primarily to the latter classification. However, it is necessary to discuss the conceptualization of UIS in order to understand why the Jenkins and Ricketts characterization and questionnaire will be employed in this study.

The Conceptualization of UIS

There has been a lack of unity in the literature on how to conceptualize 'user information satisfaction'. Nolan and Seward[18] were among the first researchers to introduce the concept of 'User Satisfaction'. They characterize 'User Satisfaction' as the satisfaction of a decision maker with the availability of information through a formal information system. They hypothesize that if a user needs information to make a decision, the first search for that information will be through a formal information system. If the information system repeatedly fails to supply the needed information, the user will expand his search to include alternative sources of information. This expanded search creates frustration for the user, because it delays the decision-making process. The information system is continually evaluated by the user as decisions are made. The more frequently that the user must conduct expanded searches, the more he is frustrated with the information system. Thus, according to Nolan and Seward, an operationally effective information system is one which requires relatively few expanded searches for information.

Since Nolan and Seward's efforts, the UIS concept has become increasingly complex and varied. Swanson[19] characterizes UIS as a manifold of valuations

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[18] R. Nolan and Seward, "Measuring User Satisfaction to Evaluate Information Systems" in R. L. Nolan (Ed.), *Managing the Data Resource Function* West Publishing Co., Los Angeles, CA 1974.

[19] E. B. Swanson, "Measuring User Attitudes in MIS Research: A Review", *Omega*, Vol. 19, No. 2, 1982.

about individual reports and queries, Bailey and Pearson[20] conceptualize UIS as attitudes that the users have toward the MIS function, and Ives, Olson and Baroudi[21] characterize UIS as a set of beliefs about the MIS function, even though the instrument they developed is a revision of the instrument developed by Bailey and Pearson. These questionnaires represent only a sample of the user satisfaction measurement instruments developed in the past ten years. Several authors have pointed out the need to settle on a particular conceptualization and measurement of user satisfaction[22]. However, there appears to be no consensus of opinion at this time. The following is a synopsis of the primary user satisfaction measurement instruments developed, along with a brief description of the unique characteristics of each study is presented.

The Bailey and Pearson Questionnaire

Ives, Olson and Baroudi [23] are partially responsible for the popularity of the Bailey and Pearson questionnaire through their review of several user satisfaction questionnaires and pronouncement of the Bailey and Pearson questionnaire as

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[20] James Bailey and Sammy Pearson, "Development of a Tool for Measuring and Analyzing Computer User Satisfaction" *Management Science*, May 1983, pp. 530-545.

[21] Blake Ives, Margrethe Olson, and Jack Baroudi, "The Measurement of User Information Satisfaction" *Communication of the ACM*, October 1983, pp. 785-793.

[22] Ives and Olson, 1984; Bailey and Pearson, 1983; Jenkins and Ricketts, 1979; Chismar, Kriebel and Melone, 1985; Treacy, 1985

[23] Ives, Olson and Baroudi, 1983.

the most complete measurement instrument. Bailey and Pearson characterize UIS as the sum of one's attitudes toward a variety of factors comprising the MIS function. Bailey and Pearson argue that "utilization is directly connected to the user community's sense of satisfaction with [the EDP staff] services" and that "measuring and analyzing computer user satisfaction is motivated by management's desire to improve the productivity of information systems" (pg. 530). Therefore, they attempted to empirically define the variables which effect UIS and then develop a questionnaire with attitudinal scales employing the semantic differential technique.

The Bailey and Pearson instrument for measuring user information satisfaction consists of 39 factors affecting satisfaction. An initial list of factors was identified through a review of the literature pertaining to the computer/user interface. Three data processing professionals were asked to review the resulting list for completeness and accuracy. The revised list was then empirically compared to interview responses from 32 middle manager users in eight different organizations. A critical incident analysis technique was applied to the responses of the managers to examine the completeness of the expanded list. Completeness was easily established, with the results suggesting a .99 probability that a mentioned factor was on the list when alpha = 0.01.

The next step was to identify a vehicle for measuring user satisfaction. The semantic differential technique was chosen because of its ability to measure an individual's perception of things. Measurement of one's perceptions using the semantic differential technique involves the rating of four bipolar adjective pairs

ranging from a negative to a positive feeling. The evaluation of one's feelings relative to any given adjective pair is accomplished, according to Osgood, Suci and Tannenbaum[24], via a seven interval scale. The seven intervals from negative to positive were denoted by the adverbial qualifiers; extremely, quite, slightly, neither/equally, lightly, quite and extremely. Figure 1 illustrates the semantic differential technique for measuring reaction to the "Degree of EDP training" factor.

The Bailey and Pearson questionnaire was initially chosen to measure user satisfaction in this study primarily because it is the instrument most frequently cited and least criticized in the literature. However, there are two major criticisms of the Bailey and Pearson questionnaire[25]. The first criticism is based on the fact that the sample of users involved in testing the instrument is relatively small (29 users). The second criticism is that the individuals involved in testing the instrument may have been biased by their prior participation in the development of the instrument. Despite these criticisms, the Bailey and Pearson questionnaire tests user satisfaction with the most complete list of factors including quality of information, mode of presentation, and service.

While the questionnaire is longer than most of the other measurement instruments, Bailey and Pearson advocate conducting a pilot study and using factor analysis to determine which questions are most appropriate for a particular

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[24] Osgood, Suci and Tannenbaum, "Studies on the Generality of Affective Meaning Systems" *American Psychology*, January 1962, pp. 10-28.

[25] Ives, Olson and Baroudi, 1983

Degree of EDP training provided to users: The amount of specialized instruction and practice that is afforded to the user to increase the user's proficiency in utilizing the computer capability that is available.

complete	1	2	3	4	5	6	7	incomplete
sufficient	1	2	3	4	5	6	7	insufficient
high	1	2	3	4	5	6	7	low
superior	1	2	3	4	5	6.	7	inferior
satisfactory	1	2	3	4	5	6	7	unsatisfactory

To me, this factor is

important	1	2	3	4	5	6	7	unimportant

Figure 1. Illustration of Bailey and Pearson Questionnaire Form

study[26]. During the research efforts involved here, a pilot study was sent out using the Bailey and Pearson questionnaire to test user satisfaction. The intention was to employ factor analysis to eliminate any questions not pertinent to the users involved in the study. Due to the length of the questionnaire it was anticipated that elimination of questions could potentially increase the response rate in the primary study. However, from the pilot study it was learned that many users found the questions confusing and difficult to answer. There was also indication that system users at the academic level were only able to evaluate the output quality aspects of the information system, while users in the controllers' offices were best qualified to answer questions pertaining to output, input and processing quality.

Due to the results of the pilot study, it was decided that a shorter questionnaire pertaining to only the information quality aspects of the information system would be appropriate for evaluating user satisfaction in the primary study. For this reason, the Jenkins and Ricketts management information systems satisfaction questionnaire will be used to measure user satisfaction in the primary study.

The Jenkins and Ricketts Questionnaire

The current version of the Jenkins and Ricketts questionnaire is the product

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[26] Bailey, James and Sammy Pearson, "Development of a Tool for Measuring and Analyzing Computer User Satisfaction" *Management Science*, May 1983, pg. 539

of over ten years of research.[27] Their instrument focuses on the information systems product alone, rather than including measurement of EDP services. The purpose of this strategy was to develop an instrument which could be used to measure satisfaction with a decision support system, as opposed to only being applicable to a transaction processing environment.

The original instrument was developed in 1979. The original instrument included twenty items, and was designed to measure user user satisfaction on the basis of "a survey of existing literature and structured interviews with leading researchers in the field" [28] Eighteen of the twenty items were chosen as representative of each of five factors defined a priori as constituting user satisfaction (i.e., input procedures, systems processing, report content, report form, report value). The other two measures were measures of overall satisfaction. Each item consisted of a seven point semantic differential scale anchored at each end by bipolar adjectives. The original model of MIS satisfaction is shown in Figure 2.

The instrument was psychometrically tested in five laboratory experiments involving 197 participants. Analysis showed each item to be normally distributed and demonstrated an acceptable overall interitem reliability of 0.85. The scores from five factors derived by factor analysis were used in a regression equation

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[27] Milton Jenkins and John Ricketts, "The Development of an MIS Satisfaction Questionnaire: An Instrument for Evaluating User Satisfaction With Turnkey Decision Support Systems", Discussion Paper No. 296, Indiana University, August 1, 1985, pg. 1

[28] Milton Jenkins and John Ricketts, "Development of an Instrument to Measure User Information Satisfaction with Management Information Systems," Unpublished working paper, Indiana University, Bloomington, November 1979, pg. 2

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                    ┌─────────────────┐
                    │     Overall     │
                    │ MIS Satisfaction│
                    └─────────────────┘
                             │
         ┌───────────────────┼───────────────────┐
   ┌───────────┐      ┌───────────┐      ┌───────────┐
   │   Input   │      │  Computer │      │  Output   │
   │ Procedures│      │ Processing│      │           │
   └───────────┘      └───────────┘      └───────────┘
                                                │
                               ┌────────────────┼────────────────┐
                         ┌───────────┐   ┌───────────┐   ┌───────────┐
                         │  Report   │   │  Report   │   │  Report   │
                         │ Contents  │   │   Form    │   │   Value   │
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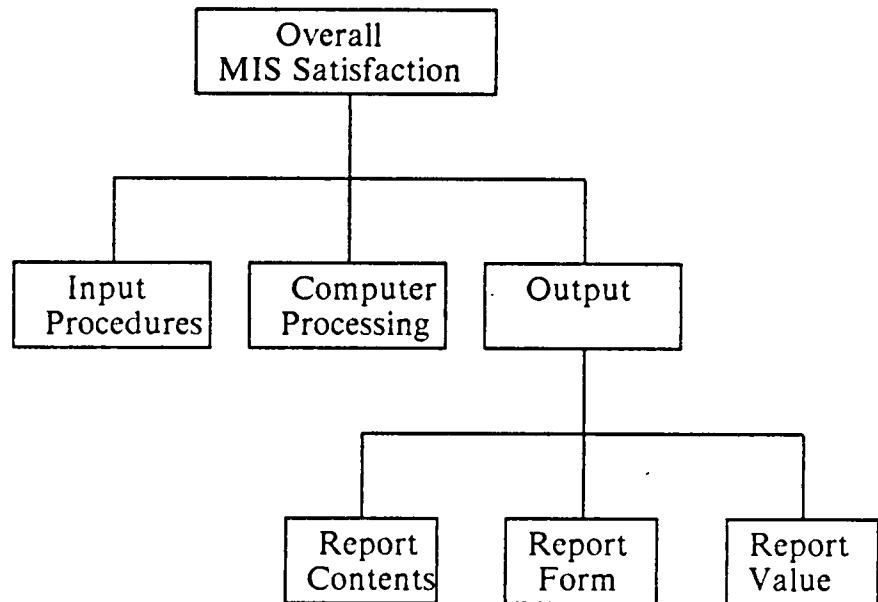
Figure 2.   Jenkins and Ricketts' First Model of MIS Satisfaction

with one of the two global satisfaction measures serving as a criterion variable. These factors significantly accounted for approximately thirty percent of the variance in global satisfaction scores. The factor analysis, however, failed to substantiate the factor structure originally proposed. Another limitation is that the two global measures of information satisfaction were included in the same instrument with the items to be validated against them, suggesting possible method variance[29]. However, full scale validation using Campbell and Fiske's multitrait, multimethod matrix is not always feasible.[30] In many research situations, it is difficult or impossible to administer two or more measures of two or more variables to relatively large samples. Though efforts to study validity must always be made, research should not be abandoned just because the full method in not feasible.[31]

The objectives of instrument revision were to improve reliability and validity while keeping the instrument relatively short and easy to administer [32] A revised a priori model of MIS satisfaction was developed by locating differences between the original a priori model and the original factor analysis, and by studying re-

[29] Blake Ives, Margarethe Olson and Jack Baroudi, "The Measurement of User Information Satisfaction" *Management Science*, October 1983, pg.786

[30] Campbell and Fiske, "Convergent and Discriminant Validation of the Multitrait, Multimethod Matrix" *Psychology Bulletin 56*, 1959

[31] Kerlinger, *Foundations of Behavioral Research, Third Edition*, CBS College Publishing, NY, NY, 1986 pp. 423-424.

[32] Jenkins, Milton and John Ricketts, "the Development of an MIS Satisfaction Questionnaire: An Instrument for Evaluating User Satisfaction With Turnkey Decision Support Systems" Discussion Paper No. 296, Indiana University, August 1, 1985, pg. 14.

sponses to an open-ended question on the original instrument. The revised model of MIS satisfaction is shown in Figure 3.

The revised instrument contains twenty five items, with only one item pertaining to overall MIS satisfaction. The remaining twenty four items were included in factor analysis with a four-factor solution being selected. Loadings of items on factors, final communalities, and percents of variance and covariance are shown in Table 1. Overall, the four-factor solution accounted for 32 percent of the variance in the raw scores. Regression analysis was applied using the global measure of user satisfaction as the dependent variable, and the factor scores accounted for 45 percent of the variance in overall MIS satisfaction. This is a relatively high percentage for a behavioral study. As a last step in analyzing the revised instrument, reliability was evaluated. For the twenty four items included in the factor and regression analyses, coefficient alpha was .84.
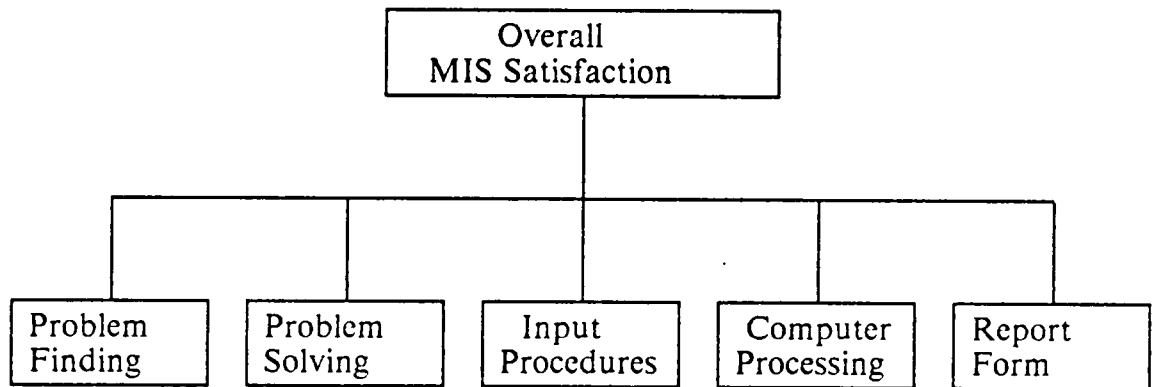
Figure 3. Jenkins and Ricketts' Revised Model of MIS Satisfaction

Table 1. Rotated Factor Loadings, Communalities and Percents of Variance and Covariance for Factor Analysis Performed in the Jenkins and Ricketts' Study

Item	Problem Solving	Input/ Output	Problem Finding	Computer Processing	Commun- alities
13 MIS indicated good decisions?	.70				.51
9 MIS indicated when problems found?	.69				.53
2 MIS indicated bad decisions?	.60				.42
18 MIS indicated when problems missed?	.59				.41
21 Reports helped select alternatives?	.53				.42
22 Input instructions easy to understand?		.60			.38
11 Input procedures prevented errors?		.54			.34
10 Reports available at right time?		.49			.28
4 Input procedures easy to use?		.47			.23
14 Reports in best mode?		.47			.25
15 Input procedures easy to understand?		.41			.26
24 Response time was good?		.41			.23
6 Reports well-formatted?		.38			.23
23 Reports had too little information?					.16
16 Reports were relevant?			.61		.49
20 MIS gave right type of information?			.58		.51
8 Reports helped form solutions?	.40		.56		.48
12 Reports had too much information?			.52		.27
5 Reports helped identify problems?	.42		.49		.44
3 Reports easy to understand?			.44		.35
17 Reports in best sequence?					.21
19 Computer available all the time?				.62	.41
7 Reliable computer system?				.42	.29
1 Report contents accurate?					.08
Percent of Variance	11.99	9.22	7.08	3.79	32.08
Percent of Covariance	37.38	28.74	22.07	11.81	

Another pilot study was conducted using the Jenkins and Ricketts questionnaire. The questions relating to the problem solving factor were eliminated, because they pertained to feedback from interactive decision support systems, and were inappropriate for the sample of users in this study. Factor analysis was performed on the pilot study data, and the results were consistent with the Jenkins and Ricketts study.

The Ives, Olson and Baroudi Questionnaire

Ives, Olson and Baroudi[33] replicated the factor analysis of the Bailey and Pearson scales, leading to four factors. These factors were EDP staff and services, information product, knowledge or involvement and vendor support, the last of which was later eliminated, however. Their ratio of sample size to number of scales was considerably better than Bailey and Pearson's (7:1 as opposed to 1:1), but the theoretical meaningfulness of the remaining three factors has been criticized by Treacy, who draws attention to their vagueness and to the non-attitudinal nature of the third factor[34].

Ives, Olson and Baroudi also define UIS as a set of beliefs about the MIS function instead of an attitude toward the MIS function. Beliefs and attitudes are not the same thing. An individual's beliefs about an object relate to whether

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[33] Ives, Olson and Baroudi, 1983.

[34] M. Treacy, "An Empirical Examination of a Causal Model of User Information Satisfaction" Unpublished Discussion Paper, MIT, April 1985.

he or she believes that relationships exist between that object and other objects, values, concepts, or goals. The individual evaluates beliefs according to personal feelings about how objects in the belief are related. Evaluated beliefs result in a set of attitudes toward the given object. These attitudes are feelings of favorableness or unfavorableness toward the object[35]. Most researchers adhere to an attitudinal interpretation of satisfaction, using attitude measurement instruments such as the semantic differential technique in their development of UIS measurement instruments.

The Gallagher Questionnaire

Gallagher's[36] questionnaire focused on user perceptions of the information value of reports provided by an information system. The questionnaire had two types of questions: requests for managers to estimate the dollar value of a report and semantic differential adjectives on which the managers rated the reports. Several problems exist with Gallagher's measures. First, the correlation between the two measures was too low to conclude that they were measuring the same phenomenon. Also, the dollar estimates had no anchor point and there was no attempt to validate the relationships between the estimated and real dollar value

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[35] M. Fishbein, "Attitude and the Prediction of Behavior," in M. Fishbein (Ed.) *Readings in Attitude Theory and Measurement,* New York, Wiley, 1967; Charles D. Schewe, "The Management Information System User: An Exploratory Behavioral Analysis" *Academy of Management Journal,* Vol. 19, No. 4, December 1976

[36] C. A. Gallagher, "Perceptions of the Value of a Management Information System" *Academy of Management Journal* (17:1) 1974, pp. 46-55.

of a report. Although Gallagher interviewed respondents to verify their beliefs in their estimates, the standard deviation was extremely high and the distribution quite skewed. Moreover, 30 percent of the respondents did not respond to the dollar value question, citing lack of familiarity with information system costs as the reason. Finally, no validation of the semantic differential scales was reported[37].

The Larcker and Lessig Questionnaire

Larcker and Lessig[38] developed two three-item scales that together constitute "perceived usefulness". The first scale measures "perceived importance", an indicator of "whether the information is relevant, informative, meaningful, important, helpful or significant" (pg. 123). The "perceived usableness" scale indicates "whether the information format is unambiguous, clear, or readable" (pg. 123).

Larcker and Lessig's measures have several critical weaknesses. The original two dimensions, importance and usableness are not empirically derived and, as the authors note, they may be "ignoring additional dimensions of perceived usefulness, such as information accuracy or timeliness" (pg. 123, footnote). The reliabilities reported for the two scales are relatively low, and the study was

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[37] Ives, Olson and Baroudi, 1983

[38] D. F. Larcker and V. P. Lessig, "Perceived Usefulness of Information: A Psychometric Examination", *Decision Sciences* Vol. 11, No. 1, 1980, pg. 121-134.

conducted in an artificial setting making the validity of generalizing the measures to more realistic settings and other problem types weak.

The Swanson Study

The research conducted by Swanson[39] was done prior to research conducted by Bailey and Pearson or Ives, Olson and Baroudi, and was meant to refine the definition of MIS attitudes to facilitate the measurement of those attitudes. Swanson proposed the term channel disposition to represent a manifold of valuations about the quality of information and the quality of access provided to the user by the information system channels. Channel disposition is the portion of an individual's attitude that reflects a tendency toward use. It is not meant to be a definition for a user's entire MIS attitude. An exploratory study of the dispositions of 186 users of ten management information system reports in four organizational settings provided limited evidence in support of the model proposed.

The Schewe Study

In an attempt to predict use from a wide assortment of perceptual,

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[39] E. B. Swanson, 1982.

attitudinal, and exogenous variables, Schewe[40] developed a questionnaire which attempted to measure the impact of MIS on decision-making effectiveness, job productivity, corporate procedures, and other exogenous variables. He reported a lack of significant association between certain user attitudes (now considered important components of user satisfaction with an MIS) and use of the system.

The Role of UIS In Research

There has been confusion about the proper role of UIS in research. The first advocates of using UIS in systems research referenced *A Behavioral Theory of the Firm*[41] as providing theoretical justification. Citing Cyert and March, Nolan and Seward state: "It can be established theoretically that user satisfaction with an information system is a valid surrogate measure for the utility of the information system in decision making".[42] Cyert and March described a "problemistic search" process in which organizations evaluate search rules, decision rules and aspiration levels in attempts to meet goals at the organizational level. Nolan and Seward adapt this theory to the individual level and imply that information system users search for and evaluate information necessary for decision making, and their

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[40] Charles D. Schewe, "The Management Information System User: An Exploratory Behavioral Analysis" *Academy of Management Journal*, December 1976, Vol. 19, No. 4, pp. 577-590.

[41] R. Cyert and J. G. March, *A Behavioral Theory of the Firm*, Prentice-Hall, Englewood Cliffs, NJ, 1963.

[42] R. Nolan and Seward, "Measuring User Satisfaction to Evaluate Information Systems" in R.L. Nolan (Ed.), *Managing the Data Resource Function*, West Publishing Co., Los Angeles, CA, 1974, pg. 257.

success or failure in the search process determines their satisfaction with the system.

Such works have recently been criticized [43] because Cyert and March describe behavior at an organizational level while user satisfaction is a construct at the individual level. Chismar, Kriebel and Melone also criticized Nolan and Seward's reasoning on the basis that the information system user's alternatives in the search process are much more limited than the alternatives available to an entire organization in its search for solutions to problems. For example, an individual may have limited access to information before a decision must be made.

Since Nolan and Seward introduced user information satisfaction as a criterion for evaluating information systems, many researchers have argued for UIS as either a surrogate measure for the success of the information system in some capacity,[44] or as a means to measure success of the implementation of an information system [45].

The argument implied by most surrogation advocates is that it would be difficult at best to measure the direct impact of the system on firm productivity or financial success, but if the users are satisfied, they will be more productive.[46] [47]

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[43] W. G. Chismar, C. H. Kriebel and N. P. Melone, "Criticism of Information Systems Research Employing 'User Satisfaction'" Graduate School of Industrial Administration, Carnegie-Mellon University, WP 24-85-86, October 1985.

[44] Bailey and Pearson, 1983; Ives, Olson and Baroudi, 1983; Jenkins and Ricketts, 1985

[45] Lucas, 1973, 1975; Ginzberg, 1979

[46] James Bailey and Sammy Pearson, "Development of a Tool for Measuring and Analyzing Computer User Satisfaction" *Management Science*, May 1983, pg. 530.

[47] W. G. Chismar, C. H. Kriebel and N. P. Melone, "Criticism of Information Systems Research Employing 'User Satisfaction'" Graduate School of Industrial Administration, Carnegie-Mellon University, WP 24-85-86, October 1985.

Therefore, if the users are satisfied, the system is successful. Research employing UIS as a measure of implementation success typically involves measures of pre-implementation user expectations and post-implementation user satisfaction. In this study, UIS as a surrogate for information system success will be analyzed.

UIS and Information System Success

Using UIS as a surrogate measure for success is controversial primarily because only theoretical arguments have been offered for or against such practices. Many of the UIS critics have relied, indirectly, on empirical evidence from the behavioral sciences literature.[48] These researchers have referred to the works of Brayfield and Crockett, 1955; Locke, 1976; and Vroom, 1964, pertaining to job satisfaction in which results indicate little or no evidence that satisfied workers are more productive in terms of enhanced performance. While job satisfaction research may need to be more carefully considered in further user information satisfaction research, it can not be overlooked that job satisfaction is not the same thing as user information satisfaction.

User information satisfaction is much more specific than job satisfaction. Individuals can be very dissatisfied with their jobs or their positions in a company, but still be satisfied with the performance of the information system and the MIS staff, or vice versa. Assuming that an information system has been ap-

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[48] Chismar, Kriebel and Melone, 1985; Strassman, 1985; Iivari, 1987

propriately designed and implemented, and has a satisfactory level of perform-ance, (e.g., the system is effective in fulfilling the organizational goals, and is cost efficient to use), it is intuitively appealing that an individual who has a favorable attitude toward the system will use it regularly, and system-related measures of productivity should be positively correlated with their satisfaction. Conversely, it seems logical that if the same individual has an unfavorable attitude toward the system, (e.g., is dissatisfied), he or she will resort to alternative methods to per-form the same tasks, if those alternatives exist, and thus potential increases in system-related measures of productivity are precluded by non-use of the infor-mation system.

It also seems logical that if the system or the way the system is managed is indeed incongruent with organizational goals or is cost or time inefficient, satis-faction might also be low. For example, if computer response time is unreason-ably slow, this not only slows the user's performance efficiency, but causes frustration and thus dissatisfaction.

However, another possibility might be that sources of information other than the computer information system (CIS) in question are more productive. Even though the user is satisfied, the use of the CIS may actually inhibit potential productivity. It may also be true that use of an information system may improve productivity, but users may be dissatisfied because it creates a change in their previous routine. Thus, neither the correlative nor the causal relationships be-tween UIS and productivity are clear. This study is designed to provide evidence concerning the correlative relationships between UIS and productivity.

General Criticisms of UIS and Inference To This Study

Iivari[49] summarizes the criticisms of UIS into eight categories. Each one is listed below along with a summary of how this study addresses these issues.

1. There is variation in the scope of the concept concerning the system and the characteristics to be assessed. The UIS concept can be related to the total MIS/IS function in an organization (e.g., Bailey and Pearson, and Ives, Olson and Baroudi measures), to an individual application system (e.g., Sanders, 1984), to the quality of the information product with respect to decision support and management information systems (e.g., Jenkins and Ricketts, 1985) or to individual reports and queries (e.g., channel disposition in Swanson, 1982).

This study will concentrate on satisfaction with quality of the information product because the users in this study use a management information system and are best qualified to answer questions pertaining only to information quality. Questionnaires designed to test satisfaction with the MIS function may be most appropriately applied in a transaction processing situation where users interact with an EDP staff and have knowledge pertaining to peripheral elements such as vendor support.[50] Questionnaires to measure satisfaction in a more limited domain, such as satisfaction with features and elements of individual reports and queries are clearly inappropriate for this study, because such questionnaires are

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[49] J. Iivari, "User Information Satisfaction Reconsidered: An Information System as the Antecedent of UIS" *Proceedings of the Eighth International Conference on Information Systems*, 1987, pp. 57-72.

[50] It was determined from the first pilot study that users participating in this research generally do not have such knowledge.

used primarily to facilitate the design and implementation of an information system.

2. The characteristics to be assessed can vary from quite direct features of the system to various beliefs concerning the effects and value of the system. For instance, the majority of the scales in the Bailey and Pearson and Swanson schemes seem to be of the former type, whereas the MIS/DSS measure developed by Sanders[51] consists of scales of the latter type.

In this study, the characteristics to be assessed were clarified in the pilot study. The sample of users in the pilot study could only respond to questions pertaining to the information system product. Therefore, it is appropriate to use the Jenkins and Ricketts questionnaire which only measures satisfaction with the information system product.

3. User information satisfaction is a subjective concept, implying that UIS does not necessarily bear any direct relation to the "real" value of the system to be assessed[52].

This criticism is the primary reason for this research. Until more empirical work is done to establish relationships between user satisfaction and productivity or economic measures of information function success, using UIS as a surrogate will be inappropriate.

It should be noted that while it would be interesting to examine the relationship between user information satisfaction and economic measures of information

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[51] G. L. Sanders, "MIS/DSS Success Measure" *Systems, Objectives, Solutions*, Vol. 4, 1984, pp. 29-34.

[52] Srinivasan, 1985; Chismar, Kriebel and Melone, 1985)

function success as measured by market returns, an event study probably would not be appropriate since the date of system implementation usually cannot be determined, nor is it possible to determine when changes in satisfaction take place.

4. There is inconsistency in the literature about the theoretical basis of the concept concerning its psychological nature. In psychological terms, UIS is characterized as a manifold of valuations (e.g., Swanson, 1982), attitudes (e.g., Bailey and Pearson, 1983), and beliefs (e.g., Swanson, 1974; Ives, Olson and Baroudi, 1983).

Satisfaction is an attitude. Iivari[53] points out that most researchers agree that an attitude measurement instrument is thus the most appropriate.

5. The theoretical basis for UIS in terms of its causal antecedents is highly deficient. While there is still a need for research that more clearly defines the causes of UIS, it is not the focus of this study. This study will concentrate on examining the relationship between user satisfaction as it is currently measured and user productivity.

6. The theoretical basis for UIS in terms of its consequents is quite inconclusive. The main interest has been in the relationship between UIS and the actual use or employment of the system to be assessed (e.g., Zmud, 1979; Srinivasan, 1985; Baroudi, Olson and Ives, 1986). Even though much of the existing research

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[53] Iivari, 1987.

has found a positive relationship, this relationship is still quite a controversial issue[54]

7. The subjectivity and limited understanding of the antecedents of UIS and the time variability of the concept may lead to its instability. A user's assessment of UIS can be expected to change through time, a fact that should be regarded as a natural phenomenon and should not be interpreted as any indication of insufficient reliability on the part of the UIS measure.

8. There are problems in measuring UIS, but the most acute problems are not measurement problems. On the contrary, the relative ease of "measurement"[55] has formed the paradox of the UIS concept, since it has diverted research from perhaps more substantive and theoretical issues and may have led to over use of the concept, loading it with various unnecessary connotations, e.g., as an IS effectiveness measure[56].

Iivari[57] clearly shows that research pertaining to user information satisfaction is still underdeveloped. While this research will not address all of the issues mentioned by Iivari, it will contribute to the clarification of several issues. Investments into information systems generally require large amounts of capital, and therefore, any steps toward the improvement of information system or information system function evaluation techniques are important.

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[54] Srinivasan, 1985.

[55] Ibid.

[56] Chismar, Kriebel and Melone 1985

[57] Iivari, 1987.

Summary of the UIS Literature

There are primarily two types of questionnaires which have been developed to measure user satisfaction: 1) questionnaires to examine satisfaction with the entire MIS function and 2) questionnaires to examine satisfaction with information quality only. Most of the first questionnaires developed pertain only to satisfaction with information quality. Research conducted to measure satisfaction with information quality includes Jenkins and Ricketts (1979, 1985), Gallagher (1974), Nolan and Seward (1974), and Larcker and Lessig (1980). The Bailey and Pearson (1983), and the Ives, Olson and Baroudi (1983) questionnaires were developed to test satisfaction with the entire MIS function.

In this study, it was originally planned to use the Bailey and Pearson questionnaire and factor out those questions which did not apply to the sample of users involved. However, from the initial pilot study it was found that the users were confused by the wording in the Bailey and Pearson questionnaire, and that the only questions they were qualified to answer were questions related to information quality. It was therefore decided to employ the Jenkins and Ricketts questionnaire. The Jenkins and Ricketts questionnaire has strong test reliability and validity and the questions are designed to be easy to answer. A second pilot study confirmed the decision to use the Jenkins and Ricketts questionnaire in the primary study. The primary purpose for this study is to examine the relationship between user satisfaction with information quality and user productivity. Measuring user productivity is discussed in the following section.

Measuring White Collar Productivity

Until very recently, it has been argued in the literature that white collar worker productivity is too difficult to measure objectively[58][59]. One reason for this is that productivity has traditionally been defined as the ratio of outputs to inputs, and it is difficult, at best, to measure the output of a white collar employee due to the nonrepetitive and qualitative nature of white collar work.

Schroeder, Anderson and Scudder[60] point out that measuring white collar workers' productivity is complicated by considerations of efficiency and effectiveness. When productivity must be measured in subjective terms, such as customer satisfaction or managerial effectiveness, the measuring system used to assess productivity is necessarily subjective as well. Despite such difficulties, productivity must be measured in order to assist in personnel tasks such as: employee development, employee evaluation and promotion, and direction of employees. For the white collar worker, more than one form of measurement may be needed.

Steedle[61] points out that forty percent of one thousand controllers surveyed do not use productivity measurement or improvement programs at all. Most of

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[58] G. L. Gass, R. Bentson and G. McMakin, "White Collar Productivity" *Management Accounting* September 1987, pp. 33-38.

[59] Stephen Roach, "America's Technology Dilemma: A Profile of the Information Economy" A Special Economic Study from Morgan Stanley, April 22, 1987.

[60] Roger Schroeder, J. Anderson and G. Scudder, "White Collar Productivity Measurement", *Management Decision*, Winter 1986, pp. 3-7.

[61] Lamont Steedle, "Has Productivity Measurement Outgrown Infancy?" *Management Accounting*, August 1988.

the productivity measurement models that are used are unsophisticated. Boyd and Fleming[62] suggest that controllers should assume a more active role in productivity improvement efforts by demonstrating managerial as well as technical expertise, and by expanding their academic and work experience backgrounds. They suggest productivity improvement through quality circles, goal-setting, employee motivation, quality control, work measurement, training and education, effective communication, improved work environments, and introduction of technology. However, Boyd and Fleming make no suggestions for initially measuring productivity.

Elam and Thomas present an approach for measuring the productivity of information systems organizations (ISO) in state government environments referred to as the Comparative Productivity Approach (CPA). Essentially, the technique requires the development of a large database of ISO's so that comparisons can be made. The database would include three measures of job satisfaction for each employee and employee performance measures obtained directly from standardized state performance evaluation data. Additionally, the database would include data pertaining to total expenditures on technology, facilities, salaries, and training, and a technology quality measure determined by rating each data center in terms of the presence of state-of-the-art technology. The purpose of developing the database is to have information available pertaining to the best achieved results, rather than comparing current performance with some unattainable ideal. To develop such a database would be a tremendous accomplishment. However,

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[62] Paul Boyd and Mary Fleming, "Productivity: The Controller's Role" *Management Accounting*, September 1987, pp. 28-32.

in addition to this obstacle, the variables proposed for measuring productivity by Elam and Thomas are not readily available at many ISO's. Thus, their approach cannot currently be used for measuring productivity.

Sanders[63] developed a questionnaire to measure MIS success in general. His questionnaire consists of two primary elements: user satisfaction and decision making effectiveness. The questionnaire in its entirety will not be used in this study because it has not been as rigorously tested as the Jenkins and Ricketts, Bailey and Pearson, or Ives, Olson and Baroudi questionnaires. However, several of the questions pertaining to decision making effectiveness are included in this study. A more detailed description of how decision making effectiveness measures were chosen is included in Chapter Three.

The American Productivity Center's Methodology

The American Productivity Center (APC), a privately supported national organization for productivity research, is currently involved in the development and testing of objective white collar productivity measurement tools. In fact, their methodology for measuring and improving white collar productivity has been successfully employed in several organizations including the United Services Automobile Association,[64] ARCO, Bank of America, BEA Associates, Inc., and

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[63] G. L. Sanders, 1984

[64] Gass, Bentson, and McMakin, 1987

TRW. While most of the measures are too objective to measure decision-making effectiveness in this study, many of the measures are appropriate for measuring technical efficiency in this study.

The most noteworthy difference in the APC's methodology is their attention to effectiveness as well as efficiency in defining productivity. For example, the purpose of the traditional 'efficiency only' approach would be to cut costs and reduce overhead, whereas the purpose of the APC's 'effectiveness' approach would be quality improvement, innovation, and adoption of changes.

One unique feature of the APC methodology is that when they assist organizations in improving productivity, one of the first things they do is ask the white collar workers to list ways in which they believe their own productivity can be measured. Obviously, not all measures generated through this technique are useful. However, after using this technique with several organizations and testing the functionality of many of the suggested measures within the organizations, the APC has developed a list of white collar productivity measures which they call the 'Family of Measures'.

These measures are categorized by function. For example, there are measures for accounting, sales and operations procedures. There are also measures appropriate for specific industries such as life insurance which would include underwriting, claims and policy service.

White Collar Productivity Measures In This Study

Two groups of users of the Financial Records System, an accounting system designed by Information Associates for use in colleges and universities are participating in this study. Both groups may be classified as white collar workers. The first group of participants are members of the controller's office. Since these individuals are involved with inputs to the system, and one way to measure their productivity may be in terms of technical efficiency. However, the participants are also involved in using outputs from the system for decision-making. Therefore, it is also important to examine how the system affects their decision-making.

The second group consists of academic department heads. These individuals are primarily involved with using outputs from the system to support decisions they must make pertaining to budgets, research grants, etc. Their system related productivity may best be measured in terms of decision-making effectiveness.

White collar productivity measures for this study were selected through a review of the literature and from additional suggestions from members of the controller's office as well as other qualified administrative personnel at Virginia Polytechnic Institute and State University. A copy of the APC's Family of Measures was obtained and circulated among select controller's office personnel and several of the measures were approved as appropriate and available for measuring productivity in the controller's office. Additional measures were also listed by some of the members who participated.

Summary

The most significant contribution of this research is a step toward investigating the external validity of user information satisfaction as a surrogate for white collar productivity, and thus IS success. In this literature review, several methods of measuring user satisfaction and productivity were discussed. The Jenkins and Ricketts questionnaire for measuring user satisfaction has been employed because it measures satisfaction with the information system product only. It was determined through two pilot studies that this type of measurement is the most appropriate for this study.

Productivity is measured at both the subjective and objective level. Subjective measures include measures of decision-making effectiveness, while objective measures include ratios assessing technical efficiency. Subjective measures are employed at both the controllers' and the academic level, while objective measures are employed at only the controllers' level.

Chapter 3

Research Methodology

This chapter will present the methodology used in acquiring the data utilized in the research and will cover the methodology used in testing the hypotheses established in Chapter 1.

Data Acquisition Methodology

Selection of the Survey Populations

The relationship between user satisfaction as it is currently measured and user productivity will be analyzed in this study. Subjects for the study are college and university users of the financial accounting and accounts payable applications of Information Associates Incorporated's Financial Records System (FRS). FRS is an online system that has been implemented in approximately 260 institutions, consisting primarily of colleges and universities in the United States. This system

was chosen for several reasons. First, the Financial Records System is well documented and has been implemented by many universities, providing a large population of data and system users for testing. Choosing a sample from a wide cross section of homogeneous users is much preferable to, for example, testing users of a system in only one organization. It is also preferable to trying to examine a relationship between satisfaction and productivity across organizations with dissimilar information systems. The results of the study will have greater external validity by choosing a cross section of homogeneous users. Also, since FRS is well documented and used by many organizations, it provides a mature and stable environment for testing the relationship between satisfaction and productivity. Finally, the results will be more meaningful to those participating in the study because they will be able to compare satisfaction and productivity at their university with the results from the participating universities as a whole.

Another reason for choosing this system is that there are diverse user groups using FRS, allowing for examination of UIS and productivity from different viewpoints. There are users within the controller's office who employ the system extensively in their daily activities and are involved primarily with data input. There are also occasional users in academe who use the system to support budgetary and other types of decision making. While the measurement of satisfaction will be the same for both groups of users, productivity measurements will be primarily objective at the accounting level within universities, and more subjective at the academic level.

Samples were drawn from each of the system user groups. The populations used for this study are as follows:

1. *Controller's office managers:* Questionnaires were distributed through the Controller to the managers of General Accounting, Accounts Payable and Financial Reporting within the Administrative Accounting Office of each participating university. Employee titles were specified in advance to reduce the potential for bias if the controller were to select the respondents. For example, if the controller were told to distribute the questionnaires to any three employees in the office, there might be a tendency to choose the three people who have used the system the most, or are the most satisfied with the system. These three particular positions were chosen because they exist in most administrative accounting offices.

2. *Academic department heads:* Questionnaires were also distributed through the Controller to the heads of the Biology, Accounting, and Chemistry academic departments. The rationale for choosing these departments is similar to that used in choosing the controller's office managers. Prior selection was made to reduce the potential for bias, and the three particular departments were chosen because they exist in most universities.

All questionnaires were sent to the controller of each college or university. If the college or university does not have one or more of the academic departments mentioned, the controller was asked to distribute the questionnaires to another

department, and to make a note of the participating department as well as the department it was replacing. It was established through informal interviews that most controllers believe the results of this study can help them understand more clearly the needs of those using FRS. Therefore, it was reasoned that the controller would be more motivated to get the questionnaires completed and returned than anyone else on campus.

In addition to the above system user groups, data was gathered by the controller pertaining to objective measures of productivity within the controller's office. These measures, in the form of a list of administrative accounting variables, were attached to the cover letter and instructions in the packet of questionnaires sent to the controller. All of the variables except full time employee equivalents and the number of internal and external reports processed are typically computed by the system. Where actual figures could not be supplied, estimates were sent by the controller.

Questionnaire Design

The questionnaire utilized in this research has six basic parts: (See Appendix C)

1. An introductory cover letter explaining the purposed of this research

2. Instructions on how to complete the questionnaire

3. Part A of the questionnaire, consisting of Likert-type scale questions pertaining to the satisfaction of the users with the information product of FRS.

4. The first half of Part B of the questionnaire, consisting of Likert-type scale questions pertaining to how decision making effectiveness is influenced by the utilization of FRS.

5. The second half of Part B of the questionnaire, consisting of demographic variables.

6. A list of administrative accounting variables included to objectively measure user productivity in the controller's office.

The cover letter, used in the primary study (Appendix C), emphasized the advantages to the controller of participation in the research and the importance to the research of his participation. The cover letter indicated that processing of individual responses would be anonymous. However, the return envelopes were numbered conspicuously in both the pre-test and primary mailings in order to send analyses of the survey results to respondents as well as to reduce unnecessary follow-ups. The research plan was to employ several follow-up mailings, if required, to obtain an appropriate response rate. Consequently, the numbering of questionnaires was necessary to prevent follow-up mailings to those who had previously responded. The plan was to use a technique, employed by Alan

Mayer-Sommer, of up to three follow-up mailings.[65] Mayer-Sommer secured an average response rate of over 90 percent for his doctoral dissertation using this technique on mail questionnaires.[66]

In addition to follow-up letters, the technique calls for a preliminary letter to be sent. The purpose of the preliminary letter is to let the potential participants know that they will be receiving questionnaires within the next few days and to pique their interest in the study.

The questionnaire instructions included with the questionnaires provided detailed instructions to assist the respondents in determining the essence of the information they were to provide. The instructions were carefully worded to ensure that each respondent relied upon his or her opinion only to express how he or she felt about each factor. An example was also provided, and instructions were given on how to properly check the scales for each factor.

Part A of the questionnaire consists of Likert-type scale questions to measure user information satisfaction. These questions were taken from the Jenkins and Ricketts questionnaire for measuring user satisfaction with the information product. The Jenkins and Ricketts questionnaire is described in detail in Chapter

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[65] Alan P. Mayer-Sommer, "Understanding and Acceptance of the Efficient Markets Hypothesis and Its Accounting Implications," *Accounting Review*, Vol. 54, No. 1, January 1979, pp. 88-106.

[66] Mayer-Sommer followed techniques proposed by Don A. Dillman, "Increase in Mail Questionnaire Response in Large Samples of the General Public," *Public Opinion Quarterly*, Volume 36, No. 2, Summer 1972, pp. 254-257; Robert J. Parsons and Thomas S. Medford, "The Effect of Advance Notice in Mail Surveys on Homogeneous Groups," *Public Opinion Quarterly*, Volume 36 No. 2, Summer 1972, pp. 258-259; Carol Fuller, "Effect of Anonymity on Return Rate and Response Bias in a Mail Survey," *Journal of Applied Psychology*, Vol. 59, No. 3, 1974, pp. 292-296; and Don A. Dillman and James H. Frey, "Contribution of Personalization to Mail Questionnaire Response as an Element of a Previously Tested Method," *Journal of Applied Psychology*, Vol. 59, No. 3, 1974, pp. 297-301.

2. Their questionnaire has been employed because it measures satisfaction with the information product only, as opposed to measuring satisfaction with the information system function as do the Bailey and Pearson and Ives, Olson and Baroudi questionnaires. It was determined through two pilot studies that this type of measurement is the most appropriate for this study. The only changes made to the Jenkins and Ricketts questionnaire for this study were to eliminate the questions pertaining to the problem solving factor, because they were inappropriate for the sample of users in this study. Factor analysis was performed on the pilot study data, and the results were consistent with the Jenkins and Ricketts study.

The first eight questions in Part B of the questionnaire are Likert-type scale questions designed to measure how much FRS has affected perceptions of decision-making quality. Since objective measures of productivity are obtainable from the controller's office, and only subjective measures are obtainable from academic users, the originally plan was to have just the academic users complete this part of the questionnaire. During the second pilot test, however, the decision making effectiveness questions were included in the questionnaires for the members of the controller's office with a space added marked 'N/A' for not applicable to each question specifically designed for academic users. The purpose of doing this was to see if in addition to measuring system related productivity objectively in the controller's office, it could also be measured subjectively. The results of the pilot test showed that the managers could complete the questions. Therefore, the questions were included in the primary study for all users.

The productivity of members of the academic community cannot be measured objectively for several reasons. First, these users are only occasional users of FRS, and their use is restricted to generation of simple queries and reports. Also, at this level information system related productivity relates primarily to how the quality of decision making is affected by the information available to the user through the information system. These administrative personnel need accounting data to support budgetary decisions and to keep track of activity in research, cash, and various other accounts. If the current system does not provide the information they need for making decisions, they will often seek information from other sources. For example, some administrative personnel will create their own accounting systems and run them parallel to the university operated systems such as FRS. If a system is not utilized, then system related productivity is low.

The decision-making effectiveness questions were developed by a review of the recent literature in information systems and accounting, including *MIS Quarterly, Management Accounting, Management Science*, and other previous research dealing with measuring white collar productivity and information system effectiveness. One recent article by Sanders[67] was particularly helpful. Sanders developed a questionnaire to measure MIS success and included several questions to indicate improvements in decision making. Questions six, seven and eight of the questionnaire used in this research were in fact contained in Sanders' dimension of success identified as 'decision making satisfaction'. Questions one through

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[67] Larry Sanders, "MIS/DSS Success Measure," *Systems, Objectives, Solutions*, 1984, vol. 4, pp. 29-34

five are similar in nature to questions in the Sanders instrument, but have been changed to relate specifically to users of FRS.

The types of decisions made by the academic users were identified through unstructured interviews with several department heads, an associate dean, and a principal investigator at Virginia Polytechnic Institute and State University. Additional information was gathered through the controller's office at VPI & SU pertaining to the similarities among other schools whose faculty members use FRS to support budgetary decisions.

The second half of Part B of the questionnaire consists of demographic variables. Questions nine through twelve were developed through the unstructured interviews mentioned above. It was discovered through these discussions that many departments maintain a separate information system and only use reports from FRS to check and reconcile their own account balances.

The type of system used before FRS might also have an impact on satisfaction and decision-making effectiveness, and was therefore included in the questionnaire. For example, academic users previously relying on data from a manual system might have greater satisfaction with FRS because they probably have more detailed information available for making budgetary decisions. Similarly, managers in the controller's office previously employing information from a batch processing system for decision-making might have greater satisfaction with FRS because the information is more likely to pertain all recent pertinent data.

Personal questions were also included based on a review of research conducted by Zmud[68]. Zmud found that several variables such as sex, age and education may have an impact on MIS success. Specifically, it has been found in the literature that males, older individuals, and less educated individuals have been observed to exhibit less positive attitudes toward MIS.

Finally, questions about how long the respondent has used FRS or a similar application system, as well as how frequently FRS is used have been included to investigate the possibility of a 'satisfaction curve'. In other words, these questions were included to investigate whether users becomes more or less satisfied with a system as they gain experience with the system.

The sixth and final part of the questionnaire utilized in this study is a list of objective administrative variables to be completed by the controller at each participating university. These variables were included to objectively measure productivity of system users in the controller's office. The list includes several variables to compute ratios designed to measure both the effectiveness and the efficiency of the users of the information system. The original list of objective administrative variables was:

1. Transactions per full time employee equivalents (FTE's)

2. Active general ledger accounts per FTE's

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[68] Robert Zmud, "Individual Differences and MIS Success: A Review of the Empirical Literature," *Management Science*, Vol. 25, No. 10, 1979.

3. Active subsidiary ledger accounts per FTE's

4. Rejected transactions per FTE's

5. Number of monthly report due dates missed per total number of monthly due dates

6. Number of transaction errors per number of transactions

7. Number of vouchers processed each month per FTE's

8. Number of checks produced each month per FTE's

9. Number of reports prepared for internal use

10. Number of reports prepared for external use

11. Number of financial and other regulatory reports filed per number of financial and other regulatory reports timely filed

These productivity measures were selected through a review of the literature and from additional suggestions from members of the controller's office as well as other qualified administrative personnel at Virginia Polytechnic Institute and State University. As mentioned in Chapter 2, a privately supported national organization called the American Productivity Center (APC) has been involved in the development of a methodology for measuring and improving white collar

productivity. Their methodology has been successfully employed in several organizations including the United Services Automobile Association, ARCO, Bank of America, BEA Associates, Inc., and TRW. A copy of what is known as the APC's Family of Measures was obtained and circulated among select controller's office personnel and several of the measures were approved as appropriate and available for measuring productivity in the controller's office. Additional measures were also listed by some of the members who participated.

Interviews with members of the controller's office provided satisfactory evidence that the resulting list of productivity measures would also be available at the other universities participating in the study for the current year. This is primarily due to the fact that most of the variables can be obtained by reviewing reports generated by FRS. While these variables may be available for up to 3-5 years prior to the current year at some universities, only measures of productivity for the current year have been used in the initial analysis of the relationship between satisfaction and productivity. A longitudinal study over 3-5 years would be interesting, but a great deal more research effort would be required by the controller, and thus response rate could be significantly reduced.[69]

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[69] Typically, universities keeping records beyond the current year will only keep printed copies of such records, significantly increasing the search time for information

Questionnaire Pilot Test

The First Pilot Test Phase

Before questionnaires were sent to the primary research group, two pilot studies were conducted. The preliminary letter for the first pilot test was mailed on March 16, 1989 (See Appendix A). This letter was mailed to ten universities, which were randomly selected from a mailing list obtained from Information Associates. The packets of questionnaires, containing one questionnaire for each of the six subjects at each school, were mailed to the controllers of the selected schools on March 21, 1989. In each packet, the cover letter and instructions were addressed to the person indicated as controller on the list obtained from Information Associates. A business reply return envelope was also included in each packet.

The first follow-up letter was mailed on April 5, 1989 and a second follow-up letter was sent on April 17, 1989. Both follow-up letters were mailed later than they would be in a typical survey where only one questionnaire is sent to each participant. The reason for doing this is that it takes extra time for the controller to distribute and collect the questionnaires. Copies of all four letters sent along with a copy of the first questionnaire are attached in Appendix A. Only two packets of questionnaires were completed and returned. Within a couple of weeks after the second follow-up letter was sent, the remaining eight packets were either returned with blank questionnaires, or the controller had called or sent a letter indicating no intent to participate.

As mentioned in Chapter 2, the Bailey and Pearson questionnaire for measuring user satisfaction was employed in the first pilot test. The primary reason for choosing the Bailey and Pearson questionnaire was that it is the most frequently cited in the literature, and because it tests user satisfaction with the most complete list of factors including quality of information, mode of presentation, and service.

In accordance with suggestions by Bailey and Pearson, the intent was to perform factor analysis on the pilot study data to determine which questions were most appropriate for this study, and to eliminate any questions not pertinent to the users in this study[70]. Due to the length of the questionnaire it was anticipated that elimination of questions could potentially increase the response rate in the primary study. However, from the pilot study it was learned that many users found the questions confusing and difficult to answer. There was also indication that system users at the academic level were only able to evaluate the output quality aspects of the information system, while users in the controllers' offices were best qualified to answer questions pertaining to output, input, and processing quality.

Due to the results of the pilot study, it was decided that a shorter questionnaire pertaining to only the information quality aspects of the information system would be appropriate for evaluating user satisfaction in the primary study. For this reason, the Jenkins and Ricketts management information systems satisfaction questionnaire was used to measure user satisfaction in the primary study.

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[70] James Bailey and Sammy Pearson, "Development of a Tool for Measuring and Analyzing Computer User Satisfaction," *Management Science*, May 1983, pg. 539.

In addition to deciding to change the user satisfaction portion of the questionnaire, some changes were also made to the decision-making effectiveness portion of the questionnaire, and to the list of administrative variables. The wording of some of the decision-making effectiveness questions was slightly modified to increase clarity. The changes made were based on comments and suggestions made by participants in the first pilot study. In addition to those changes, more demographic variables were added to Part B of the questionnaire. This decision was based on suggestions from researchers at universities where the proposal for this research project was presented soon after the first pilot study was sent out.

Finally, several changes were made to the list of administrative variables, based on suggestions from participants. The following is a list of the changes made:

1. 'Number of Active Accounts' was replaced by 'Number of Active General Ledger Accounts' and 'Number of Active Subsidiary Accounts'.

2. 'Number of Report Due Dates Missed' was replaced by 'Number of Monthly Report Due Dates Missed'. Correspondingly, 'Total Number of Report Due Dates' was replaced by 'Total Number of Monthly Due Dates'.

3. 'Number of Reports Filed' was expanded to 'Number of Reports Prepared/Processed for Internal Use', 'Number of Reports

Prepared/Processed for External Use', and 'Number of Financial and Other Regulatory Reports Filed'.

4. 'Number of Vouchers Processed Each Month' and 'Number of Checks Produced Each Month' were added to the list

A note was also added to the bottom of the list emphasizing the importance to the study of returning the completed list with the questionnaires.

The Second Pilot Test Phase

Due to the length of time involved in mailing out and returning each packet of questionnaires, the second pilot test was conducted only at Virginia Polytechnic Institute and State University. The revised questionnaires, shown in Appendix B, were administered to the three accounting managers and three department heads mentioned above during the first week in May.

The primary purposes of this pilot test phase were to determine if other content and clarity revisions of the questionnaire were necessary, and to ensure that the Jenkins and Ricketts questionnaire for measuring user satisfaction was appropriate and comprehensible to the users. After reviewing the completed questionnaires from the second pilot test, no further revisions were deemed necessary before mailing the primary study.

Some statistical rules of thumb along with a pragmatic analysis of the first pretest responses helped to determine the sample size. While there is no known way to test the power in canonical correlation, a rule of thumb for sample size is ten subjects for each variable when applying multivariate statistics. This includes canonical correlation, which is the primary method of analysis in this study.[71] It was anticipated that after conducting factor analysis on the satisfaction questionnaire responses, there would be three factors. Based on Jenkins and Ricketts' research,[72] factor analysis using varimax rotation should yield four factors: satisfaction with problem solving, satisfaction with inputs/outputs, satisfaction with problem finding, and satisfaction with computer processing. However, as mentioned in Chapter 2, the questions relating to the problem solving factor were eliminated, because they pertained to feedback from interactive decision support systems, and were inappropriate for the sample of users in this study.

The relationships between user satisfaction and decision-making quality, demographic variables, and the administrative accounting variables were to be analyzed separately. It was anticipated that upon receipt of all completed questionnaires there would be approximately eight decision-making quality variables, five demographic variables, and eight productivity measures which would

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[71] R. B. Darlington, S. L. Weinberg and H. J. Wahlberg, "Canonical Variate Analysis and Related Techniques" *Review of Educational Research*, Vol. 43, 1973, pp. 433-454.

[72] Jenkins, Milton and John Ricketts, "The Development of an MIS Satisfaction Questionnaire: An Instrument for Evaluating User Satisfaction With Turnkey Decision Support Systems" Discussion Paper No. 296, Indiana University, August 1, 1985.

be computed using the list of administrative accounting variables. These estimates were based on the observation that there might be some questions consistently marked 'not applicable' by either of the two user groups. For example, the academic users consistently marked questions in Part A pertaining to input procedures 'N/A'. This observation is logical and consistent with previous definitions of the user groups.

Based on these estimates, it was anticipated that approximately 110 responses from the controllers' offices and 90 responses from academic users would be needed to obtain an adequate sample size. Therefore, since six questionnaires would be sent to each university or college (three for managers in the controller's office and three for academic users), it was estimated that full responses were needed from approximately 36 universities to meet the response requirements from the controllers' offices.

In addition to these observations, it was observed from the first pilot study that colleges with a population less than approximately six thousand students felt that either they could not adequately respond to the questions, or that they did not have a large enough staff to have the questionnaires completed. Also, it was observed through returned written comments and telephone calls that academic departments of schools this size frequently do not use FRS in any way. For this reason, schools with a population of less than approximately six thousand students were eliminated from the sample for selection. This led to the elimination of approximately 160 of the 260 schools and universities using FRS. Conservatively assuming that a 35-36 percent response rate could be attained,

questionnaire packets were mailed to the remaining 100 schools and universities on the customer list obtained from Information Associates.

The Primary Study

The preliminary letters for the primary study were mailed to the controllers on May 12, 1989 (Appendix C). As it was pointed out earlier, the purpose of the preliminary letter is to let the potential participants know that they will be receiving questionnaires within the next few days and to pique their interest in the study.

The questionnaire packets for the primary study were mailed to the controllers one week later on May 19, 1989. A cover letter, shown in Appendix C, six questionnaires, a list of administrative accounting variables and an addressed large business reply envelope were enclosed. Each return envelope was numbered conspicuously in the lower left hand corner to identify which school or university a reply was from and to prevent follow-up mailings to those who had previously responded.

A follow-up letter was mailed to nonrespondents on June 12, 1989. This mailing consisted of just the letter shown in Appendix C. In addition to general encouragement to participate in the study, the letter addressed two issues which had been raised either through observation of initial responses, or through telephone calls from potential respondents. The first issue pertained to the fact that if participants did not how to obtain exact figures for the list of administrative

accounting variables, they felt they had to leave the spaces blank. The letter addressed the issue by asking them to provide estimates for the variables where exact figures were not available, but to note those figures which represented estimates.

The second issue addressed in the letter pertained to clarification of the selection of FRS for this study. Several potential participants were concerned that if they lacked a great deal of experience with FRS, or if they were dissatisfied with the system that they should not participate in the study. In the letter it was stressed that responses from satisfied and dissatisfied, and experienced and inexperiences users would be necessary to obtain the richest results. Additionally, it should be noted here that about the same time that the first follow-up letter was mailed, Sherry Amos from Information Associates sent a memo out to all of the regional offices encouraging participation in the study. A reproduced copy of the memo is included in Appendix C.

A second follow-up letter was mailed to all nonrespondents on July 12, 1989. This letter was simply a reminder that the questionnaires had not yet been received. There was approximately a month between mailings of follow-up letters because the controllers needed time to distribute and then collect all of the questionnaires. This process was particularly time consuming for questionnaires being routed to academic department heads via campus mail. Additional time was also allowed since the survey was conducted during the summer months and many people were on vacation.

During the last week of July, telephone calls were made to the controllers of all the colleges and universities from whom no response had been received. At that time, responses had been received from 35 schools, and 10 schools had indicated that they had just begun implementation of FRS and could not respond. Another 3 returned blank questionnaires expressing a lack of interest in the study and 2 packets were returned unopened, stamped "return to sender". Of the remaining 50 universities, 13 schools agreed to participate if a second packet of questionnaires could be mailed to them. Another 14 schools expressed a lack of interest in participating, and the remaining 23 would not respond to telephone calls. A second packet of questionnaires along with the cover letter in Appendix C and a business reply envelop were sent to the 13 schools agreeing to participate on August 8, 1989.

During the first two weeks of August, data received to date was coded and input for analysis and the administrative accounting variables were plotted to observe distributions. From this analysis, there appeared to be a great deal of variation in the way the list of administrative accounting variables had been perceived. A conference was held with members of the controller's office at Virginia Tech, and it was concluded that perhaps the list was easy for the controller at Virginia Tech to complete because he had an indepth understanding of the study and knew precisely how to fill it out. It was also concluded that different universities and colleges use different modules of FRS. For example, some universities may have implemented FRS, but use only the accounts payable or the financial accounting module. Therefore, a response to the item 'Number of

Transactions from FRS including system indirects' by a school using one module would be different from a response to the same item from a school using all of the modules.

After consulting with members of the controller's office and with individuals at Information Associates, a new confirmatory list of administrative accounting variables was developed. The new list had greater detail and made reference to reports generated by FRS which could be helpful in locating actual figures for some of the variables. The revised list is shown in Appendix D. The revised list along with a copy of the list of administrative accounting variables originally returned with the packet of questionnaires was sent to each controller that had already responded. This mailing was made on August 29, 1989. The cover letter for this mailing is also included in Appendix D.

None of 13 packets sent in the second mailing had been received before the revised list of variables had been completed. Therefore, a copy of the revised list was sent to the controller at each of these schools with a cover letter asking them to replace the old list with the new one. This mailing was also made on August 29, 1989 and shown in Appendix D. Follow-up letters were mailed to both groups on September 14, 1989.

Nonresponse Bias Test

A question which may arise is whether those that did not respond to the questionnaire may have responded differently to the variables than those that did

respond. For example, if a controller believed that the FRS users in the university were very satisfied with the system, they might be more willing to participate in the study.

An attempt was made to obtain as many responses as practical from those who had not responded to the questionnaires mailed during the primary study. As mentioned above, thirteen schools agreed to participate if a second packet of questionnaires could be mailed to them. The effort to obtain responses from these schools was cut off on November 1, 1989. Of these thirteen schools, six packets were returned. In addition, one of the six packets returned was not usable because only two questionnaires were returned, both of which had excessive data missing.

From the five packets, usable responses were obtained from 27 managers within the controllers' offices and 15 academic users. Student's t tests were used to determine if the sample of nonrespondents of each user group were significantly different from the respondents of each user group. These were performed only on variables that were found to contribute to significant relationships in the analysis of data. These relationships will be discussed in Chapter 4. The t tests were performed on the following variables for managers in the controllers' offices:

1. Overall satisfaction

2. Effects of FRS on quality of operating budget decisions

3. Whether utilization of FRS has help eliminate decision-making steps

4. Age of user

5. Frequency of use of the system

6. Financial transactions per full time employee equivalents

7. General Ledger accounts per full time employees equivalents

8. Late internal reports per total internal reports

   T tests were also performed on the following variables for academic users:

1. Overall satisfaction

2. Effects of FRS on quality of operating budget decisions

3. Whether utilization of FRS has help eliminate decision-making steps

4. Overall benefit for individual from existence of the system

5. Age of user

6. Frequency of use of the system

   The t tests resulted in a failure to find any significant differences with an alpha = .05. In addition to the t tests, an attempt was made to gather information from

individuals who expressed a lack of interest to participate during telephone conversations. The following reasons were noted by this group of nonrespondents:

1. Only in the implementation stages with FRS - system not up and running

2. Completion of the questionnaire would be too time consuming

3. Stopped using FRS

4. No academic users of the system

5. Use only the purchasing module

The conversations with the nonrespondents did not indicate any pattern of bias that might suggest that nonrespondents would respond differently from respondents. From the telephone conversations combined with the t tests, it was concluded that there was no difference between respondents and nonrespondents.

Summary of the Questionnaire Response

Table 2 provides a summary of the questionnaire response, including the second pilot test, the primary study and the nonresponse follow-up. Questionnaires were mailed to 100 universities. A total of 39 colleges and universities responded. Thirty three of the colleges and universities responded to the first mailing while

the remaining six schools were respondents to a follow-up mailing of the questionnaires. Some of the schools that responded did not send back all six of the questionnaires that were originally mailed to them. Reasons for not returning a complete set included:

1. Users on vacation

2. No academic users, or not enough users to have all questionnaires completed.

3. Not enough time to have all of the questionnaires completed

4. Only use one module of FRS; Not all managers in the controller's office use FRS

Table 2, therefore, summarizes the usable responses received by user group. While the response rate was a little lower than expected for the academic users, it was considered adequate, because multiple methods of statistical analysis were used to test hypotheses 1A, 1B and 2 (canonical correlation and multiple regression), and both methods obtained the same statistical results.

Table 2. Summary of the Questionnaire Response

	Questionnaires Mailed (No.)	Responses Received (No.)	Usable Responses (No.)	Usable Response Rate (Percent)
Controller's Office Mgrs.	300	108	107	35.7
Academic Users	300	79	77	25.6
Total	600	187	184	30.7

Analysis of Data Methodology

The Hypotheses

In Chapter 1 the following hypotheses were stated:

Hypothesis 1A (Objective 1A)

There is no relationship between user satisfaction and perceptions of decision-making quality for academic department heads.

Hypothesis 1B (Objective 1B)

There is no relationship between user satisfaction and perceptions of decision-making quality for managers within the controller's office.

Hypothesis 2 (Objective 2)

There is no relationship between user satisfaction and objectively measured productivity for managers within the controller's office.

Hypothesis 3 (Objective 3)

There is no relationship between a user's length of experience with an information system and a user's satisfaction with a system.

Hypothesis 4A (Objective 4A)

There is no relationship between a user's age and a user's satisfaction with an information system.

Hypothesis 4B (Objective 4B)

There is no relationship between a user's sex and a user's satisfaction with an information system.

Hypothesis 4C (Objective 4C)

There is no relationship between a user's level of education and a user's satisfaction with an information system.

Initially, the data were analyzed to identify any missing data and any discernible patterns in the data that were missing. Since all multivariate techniques exclude observations containing missing values from analysis, it was particularly important to minimize this potential problem. For example, if one respondent answered eighteen out of the nineteen satisfaction questions, his entire response would be deleted from the analysis because of the one missing value. This happens because of the matrix algebra which is used by all multivariate techniques in analyzing relationships between variables. Missing data was not as much of a problem in the controllers' offices as it was with the academic users. The academic users consistently left four questions pertaining to satisfaction with input

procedures blank. Since they typically are not involved with inputs to the system, this was not considered unusual. Therefore, these four questions were eliminated from analysis of satisfaction for the academic users only.

In addition to this finding, there were approximately three out of 107 users in the controllers' offices and ten out of 77 academic users who left one satisfaction question blank, but responded to the other satisfaction questions. There was no discernible pattern for these missing data. Most of the participants in the study did not identify themselves on the questionnaires, and anonymity was promised in the cover letter. Therefore, it would have been inappropriate to try to contact the respondents and ask them to provided the missing data. Since the number of questions left blank represented such a small portion of the total possible questions to be answered ($(77 + 107) \times 19 = 3496$ total satisfaction questions), it was deemed appropriate to predict values for the missing data using multiple regression analysis. By predicting values for the missing data, the entire responses from the thirteen users who left one question blank became usable in the remaining multivariate analyses.

The alternative to using regression, would have been to use an average based on responses to other questions by that individual. Regression analysis was used, however, because it is a much more powerful technique for prediction purposes.

Factor analysis was performed on responses to the user satisfaction portion of the questionnaire. This was done for two reasons. The first reason was to verify the factors obtained by Jenkins and Ricketts in their original studies to test the questionnaire. Jenkins and Ricketts used the varimax rotation method to

obtain the factors reported in their papers. Therefore, to be consistent, the varimax rotation method was also used in this study.

The term 'rotation' means that the reference axes of the factors are turned about the origin until some other position has been reached. The simplest case is an orthogonal rotation in which the axes are maintained at 90 degrees. The varimax rotation is one of three major orthogonal approaches which have been developed and is the most widely utilized.[3]

The second reason for performing factor analysis was to obtain factor scores to be input as the satisfaction variables instead of using the raw scores. This was desirable because Jenkins and Ricketts include several questions to measure each dimension of satisfaction, which could result in problems with multicollinearity in the final analysis. For example, there are six questions in the questionnaire designed to measure satisfaction with how the system assists in problem finding. If the raw scores were used as input to further analysis, there would be a high degree of collinearity among these six variables, and the results from the examination of the relationships between satisfaction and anything else would not be very meaningful. By performing factor analysis on the raw data, scores representing linear combinations of the variables can be obtained. Together, the factors can be used to represent overall satisfaction with the system, and can be used as input to analyze relationships between satisfaction and productivity or demo-

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[3] Joseph F. Hair, Jr., R. E. Anderson, R. L. Tatham, and B. J. Grablowsky, *Multivariate Data Analysis* Petroleum Publishing Company, Tulsa, Oklahoma, 1979, pg. 230.

graphic variables. This practice is suggested not only as a means of nullifying multicollinearity, but also as a means of correcting error variances.[74]

Hypotheses 1A, 1B and 2

Canonical correlation was used to test the relationships stated in hypotheses 1A, 1B and 2. A significance level of (alpha = .05) was used. The variables used for input to the canonical correlation were not measured in the same units. First, the factors obtained from factor analysis were used as input for user satisfaction in the testing of each of these three hypotheses. The raw data, however, were used as input for perceptions of decision-making quality to test hypotheses 1A and 1B. Finally, the data obtained from the list of administrative accounting variables was used to calculate the productivity measures previously discussed. The productivity measures were then used as input for analysis to test hypothesis 2. Each of the hypotheses were tested independently.

Canonical correlation analysis was chosen for this study because it is a highly useful, powerful technique for exploring the relationships among two sets of multiple variables.[75] There is really no alternative method to use when maintaining multiple criterion and predictor variables. It would, however, be possible

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[74] R. Gittins, *Ecological Applications of Canonical Analysis*, Reprinted from *Multivariate Methods in Ecological Work*, International Co-operative Publishing House, Burtonsville, Maryland, 1979, pg. 504.

[75] Bruce Thompson, *Canonical Correlation Analysis, Uses and Interpretation*, Vol. 47, 1984, Sage Publications, Beverly Hills, CA.

to combine one set of variables in some way into a composite score to be used as the dependent variable in regression analysis. For example, a composite score could be computed for overall satisfaction to be used as the dependent variable, with each of the decision-making quality questions representing the independent variables. However, all of the information pertaining to satisfaction with specific elements such as input procedures or output quality would be lost in such a composite score. Therefore, canonical correlation was chosen as the primary method for analyzing the relationships stated in hypotheses 1A, 1B and 2.

The goal of canonical correlation is to determine the primary independent dimensions which relate one set of variables to another. In particular, the objectives may be any or all of the following:

1. Determining whether two sets of variables are independent of one another or conversely, determining the magnitude of the relationships which may exist between the two sets.

2. Deriving a set of weights for each set of criterion and predictor variables such that the linear combinations themselves are maximally correlated.

3. Deriving additional linear combinations that maximize the remaining correlation, subject to being independent of the preceding set (or sets) of linear combinations.

4. Explaining the nature of whatever relationships exist between the sets of criterion and predictor variables, generally by measuring the relative contributions of each variable to the canonical functions (relationships) that are extracted.[76]

Initially, canonical variates and canonical loadings are obtained from analysis. The canonical variates, also known as the linear composites, represent the weighted sum of each set of variables in canonical analysis. For example, when analyzing the relationship between satisfaction and perceptions of decision-making quality, there would be a canonical variate for satisfaction, and one for decision-making quality. The canonical loadings measure the simple linear correlation between the individual independent variables and their respective linear composites, and can be interpreted like factor loadings. An example of a canonical loading would be the correlation between the first decision-making quality question and the decision-making canonical variate.

The canonical correlation measures the strength of the overall relationships between the canonical variates of the two sets of variables. In effect, it represents the bivariate correlation between the two linear composites. When squared, the canonical correlation represents the amount of variance in one canonical variate that is accounted for by the other canonical variate. This is called the canonical root, or eigenvalue. The canonical root provides an estimate of the amount of

[76] Hair, Joseph F., Rolph E. Anderson, Ronald L. Tatham and Bernie J. Grablowsky, Chapter 5 of *Multivariate Data Analysis* The Petroleum Publishing Company, Tulsa, OK, 1979.

shared variance between the respective optimally weighted linear composites of criterion and predictor variables.

Also of interest is the redundancy index. While the canonical roots provide an estimate of shared variance between the canonical variates, it may lead to some misinterpretation. This is because the squared canonical correlations represent the variance shared by the linear composites of the sets of criterion and predictor variables, and not the variance extracted from the sets of variables. For example, hypothetically, the squared canonical correlation for the linear composites of satisfaction factors and decision-making quality variables may be .85. However, the linear composite of satisfaction factors may only represent ten percent of the variance from the set of satisfaction factors. Likewise, the linear composite of decision-making quality variables may represent only fifteen percent of the variance from the set of decision-making quality questions. Thus, a relatively strong canonical correlation may be obtained between two canonical variates even though these variates may not extract significant portions of variance from their respective sets of variables.[77]

To overcome this inherent bias and uncertainty in using canonical roots (squared canonical correlations) as a measure of shared variance, the redundancy index should be considered. This index, which is given on analysis output, is the equivalent of computing the squared multiple correlation coefficient between the total predictor set and each variable in the criterion set, and then averaging these squared coefficients to arrive at an average R^2. It provides a summary measure

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[77] Ibid.

of the ability of a set of predictor variables taken as a set to explain variation in the criterion variables taken one at a time. As such, the redundancy measure is perfectly analogous to multiple regression's R^2 statistic, and its value as an index is similar. The redundancy index can be computed for both sets of variables.[78]

All multivariate techniques are believed to be reasonably robust.[79] In other words, the sensitivity of the results from analysis to departures from the assumptions of the methodology are often not serious. However, it may be of value to present the three primary assumptions of canonical correlation[80], and evidence that the data in this study reasonably meet these assumptions.

First, it is assumed that the measurement error of the variables is minimal. This assumption can be met under field conditions by giving clear and specific instructions to subjects[81]. In addition to providing instructions for completing the questionnaires in this study, suggestions were given on the list of administrative variables to help the controllers locate the appropriate information. The second assumption is that the variances of the variables are not restricted. This assumption can be met with adequate sampling of subjects.[82] As previously discussed, care was taken in this study to obtain the largest and most representative

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[78] Ibid.

[79] R. Gittins, *Ecological Applications of Canonical Analysis*, Reprinted from *Multivariate Methods in Ecological Work*, International Cooperative Publishing House, Burtonsville, Maryland, pg. 509.

[80] Bruce Thompson, *Canonical Correlation Analysis, Uses and Interpretations* Vol. 47, 1984, Sage Publications, Beverly Hills, CA.

[81] Fred N. Kerlinger, *Foundations of Behavioral Research, Third Edition*, CBS Publishing, 1986, pg. 290.

[82] Bruce Thompson, 1984.

sample possible. The third assumption is that there should not be large differences in the shapes of the distributions for the variables. All variables used in this study were studied for evidence of departure from normality. All variables appeared to have reasonably normal distributions.

Whenever performing experiments under field conditions, it appears that there is no complete assurance that the data meets all of these assumptions.[83] Considerable violation of these assumptions would typically result in limiting the robustness of the analytic technique. Therefore, multiple regression analysis was utilized to confirm and further explore the relationships that exist for hypotheses 1A, 1B and 2. The use of regression for this purpose will be discussed later in this chapter.

Using canonical correlation, the null hypotheses 1A, 1B and 2 can be restated as follows:

H_{1A} There are no significant canonical correlations between user satisfaction and perceptions of decision-making quality for academic department heads.

H_{1B} There are no significant canonical correlations between user satisfaction and perceptions of decision-making quality for managers within the controller's office.

H_2 There are no significant canonical correlations between user satisfaction and objectively measured productivity for managers within the controller's office.

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[83] Kerlinger, 1986.

These null hypotheses can be restated in notation form as follows:

$$H_{1a} : p_1 = p_2 = ... = p_s = 0$$

$$H_{1b} : p_1 = p_2 = ... = p_s = 0$$

$$H_2 : p_1 = p_2 = ... = p_s = 0$$

Where:

p_s = The user population relationships corresponding to the sample canonical correlation coefficients.

Joint nullity of all s canonical correlations would indicate the absence of any linear relationship between the predictor and the criterion variables for each hypothesis.

Multiple Regression Analysis

Multiple regression analysis was used to further explore and confirm relationships stated in hypotheses 1A, 1B and 2. Multiple regression is actually a specific case of canonical correlation analysis.[84] While canonical correlation predicts multiple criterion variables from multiple predictor variables, multiple regression predicts a single criterion variable from a set of predictor variables.

Once the canonical correlation analysis had been performed, multiple regression analysis was performed using each of the user satisfaction factors as criterion variables. The decision-making quality questions were the predictor

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[84] Bruce Thompson, 1984.

variables to test hypotheses 1A and 1B, while the administrative productivity measures were the predictor variables to test hypothesis 2. For example, there were three user satisfaction factors obtained from factor analysis for each of the user groups. Therefore, three multiple regression models were tested for each of the hypotheses 1A, 1B and 2. The multiple R^2 and the significance level of the F test were of primary concern in this analysis. The purpose of this analysis was to confirm the strength of relationships between the individual variables that appeared to be significant from interpretation of the canonical analyses. The hypothesized relationship can be written in notation form as:

$$S_j = P_1 + P_2 + ... + P_i$$

Where:

S_j = The jth user satisfaction factor

P_i = the ith productivity (decision-making quality or objectively measured productivity) variable

Hypotheses 3, 4A, 4B and 4C

Multiple regression was also used to test hypotheses 3, 4A, 4B, and 4C. Plots of data and stepwise regression were used in addition to multiple regression to explore these relationships. Tests of hypotheses 4A, 4B and 4C were performed to either confirm or reject relationships found in previous empirical research.[85]

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[85] Robert Zmud, "Individual Differences and MIS Success: A Review of the Empirical Literature" *Management Science*, Vol. 25, No. 19, 1979.

The relationships between all demographic variables and satisfaction were tested at the same time using an overall measure of user satisfaction as a dependent variable. The overall measure of satisfaction was used to test these hypotheses in order to be consistent with the previous research. As with the other hypotheses, each user group was tested separately.

Hypothesis 3 can be restated in notation form as follows:

$$S = E_1 + E_2 + ... + E_i$$

Where:

S = Overall user satisfaction

E_i = the ith length of experience variable

The coefficient of determination and the significance level of the F test were of primary interest here. Stepwise regression was performed after the multiple regression to observe which length of experience variables entered the model first, indicating the strongest relationship with overall satisfaction.

Hypotheses 4A, 4B and 4C can be restated in notation form as follows:

$$S = D_1 + D_2 + ... + D_i$$

Where:

S = Overall user satisfaction

D_i = the ith demographic variable

As with hypothesis 3, the coefficient of determination and the significance level of the F test were of primary interest. Stepwise regression was also performed after the multiple regression analysis to observe which demographic variables entered the model first.

Chapter Summary

This chapter has presented the methodology used in acquiring the data utilized in the research and has covered the methodology used in testing the hypotheses stated in Chapter 1.

The data for the research were acquired through questionnaires mailed to the controllers of 100 universities. These questionnaires were then distributed by the controllers to three managers within the controllers' offices and to three academic department heads within each university.

Each questionnaire consisted of two parts: Part A and Part B. Part A consisted of nineteen Likert-type questions about the user's satisfaction with FRS's inputs/outputs, problem finding assistance, and processing reliability and availability. Part B consisted of 20 questions. The first eight questions in Part B were designed to measure how much FRS had affected decision-making quality. The second half of Part B of the questionnaire consisted of demographic variables. Two pretests were conducted since the first pretest resulted in significant changes being made to the questionnaire.

The primary study questionnaires were mailed out on May 19, 1989. A first follow-up letter was sent to all nonrespondents on June 12, 1989 and a second follow-up letter was sent on July 12, 1989. Two weeks after the second follow-up letter had been mailed, telephone calls were made to all nonrespondents. At that time responses had been received from 35 colleges or universities, and 13 con-

trollers agreed to participate during telephone conversations. New questionnaire packets were mailed to these individuals on August 8, 1989.

Responses from the 13 colleges and universities that were mailed a second packet were used to test for a nonresponse bias. The findings of the nonresponse bias tests and interviews failed to indicate that nonrespondents were different from respondents in relation to the variables of the research.

The analysis of data methodology includes the use of factor analysis and canonical correlation analysis to test hypotheses 1A and 1B that there is no relationship between user satisfaction and decision-making quality for academic department heads or for managers within the controller's office. These methods were also used to test hypothesis 2 that there is no relationship between user satisfaction and objectively measured productivity for managers within the controller's office. Hypotheses 3, 4A, 4B and 4C state that there is no relationship between user satisfaction and demographic or personal variables, and were primarily tested with multiple regression analysis.

Chapter 4

Analysis of the Data ·

This chapter will present a summary of the statistics computed for each of the hypotheses stated in Chapter One, along with the results of the tests.

Tests of Hypotheses 1A and 1B

Hypothesis 1A stated that "there is no relationship between user satisfaction and perceptions of decision-making quality for academic department heads." Hypothesis 1B stated that "there is no relationship between user satisfaction and perceptions of decision-making quality for managers within the controller's office." This section will present the results of the tests of these hypotheses. However, prior to discussing these results it would be useful to briefly review the inferences which can be drawn from the rejection of, or failure to reject, hypotheses 1A and 1B.

Rejection of these hypotheses would provide evidence that the satisfaction of a user with a system is somehow correlated with the quality of decisions made using the information provided by the system. The controversial issue of using UIS as a surrogate measure of information system success is the primary reason for investigating this relationship. Information system success can be assessed in many ways, including analysis of changes in productivity levels of the users of a system. As mentioned in Chapter Two, the argument implied by most surrogation advocates is that if the users of a system are satisfied with the system, then they will be more productive. Therefore, rejection of hypotheses 1A and 1B would lend support for the surrogation argument in situations where the system related productivity of a user relates to the quality of decisions made using information and reports obtained from use of the system.

Rejection of both hypotheses would lend the strongest support to the surrogation argument since this would indicate a correlation between satisfaction and perceptions of decision-making quality for more than one type of user group. The managers in the controllers' offices use information from FRS on a daily basis for making a broad range of decisions. These decisions may include, but are not limited to, assessing controls over the accounts payable and financial accounting functions, fiscal planning and budgeting, and decisions related to purchasing. Each controller's office is managed differently, making it difficult at best to specify all of the decisions made by the managers using information from FRS. Decisions made by academic users have a narrower focus. Typically, these indi-

viduals use FRS on a weekly or monthly basis to make decisions related to operating budgets and to keep track of activity in research, grant, designated gift, and cash accounts. Therefore, rejection of hypotheses 1A and 1B would indicate a correlation between satisfaction and perceptions of decision-making quality for at least two different user groups.

Failure to reject hypotheses 1A and 1B would suggest that there is no support for assuming that greater satisfaction means greater productivity, at least where productivity relates to perceptions of decision-making quality. For example, the academic users may be satisfied with the outputs from FRS because the outputs are easier to read, contain more or less information, or are received more or less frequently than reports from a previous system. However, these same users may feel that changing to FRS has neither positively or negatively affected the quality of the decisions that they make.

In Chapter Three it was stated that hypotheses 1A and 1B would be tested using both factor analysis and canonical correlation, with factor analysis being performed only on the satisfaction variables and canonical correlation being used to test for relationships between satisfaction and perceptions of decision-making quality. Additionally, multiple regression analysis was performed to regress the decision-making quality variables on to each of the satisfaction factors in separate analyses. This was done to confirm and further explain results obtained from the canonical correlation. Prior to these analyses, however, the data were analyzed to identify missing data and patterns in missing data. An item was coded with a dot (.) whenever there was no response to the item. These are the items re-

ferred to here as missing data. Also, all of the variables were plotted against each other to identify outlyers, or unique relationships. The plots provided satisfactory evidence that there were no outlyers or unusual relationships.

A complete summary of the total number of individuals responding to each level of satisfaction or each level of perceived decision-making quality for each categorical question on the questionnaire is given in Appendix E. Responses from managers within the controller's office and academic users are listed separately.

Initially, the data were analyzed for trends in missing data. Since multivariate statistical techniques exclude all observations containing missing values from analysis, it was crucially important to minimize this potential problem. There was not a problem with missing satisfaction data for the managers in the controller's office. In fact, there were only three users who each left one question blank from the controller's offices. The academic users, on the other hand, consistently left satisfaction questions 3, 8, 11 and 16 blank. These four questions comprise all of the questions pertaining to procedures and instructions for inputting data. Since academic users typically are not involved in such activities, this was not a surprising finding. These four questions were eliminated from further analysis of satisfaction and perceptions of decision-making quality for academic users. In addition to finding missing values for these four questions, there were also approximately ten observations with missing items on different questions. A summary of the specific question responses that were predicted is given in Table 3.

Table 3. Summary of the Question Responses Predicted

	Controller's Office Mgrs.	Academic Users
Question #2		1
Question #5	1	2
Question #7		2
Question #13	1	2
Question #14		2
Question #15	1	1
Total	3	10

Values were estimated for these ten missing items and for the three missing items for managers in the controller's offices by using stepwise regression and regression to predict values for the missing items.

As discussed in Chapter Two, Jenkins and Ricketts used factor analysis and found that the questions grouped into satisfaction with four elements: the problem finding, problem solving, computer processing and input/output capabilities of a system. Questions pertaining to problem solving were deemed inappropriate for this study and were therefore eliminated. In order to predict values for missing items, the questions related to each of the remaining three elements of satisfaction were put in to stepwise regression models using the question number with the missing value as the dependent variable. For example, questions 2, 4, 9, 12 and 15 pertain to satisfaction with the information system for helping the users find problems or potential problems. If there was a missing value for question number 9 for one user, then the stepwise regression model would appear as follows:

$$A9 = a + b_1 A2 + b_2 A4 + b_3 A12 + b_4 A15$$

Where:

a, b_1, b_2, b_3, and b_4 = parameters of the relationship between question 9 and questions 2, 4, 12 and 15.

and

A9, A2, A4, A12 and A15 = the coded values for the satisfaction questions pertaining to the problem finding capabilities of an information system.

Only those items which contributed more than 2 percent to the total R-square were included in a regression model to predict values for the missing items.

Once the missing values were replaced with the predicted values, a prelimi-
nary factor analysis was performed on the satisfaction variables. From this anal-
ysis it was observed that three questions which failed to load on any factor in the
Jenkins and Ricketts study, also did not load on any factor for either user group
in this study. These three questions were questions number 1, 13 and 17 in this
study. These questions were therefore eliminated from the final factor analysis
in this study for both user groups. Table 4 summarizes the questions asked in the
Jenkins and Ricketts questionnaire and illustrates the changes made during de-
velopment and analysis in this study. The first six questions listed in Table 6 are
the questions from the Jenkins and Ricketts questionnaire pertaining to problem
solving. These questions were designed for users who interact with a decision
support system. As previously mentioned, these questions were deemed inap-
propriate for the users in this study, because they do not interact in this way with
FRS.

Factor Analysis

The varimax rotation method was used in the factor analysis of the satisfac-
tion variables for both sets of users. This method was used in order to be con-
sistent with the analysis performed by Jenkins and Rickett. The varimax rotation
is one of three major orthogonal approaches which have been developed and is

Table 4. Changes Made to the Jenkins and Ricketts Questionnaire

Item	Elimin-ated	Controller Managers Only	Both Groups	Not Used
13 MIS indicated good decisions?	**			
9 MIS indicated when problems found?	**			
2 MIS indicated bad decisions?	**			
18 MIS indicated when problems missed?	**			
21 Reports helped select alternatives?	**			
8 Reports helped form solutions?	**			
22 Input instructions easy to understand?		**		
11 Input procedures prevented errors?		**		
4 Input procedures easy to use?		**		
15 Input procedures easy to understand?		**		
10 Reports available at right time?			**	
14 Reports in best mode?			**	
24 Response time was good?			**	
6 Reports well-formatted?			**	
16 Reports were relevant?			**	
5 Reports helped identify problems?			**	
20 MIS gave right type of information?			**	
12 Reports had too much information?			**	
3 Reports easy to understand?			**	
19 Computer available all the time?			**	
7 Reliable computer system?			**	
23 Reports had too little information?				**
17 Reports in best sequence?				**
1 Report contents accurate?				**

Eliminated = Question eliminated from questionnaire
Manager Only = Only responses from managers retained for analysis
Both Groups = Responses from managers and academic users retained
Not Used = Questions asked but not used in analysis

the most widely utilized.[86] The rotated factor loadings, final communalities and percents of variance are presented in Table 5 for the academic users and Table 6 for managers within the controllers' offices. The factor loadings represent the the simple linear correlation between the individual independent variables and their respective factors. The communalities represent the percentage of variance that each variable contributes to the entire factor solution, while the percents of variance represent the amount of variance in user satisfaction explained by each factor.

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[86] Joseph F. Hair, Jr., R. E. Anderson, R. L. Tatham, and B. J. Grablowsky, *Multivariate Data Analysis* Petroleum Publishing Company, Tulsa, Oklahoma, 1979, pg. 230.

Table 5. Rotated Factor Loadings, Communalities, and Percents of Variance for Factor Analysis Performed on Satisfaction Responses from Academic Users.

Item	Problem Finding	Computer Processing	Output	Communalities
2 Reports easy to understand?	.77			.72
4 Reports helped identify problems?	.81			.70
5 Reports well-formatted?	.83			.74
9 Reports had too much information?	-.66			.47
12 Reports were relevant?	.74			.61
15 MIS gave right type of information?	.74			.76
6 Reliable computer system?		.79		.75
14 Computer available all the time?		.82		.72
10 Reports in best mode?		.70		.54
7 Reports available at right time?			.86	.82
18 Response time was good?			.84	.82
Percent of Variance	43.01	18.54	7.97	69.52

Table 6. Rotated Factor Loadings, Communalities, and Percents of Variance for Factor Analysis Performed on Satisfaction Responses from Managers in the Controllers' Offices.

Item	Input	Problem Finding	Computer Processing	Commun- alities
3 Input procedures easy to use?	.87			.81
8 Input procedures prevent errors?	.75			.71
11 Input procedures easy to understand?	.87			.80
16 Input instructions easy to understand?	.91			.87
2 Reports easy to understand?		.71		.54
4 Reports helped identify problems?		.63		.46
5 Reports well-formatted?		.82		.69
9 Reports had too much information?				.04
10 Reports in best mode?		.53		.31
12 Reports were relevant?		.69		.58
15 MIS gave right type of information?		.61		.48
6 Reliable computer system?			.77	.69
7 Reports available at right time?			.78	.68
14 Computer available all the time?			.65	.58
18 Response time was good?			.73	.60
Percent of Variance	36.26	12.21	10.51	58.97

A comparison of the Jenkins and Ricketts' results from factor analysis and the results presented here for both user groups will reveal both minor and major differences. One major difference is that three factors explain approximately twice the variance in this study than the four factors explain in the Jenkins and Ricketts study. In effect, this result lends greater support to the instrument as an overall measure of satisfaction than was found in the original study. However, it should be noted that it would be desirable to have an even higher percent of variance explained by the three factors. A higher percent of variance explained strengthens the argument for using the factors in subsequent testing of the relationship between satisfaction as measured by the factors and other constructs.

Another difference between Jenkins and Ricketts' results and the results from this study is the loading pattern for the factor that Jenkins and Ricketts labeled 'Input/Output'. As previously mentioned, the questions related to inputs were not included in the factor analysis for academic users because most are not involved with inputs and were not able to respond to these questions. Therefore, in Table 5, the factor pertaining to the remaining questions was labeled 'Output'. However, questions 5 and 10 which loaded on the 'Input/Output' factor in the Jenkins and Ricketts study did not load on the output factor in this study. Instead, question 5, pertaining to satisfaction with report formats, loaded on the problem finding factor while question 10, pertaining to satisfaction with the mode in which reports are delivered (CRT, Hardcopy, etc.) loaded on the computer processing factor. These findings are not terribly disconcerting as it would be highly unlikely to obtain identical results from factor analysis performed in two

studies with entirely different participants. For example, to a user, the mode in which reports are delivered is likely to be perceived as a computer processing factor, especially if the reports are typically delivered in only one mode.

Differences in the loading pattern of questions pertaining to the original 'Input/Output' factor were also observed for managers in the controllers' offices. All of the questions pertaining to satisfaction with inputs loaded separately on one factor. Two of the four remaining questions pertaining to satisfaction with outputs loaded on the problem finding factor while the other two loaded with computer processing. Accordingly, it was considered that four factors might be a better representation of overall satisfaction. Therefore, factor analysis was performed retaining four factors. There were no significant differences in loading patterns, suggesting that three factors were sufficient for the subsequent analysis. Again, these minor differences are not terribly disconcerting considering all of the other strong similarities and the higher percentage of variance explained.

Satisfaction and Decision-Making Quality for Controller's Office Managers

Initially, the relationship between satisfaction and perceptions of decision-making quality was examined by performing canonical correlation with the factors pertaining to satisfaction and the responses to the first eight decision-making quality questions from Part B of the questionnaire. Results concerning responses from managers in the controllers' offices will be discussed first.

The correlations between satisfaction and perceptions of decision-making quality (dmq) are moderate, the largest being .5367 between satisfaction with problem finding and the first dmq question, which pertains to the individual's belief that FRS has enabled them to make better operating budget decisions. This set of correlations is presented in Table 7.

There are larger within-set correlations for the decision-making quality (dmq) questions. A correlation matrix for the dmq variables is presented in Table 8. This matrix is the first indicator of which dmq variables are likely to be grouped together in the canonical variates. Within-set correlations for the satisfaction factors are not presented, because they were extremely low. Very low within-set correlations for the satisfaction factors are not surprising since responses to the satisfaction questions which are correlated were grouped together during factor analysis.

The canonical correlations, the squared canonical correlations, and the significance levels of each canonical correlation are presented in Table 9. The first canonical correlation is 0.719993, which would appear to be substantially larger than any of the between-set correlations. The probability level for the null hypothesis that all the canonical correlations are 0 in the population is .0026. Therefore, at the alpha = .05 level, there is strong evidence to conclude that at least the first satisfaction canonical variate (linear composite of factors) is related to the first decision-making quality (dmq) canonical variate (linear composite of dmq variables).

Table 7. Correlation Matrix for Decision-Making Quality Variables and Satisfaction with Inputs, Problem Finding and Computer Processing Factors for Managers in the Controllers' Offices

	DMQ1	DMQ2	DMQ3	DMQ4	DMQ5	DMQ6	DMQ7	DMQ8
Inputs	0.1111	0.1495	0.1614	0.0055	0.1791	0.1969	0.2611	0.1873
Prob. Find.	0.5367	0.3693	0.4285	0.3071	0.5134	0.3747	0.2239	0.2273
Comp. Proc.	0.3911	0.4272	0.3990	0.5093	0.2489	0.4450	0.4824	0.3888

Table 8. The Correlation Matrix for the Decision-Making Quality Variables for Managers in the Controllers' Offices

	DMQ1	DMQ2	DMQ3	DMQ4	DMQ5	DMQ6	DMQ7	DMQ8
DMQ1	1.0000	0.5259	0.6466	0.6984	0.8365	0.6551	0.5415	0.4179
DMQ2		1.0000	0.8240	0.6606	0.6943	0.8781	0.8321	0.8058
DMQ3			1.0000	0.7121	0.7276	0.8289	0.6588	0.6568
DMQ4				1.0000	0.7008	0.7928	0.6506	0.5888
DMQ5					1.0000	0.7948	0.7307	0.5971
DMQ6						1.0000	0.8700	0.7532
DMQ7							1.0000	0.7933
DMQ8								1.0000

Table 9. Canonical Correlations, Squared Canonical Correlations and Probability Levels Between Satisfaction and Decision-Making Quality for Managers in the Controller's Offices

	Canonical Correlation	Squared Canonical Correlation	Probability Level
First	0.719993	0.518390	0.0026
Second	0.615817	0.379230	0.0239
Third	0.576575	0.332439	0.0602

The variables are not measured in the same units since factor scores are the inputs for satisfaction and raw scores are the inputs for the decision-making quality variables. Therefore, the standardized coefficients rather than the raw coefficients should be interpreted. The standardized canonical coefficients are given in Table 10. These coefficients can be used to determine which of the individual variables influence the linear composites for each of the sets of variables and are analogous to beta weights in multiple regression analysis. The first canonical variable for the satisfaction factors is a weighted sum of satisfaction with problem finding (.3947) and computer processing (.8785) with more emphasis on computer processing. The coefficient for satisfaction with inputs is near 0.

The correlations between the individual variables and their respective canonical variables are given in Table 11. The correlations between problem finding and computer processing and the first canonical satisfaction variable (Canonical Var. 1 at top of Table 11) are both positive, with 0.4609 for problem finding and 0.9155 for computer processing.

Table 10. Standardized Canonical Coefficients Associated with the Canonical Variates for the Managers in the Controllers' Offices

Standardized Canonical Coefficients for the Satisfaction Variables

	Coeff. 1	Coeff. 2	Coeff. 3
Inputs	-0.0681	0.1553	0.9951
Problem Finding	0.3947	-0.8981	0.2115
Computer Processing	0.8785	0.4865	0.1138

Standardized Canonical Coefficients for the Decision-Making Quality Variables

	Coeff. 1	Coeff. 2	Coeff. 3
DMQ1	1.0468	-0.3182	-1.2189
DMQ2	0.3694	-0.7297	-0.8512
DMQ3	0.1501	0.3091	0.7542
DMQ4	0.3340	0.6089	-0.3674
DMQ5	-1.0739	-1.1369	1.1629
DMQ6	-0.2379	-0.4698	0.3428
DMQ7	0.5215	1.5534	0.6363
DMQ8	-0.0425	-0.0173	-0.0580

Table 11. Correlations Between Individual Variables and Their Canonical Variables for the Managers in the Controllers' Offices

Correlations Between the Satisfaction Variables and Their Canonical Variables

	Canonical Var. 1	Canonical Var. 2	Canonical Var. 3
Inputs	-0.2026	0.1392	0.9693
Problem Finding	0.4609	-0.8715	0.1676
Computer Processing	0.9155	0.4023	-0.0002

Correlations Between the Decision-Making Quality Variables and Their Canonical Variables

	Canonical Var. 1	Canonical Var. 2	Canonical Var. 3
DMQ1	0.7820	-0.5017	-0.0823
DMQ2	0.7096	-0.1634	0.4778
DMQ3	0.7064	-0.2690	0.5146
DMQ4	0.7892	-0.0441	0.2227
DMQ5	0.5682	-0.5068	0.5465
DMQ6	0.7297	-0.1453	0.5651
DMQ7	0.6867	0.1204	0.6279
DMQ8	0.5813	0.0229	0.4833

In Table 10 it is also shown that the coefficients (weights) of the individual decision-making quality (dmq) variables associated with the first dmq linear composite show a mixture of signs. The most significant coefficients[87] are associated with questions five (-1.0739), six (-0.2379), one (1.0468), two (0.3694), four (0.3340) and seven (0.5215), with the most weight on one, five and seven. All the correlations between these variables and the first decision-making quality (dmq) canonical variable are positive. Responses to questions five and six therefore appear to be suppressor variables, meaning that their coefficients and their correlations have opposite signs. Suppressor variables act to partial out or suppress any irrelevant variance on the other predictor variables so that the remaining variance on the other predictor variables is more strongly tied to the criterion variables.[88] A suppressor variable is a variable which is highly correlated with the corresponding predictor (independent) variables, but has low correlations with the criterion (dependent) variables. In other words, in addition of having different signs one would expect decision-making quality questions five and six to be highly correlated with the other decision-making quality (predictor or independent) variables, but have low correlations with the satisfaction (criterion or dependent) variables. However, from a closer observation of the correlations in Table 11, it appears that each of the individual decision-making quality (dmq) variables is fairly equally correlated with the decision-making quality canonical

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[87] Joseph F. Hair, Rolph E. Anderson, Ronald L. Tatham and Bernie J. Grablowsky. *Multivariate Data Analysis*, Petroleum Publishing Company, Tulsa, Oklahoma, 1979.

[88] James Stevens, *Applied Multivariate Statistics for the Social Sciences* Lawrence Erlbaum Associates, New Jersey, 1986, pg. 67.

variate. Also, the correlation matrix of decision-making quality variables in Table 8 gives no indication that questions five and six are more highly correlated with the decision-making quality variables than any of the other variables are with each other. In situations where the correlations are fairly equally distributed, the signs can be ignored and only the size of the relationships between sets of variables may be interpreted.

The general interpretation of the first canonical correlation is therefore that satisfaction with computer processing (the most heavily weighted satisfaction factor) is most strongly correlated with decision-making quality (dmq) question 1 (FRS enables better operating budget decisions), dmq 5 (FRS helped eliminate steps previously taken) and dmq 7 (FRS has made it easier to perform jobs well). The canonical redundancy analysis revealed that neither of the first pair of canonical variables is a good overall predictor of the opposite set of variables, the proportions of variance explained being 0.1886 for the satisfaction factors and 0.2528 for the decision-making quality variables. This means that while the canonical variates are significantly correlated with each other, the three satisfaction factors explain only 25 percent of the variance in the first satisfaction canonical variate, while the eight decision-making quality variables explain only 19 percent of the variance in the first decision-making quality canonical variate.

The second canonical correlation is 0.615817 (Table 9), which is also larger than any of the between-set correlations. The probability level that the second canonical correlation is 0 in the population is .0239. At the alpha = .05 level,

there is sufficient evidence to conclude that a second significant relationship exists between satisfaction and decision-making quality.

In contrast to the first canonical variate, the second canonical variate for the satisfaction variables is a weighted difference of satisfaction with problem finding (-0.8981) and computer processing (0.4865), with more emphasis on problem finding instead of computer processing (Table 10). The correlations between problem finding and computer processing and the second canonical variable (Table 11) are correspondingly negative for problem finding (-0.8715) and positive for computer processing (0.4023).

The second canonical variate for the dmq variables again shows a mixture of signs, subtracting variables one (-0.3182), two (-0.7297), five (-1.1369) and six (-0.4698) from variables three (0.3091), four (0.6089) and seven (1.5534). All of the correlations have corresponding signs with the coefficients.

The general interpretation, therefore, is that satisfaction with problem finding is correlated with decision-making quality variables two (FRS helps keep track of activity in research accounts better), five (FRS has allowed the elimination of previous steps taken) and seven (FRS has made it easier to perform jobs well). The canonical redundancy analysis showed that neither of the second pair of canonical variables was a good overall predictor of the opposite set of variables, the proportions of variance explained being 0.1189 and 0.0306. The cumulative proportions of variance explained was 0.3076 and 0.2834.

The third canonical correlation is 0.576575 (Table 9), and is only slightly larger than the largest between-set correlation, which is between decision-making

quality question one (dmq1) and satisfaction with problem finding (0.5367). The probability level that the third canonical correlation is 0 in the population is .0602. At the alpha = .05 level, there is insufficient evidence to conclude that a third significant relationship exists between satisfaction and decision-making quality. However, this canonical correlation may be strong enough to be of practical interest.

In contrast to the first and second canonical variates, the third canonical variate for the satisfaction variables (Table 10) represents almost exclusively satisfaction with-inputs (0.9951), with only marginal influence by satisfaction with problem finding (0.2115) and computer processing (0.1138). The correlation between inputs and the third canonical variate is positive (0.9693) (Table 11), and the correlation between satisfaction with problem finding and the third canonical variable is also positive, but small (0.1676). The correlation between satisfaction with computer processing and the third canonical variable is negative, but insignificant (-0.0002).

The third canonical variate for the dmq variables again shows a mixture of signs, subtracting variables one (-1.2189), and two (-0.8512) from variables three (0.7542) and seven (0.6363). Therefore, while the correlation is weak, there appears to be a the strongest relationship between satisfaction with inputs and decision-making quality question one (FRS enables better operating budget decisions).

The canonical redundancy analysis showed once again that neither of the third pair of canonical variables was a good overall predictor of the opposite set

of variables, the proportions of variance explained being 0.1072 and 0.0746. The cumulative proportions of variance explained was 0.4148 and 0.3580.

To confirm and clarify the results from the canonical correlation, regression analysis was performed using each of the satisfaction factors as the dependent variables and responses to the eight decision-making quality questions as independent variables. The factor pertaining to satisfaction with computer processing had the strongest relationship with the decision-making quality questions (R^2 = .5618, p = .0049). This is not surprising since the first and strongest canonical satisfaction variable was most heavily weighted by satisfaction with computer processing. It is also interesting to note that only decision-making questions one, five and seven had probability levels that were significant at alpha = .05. This is interesting because these three variables had the strongest influence on the first canonical decision-making quality variable.

As might be expected, the factor related to satisfaction with problem finding had the second strongest relationship with the decision-making quality questions (R^2 = .4368, p = .0524). This is not surprising because this factor had some influence on the first canonical satisfaction variable and had the strongest influence on the second canonical satisfaction variable. Only dmq question seven had a probability level that was significant at the alpha = .05 level. Question seven had the greatest influence on the second canonical dmq variable. The relationship between satisfaction with inputs and the dmq variables as measured by regression analysis was not significant at alpha = .05 (p = .1661).

Although similar overall relationships are confirmed with the regression analysis, some of the specific relationships between the satisfaction factors and the decision-making quality variables appear to different. Part of the differences are due to the moderate to high correlations between the dmq variables (See Table 8). Correlations within a group of variables is desirable for canonical correlation, since the motivation for performing canonical is that linear combinations of variables are expected to explain more variance than the individual variables can explain. On the otherhand, when performing regression analysis, it is desirable to have low intercorrelations among the independent variables. While the differences between the two methods are interesting to observe, canonical correlation is theoretically more appropriate in this analysis for two reasons:

- The primary purpose of the study is to investigate whether overall satisfaction, as measured by the combination of the three satisfaction factors, is a good surrogate for productivity, as measured here by effects on perceptions of decision-making quality. Therefore, overall measures of satisfaction and perceptions of decision-making quality are better than partial measures of each.

- The moderate to high intercorrelations among the raw satisfaction and the raw dmq variables suggest that linear combinations may present valuable information.

The relationships between satisfaction and perceptions of decision-making quality for academic users are not dramatically different from the relationships observed for managers within the controllers' offices. The simple correlations between the satisfaction factors and the dmq variables are given in Table 12.

The correlations between satisfaction and perceptions of decision-making quality (dmq) are slightly stronger than those found for the managers within the controller's offices, the largest being .6937 between problem finding and the eighth dmq question.

There are, again, larger within-set correlations for the decision-making quality questions. A correlation matrix for the decision-making quality variables is presented in Table 13. As anticipated, the within-set correlations for the satisfaction factors are extremely low, and are therefore not presented.

The first canonical correlation is 0.807992, which is larger than the first canonical correlation for managers within the controllers' offices, and would appear to again be substantially larger than any of the between-set correlations. The canonical correlations, squared canonical correlations and probability levels are given in Table 14. The probability level for the null hypothesis that all the canonical correlations are 0 in the population is .0001. Therefore, at the alpha = .05 level, there is strong evidence to conclude that the first satisfaction canonical variate is related to the first decision-making quality canonical variate for academic users as well.

Table 12.	Correlation Matrix for Decision-Making Quality Variables and Satisfaction with Problem Finding, Computer Processing and Output Factors for Academic Department Heads							
	DMQ1	DMQ2	DMQ3	DMQ4	DMQ5	DMQ6	DMQ7	DMQ8
Prob. Find.	0.5262	0.4931	0.4561	0.4093	0.5218	0.6311	0.6760	0.6937
Comp. Proc.	0.2339	0.5505	0.5610	0.3976	0.1256	0.2967	0.3001	0.3053
Outputs	0.0757	0.0352	0.0186	0.2224	0.2772	0.2089	0.2669	0.2991

Table 13. The Correlation Matrix for the Decision-Making Quality Variables for Academic Users

	DMQ1	DMQ2	DMQ3	DMQ4	DMQ5	DMQ6	DMQ7	DMQ8
DMQ1	1.0000	0.8002	0.7631	0.7527	0.6747	0.7314	0.6989	0.7186
DMQ2		1.0000	0.9373	0.7969	0.5666	0.6957	0.7011	0.7165
DMQ3			1.0000	0.7170	0.5071	0.6886	0.6886	0.7082
DMQ4				1.0000	0.6500	0.6595	0.7120	0.6929
DMQ5					1.0000	0.7798	0.7546	0.7558
DMQ6						1.0000	0.9081	0.8724
DMQ7							1.0000	0.9219
DMQ8								1.0000

Table 14. Canonical Correlations, Squared Canonical Correlations and Probability Levels Between Satisfaction and Decision-Making Quality for Academic Department Heads

	Canonical Correlation	Squared Canonical Correlation	Probability Level
First	0.807992	0.652851	0.0001
Second	0.683386	0.467017	0.0073
Third	0.344663	0.118793	0.5372

The standardized canonical coefficients are given in Table 15. The first canonical variable for the satisfaction factors is a weighted sum of satisfaction with problem finding (.8677) and outputs (.4112) with more emphasis on problem finding. The coefficient for satisfaction with computer processing is very low (.2048). The correlations between problem finding and outputs and the first canonical variable are both positive, 0.8839 for problem finding and 0.3965 for satisfaction with outputs. The correlations between the variables and their respective canonical variates is given in Table 16.

The first canonical variate for the decision-making quality (dmq) variables shows a mixture of signs, subtracting variables three (-0.5515) from questions two (0.5489), seven (0.3723) and eight (0.8347), with the most weight on eight. All the correlations between these variables and the first dmq canonical variate are positive. The general interpretation of the first canonical correlation is therefore that satisfaction with problem finding is correlated with decision-making quality question eight (benefitting greatly from the existence of FRS).

The canonical redundancy analysis revealed that the first pair of canonical variates are better overall predictors of the opposite sets of variables than was found with managers in the controller's office, but are still fairly weak. The proportions of variance explained are 0.2360 for the satisfaction variables and 0.4031 for the dmq variables.

The second canonical correlation is 0.683386, which is also larger than any of the between-set correlations. The probability level that the second canonical

Table 15. Standardized Canonical Coefficients for the Academic Users

Standardized Canonical Coefficients for the
Satisfaction Variables

	Coeff. 1	Coeff. 2	Coeff. 3
Problem Finding	0.8677	-0.1845	-0.4827
Computer Processing	0.2048	0.9441	0.2972
Outputs	0.4112	-0.4050	0.8190

Standardized Canonical Coefficients for the
Decision-Making Quality Variables

	Coeff. 1	Coeff. 2	Coeff. 3
DMQ1	-0.0451	-0.7589	-1.2750
DMQ2	0.5489	-0.6379	-0.2768
DMQ3	-0.5515	0.9686	-0.1313
DMQ4	-0.1297	0.1635	1.4823
DMQ5	-0.0624	-0.2558	0.1333
DMQ6	-0.0419	0.3563	0.0396
DMQ7	0.3723	-0.3057	-0.7617
DMQ8	0.8347	-0.4891	0.7502

Table 16. Correlations Between Individual Variables and Their Canonical Variables for Academic Users

Correlations Between the Satisfaction Variables and Their Canonical Variates

	Canonical Var. 1	Canonical Var. 2	Canonical Var. 3
Problem Finding	0.8837	-0.0451	-0.4659
Computer Processing	0.3427	0.8990	0.2725
Outputs	0.3965	-0.3528	0.8476

Correlations Between the Decision-Making Quality Variables and Their Canonical Variables

	Canonical Var. 1	Canonical Var. 2	Canonical Var. 3
DMQ1	0.6629	0.1363	-0.3553
DMQ2	0.6871	0.6066	-0.1324
DMQ3	0.6225	0.6630	-0.1992
DMQ4	0.6535	0.3070	0.2979
DMQ5	0.7333	-0.1316	0.0362
DMQ6	0.8593	0.1158	-0.1317
DMQ7	0.9379	0.0739	-0.0538
DMQ8	0.9746	0.0573	0.0026

correlation is 0 in the population is .0073. At the alpha = .05 level, there is suffi-cient evidence to conclude that a second significant relationship exists between satisfaction and perceptions of decision-making quality for academic users.

The second canonical variable for the satisfaction variables is a weighted dif-ference of satisfaction with computer processing (0.9441) and outputs (-0.4050), with more emphasis on computer processing. The correlations between computer processing and problem finding and the second canonical variable are corre-spondingly positive for computer processing (0.8990) and negative for computer processing (-0.3528).

The second canonical variable for the dmq variables again shows a mixture of signs, subtracting variables one (-0.7589), seven (-0.3057), and eight (-0.4891) from variables two (0.6379), three (0.9682) and six (0.3563). The general inter-pretation, therefore, is that satisfaction with computer processing is correlated with decision-making quality questions one (FRS enables better operating budget decisions) and three (FRS helps keep track of activity in grant and designated gift accounts better).

The canonical redundancy analysis showed that neither of the second pair of canonical variables was a good overall predictor of the opposite set of variables, the proportions of variance explained being 0.1376 and 0.0551. The cumulative proportions of variance explained was 0.3737 and 0.4582. The third canonical correlation did not approach significance, and is therefore not worth discussion.

Regression analysis was also performed for academic users, using each of the satisfaction factors as the dependent variables and responses to the eight

decision-making quality questions as independent variables. The factor pertaining to satisfaction with problem finding had the strongest relationship with the decision-making quality questions (R^2 = .8864, p = .0019). This is not surprising since the first and strongest canonical satisfaction variable was most heavily weighted by satisfaction with problem finding. Only decision-making question eight (benefitted greatly from the existence of FRS) had a probability level that was significant at alpha = .05 (p = 0.0012).

There appear to be no significant relationships between satisfaction with computer processing and the decision-making quality variables or between satisfaction with outputs and the decision-making quality variables. This is particularly surprising for computer processing because the second canonical correlation had a probability level of .0073, and the canonical satisfaction variable was heavily weighted by satisfaction with computer processing. However, as previously mentioned, the intercorrelations among the dmq variables could be responsible for differences in the outcomes of regression analysis and canonical correlation. The intercorrelations of the decision-making quality variables was even higher for the academic users than it was for the managers in the controllers' offices.

Tests of Hypothesis 2

Hypothesis 2 stated that "there is no relationship between user satisfaction and objectively measured productivity for managers in the controller's office." This section will present the results of the tests of this hypothesis. Prior to discussing these results, however, there will be a brief discussion of the inferences which can be drawn from the rejection of, or failure to reject, hypothesis 2.

The Hypothesis

Rejection of this hypothesis would provide evidence that the satisfaction of a user with a system is somehow correlated with productivity as measured by the administrative variables. Along with testing hypotheses 1A and 1B, the objective of testing this hypothesis is to investigate the controversial issue of using UIS as a surrogate measure of information system success. Rejection of hypothesis 2 would lend support for the surrogation argument in situations where the system related productivity of a user can be measured in terms of objectively measured administrative accounting variables. Failure to reject hypothesis 2 would suggest that there is no support for assuming that greater satisfaction means greater productivity, where productivity can be measured through objective accounting variables.

As with the analysis of hypotheses 1A and 1B, the relationship between satisfaction and objectively measured productivity was examined by performing canonical correlation with the factors pertaining to satisfaction and the responses to the list of administrative accounting variables (productivity measures). Before performing the analysis, however, the responses to the list of variables were used to calculate ratios. The primary objective of calculating the ratios was to create productivity measures out of the list of administrative variables completed by each college or university.

The list of productivity measures calculated from the responses to the list of administrative accounting variables include:

- Accounts Payable Transactions per Full Time Accounts Payable Employee Equivalents (APTFTE)

- Financial Accounting Transactions per Full Time Financial Accounting Employee Equivalents (FINTFTE)

- Rejected Accounts Payable Transactions per Full Time Accounts Payable Employee Equivalents (APRFTE)

- Rejected Financial Accounting Transactions per Full Time Financial Accounting Employee Equivalents (FINRFTE)

- Number of Vouchers per Full Time Accounts Payable Employee Equivalents (VOUCH1)

- Number of Vouchers per Full Time Accounts Payable and Financial Accounting Employee Equivalents (VOUCH2)

- Number of General Ledger Accounts per Full Time Accounts Payable and Financial Accounting Employee Equivalents (GENACCT)

- Number of Subsidiary Ledger Accounts per Full Time Accounts Payable and Financial Accounting Employee Equivalents (SSACCT)

- Number of Late Internal Reports per Number of Internal Reports (LATEIN)

- Number of Late External Reports per Number of External Reports (LATEEX)

Due to larger quantities of missing values for the number of vouchers, accounts payable transactions and accounts payable rejected transactions, productivity measures related to these variables were eliminated from further analysis. As previously mentioned, one missing value in an observation will cause the entire observation to be deleted in a multivariate analysis. Therefore, by eliminating productivity measures with missing values, the number of observations retained will be higher.

The correlations between satisfaction and the productivity measures are fairly low, the largest being -0.3041 between satisfaction with problem finding and late internal reports per total number of internal reports (LATEIN). These correlations are presented in Table 17. A correlation matrix for the ratio variables is presented in Table 18. From this Table, it can be seen that there are larger within-set correlations for the administrative productivity measures than there are between set simple correlations.

The first canonical correlation is 0.509455, which is not very large, but is larger than any of the between-set correlations. The canonical correlations, squared canonical correlations and probability levels are given in Table 19. The probability level for the null hypothesis that all the canonical correlations are 0 in the population is .0419. Therefore, at the alpha = .05 level, there is marginal evidence to reject the null hypothesis and conclude that the first satisfaction canonical variate is related to the first productivity canonical variate.

The standardized canonical coefficients are given in Table 20. The first canonical variable for the satisfaction factors is a weighted difference of satisfaction with inputs (.7842) and problem finding (-0.5326) with more emphasis on inputs. The coefficient for satisfaction with computer processing is near 0 (.0571). The correlations between inputs and problem finding and the first canonical variable are correspondingly positive for inputs (0.8464) and negative for satisfaction with problem finding (-0.6158). The correlations between the variables and their respective canonical variates is given in Table 21.

Table 17. Correlation Matrix for the Productivity Measures and the Satisfaction with Inputs, Problem Finding and Computer Processing Factors for the Managers in the Controllers' Offices

	FINTFTE	FINRFTE	GENACCT	SSACCT	LATEIN	LATEEX
Inputs	0.1886	-0.1525	-0.0477	0.0248	0.1309	-0.1969
Prob. Find.	0.1411	0.1556	0.2596	0.2401	-0.3041	0.0602
Comp. Proc.	0.0264	0.0629	0.0556	0.1237	-0.1128	-0.1509

Table 18.   The Correlation Matrix for the Productivity Measures

	FINTFTE	FINRFTE	GENACCT	SSACCT	LATEIN	LATEEX
FINTFTE	1.0000	0.2245	0.5573	0.2498	-0.2231	-0.1803
FINRFTE		1.0000	0.7493	0.6756	0.1387	-0.1242
GENACCT			1.0000	0.8312	-0.1131	-0.1200
SSACCT				1.0000	-0.0835	-0.1177
LATEIN					1.0000	0.2789
LATEEX						1.0000

The first canonical variable for the productivity variables shows a mixture of signs, subtracting rejected financial accounting transactions per full time employee equivalents (FINRFTE) (-0.5901), number of general ledger accounts per full time employee equivalents (GENACCT) (-0.8916) and late external reports per total external reports (LATEEX) (-0.4254) from financial transactions per full time employee equivalents (FINTFTE) (0.6856), subsidiary ledger accounts per full time employee equivalents (SSACCT) (0.7884) and number of late internal reports per total number of internal reports (LATEIN) (0.8250) with the weight of the variables fairly well distributed. The canonical redundancy analysis revealed that the first pair of canonical variables are not good overall predictors. The proportions of variance explained are 0.0966 for the satisfaction variables and 0.0281 for the administrative productivity measures. No other canonical correlations were significant.

Table 19. The Canonical Correlations, Squared Canonical Correlations and Probability Levels Between Satisfaction and Objectively Measured Productivity

	Canonical Correlation	Squared Canonical Correlation	Probability Level
First	0.509455	0.259544	0.0419
Second	0.390981	0.152866	0.2743
Third	0.207340	0.042990	0.6360

Table 20. The Standardized Canonical Coefficients for the Relationships Between Objective Measures of Productivity and Satisfaction

Standardized Canonical Coefficients for the Satisfaction Variables

	Coeff. 1	Coeff. 2	Coeff. 3
Inputs	0.7842	0.4717	0.4306
Problem Finding	-0.5326	0.7621	0.3830
Computer Processing	0.0571	0.4805	-0.8817

Standardized Canonical Coefficients for the Productivity Measures

	Coeff. 1	Coeff. 2	Coeff. 3
FINTFTE	0.6856	0.4921	1.0570
FINRFTE	-0.5901	-0.5344	0.8010
GENACCT	-0.8916	-0.3545	-1.0811
SSACCT	0.7884	1.1571	0.1481
LATEIN	0.8250	-0.3398	0.0023
LATEEX	-0.4254	0.0239	0.7255

Table 21. Correlations Between Individual Variables and Their Canonical Variates for Satisfaction and Productivity Measures for Managers in the Controllers' Offices.

Correlations Between the Satisfaction Variables and Their Canonical Variates

	Canonical Var. 1	Canonical Var. 2	Canonical Var. 3
Inputs	0.8464	0.4427	0.2960
Problem Finding	-0.6158	0.7079	0.3459
Computer Processing	0.1458	0.5237	-0.8393

Correlations Between the Productivity Measures and Their Canonical Variates

	Canonical Var. 1	Canonical Var. 2	Canonical Var. 3
FINTFTE	0.0743	0.2092	0.1120
FINRFTE	-0.2060	0.0165	0.0494
GENACCT	-0.1725	0.2020	0.0298
SSACCT	-0.1013	0.2541	-0.0064
LATEIN	0.2581	-0.2242	0.0394
LATEEX	-0.1179	-0.0731	0.1137

Regression analysis was also performed to confirm the results of the canonical analysis for hypothesis 2. Again, each of the satisfaction factors were used as the dependent variables and the six productivity measures were used as the independent variables. The factor pertaining to satisfaction with inputs had the strongest relationship with the productivity measures (R^2 = .2197, p = .0234). This is not surprising since the first canonical satisfaction variate was most heavily weighted by satisfaction with inputs. Financial transactions per full time employee equivalents (FINTFTE) (p = 0.0120), subsidiary accounts per full time employee equivalents (SSACCT) (p = 0.0254) and late internal reports per total number of internal reports (LATEIN) (p = 0.0279) all had probability levels that were significant at the (alpha = .05) level.

Regression analysis also uncovered a marginally significant relationship between satisfaction with problem finding and the productivity measures (R^2 = 0.1802, p = 0. 0688). The only productivity measure that appears to have a significant probability level is late internal reports per total number of internal reports (LATEIN) (p = 0.0115).

Tests of Hypothesis 3

Hypothesis 3 states that "there is no relationship between a user's length of experience with an information system and a user's satisfaction with a system." A nondirectional rejection of this hypothesis would indicate that users with either

more or less experience with a system have higher satisfaction. Either direction is theoretically arguable. Users with less experience might be more satisfied because they know less about the problems with the system. However, a positive correlation between satisfaction and experience is more intuitively appealing. It is human nature to resist change. Therefore, an individual with very little experience, and thus still in the learning process with the system, is not very likely to be highly satisfied with the system. Accordingly, an individual with a great deal of experience with the system would feel more comfortable with the system, and might be more likely to report a high level of satisfaction with the system. Failure to reject the hypothesis would indicate that there is neither a positive or a negative relationship between satisfaction and length of experience.

To test hypothesis three, regression analysis was used with an overall measure of satisfaction as the dependent variable and responses to five questions related to length of experience as the independent variables. A question asking about overall satisfaction with FRS was included in the satisfaction portion of the questionnaire (Question 19). To examine how well the questions taken from the Jenkins and Ricketts questionnaire accounted for overall satisfaction with FRS, regression analysis was performed using the overall question as a dependent variable. The results indicate that the Jenkins and Ricketts questions were a very strong indicator of overall satisfaction (R^2 = .9806, p = 0.0003) for academic users. However, the relationship was not as strong for the managers within the controllers' offices (R^2 = .7339, p = 0.0001).

Since it is conceivable that both user groups could be combined for analysis where satisfaction is measured with one global question, this was initially considered. A t-test was performed to analyze the difference in the mean response from the two user groups on the overall satisfaction question. On a seven-point Likert-type scale, the mean response from managers in the controllers' offices was 5.038. The mean response from academic users was 3.863. The difference between the mean scores was highly significant (alpha = .0005). One potential reason for this difference could be that FRS was designed first and foremost to meet the needs of users in the controller's offices. Due to the significant difference in overall satisfaction, each group was analyzed separately.

The questions related to length of experience were included in Part B of the questionnaire. The questions included in this analysis were questions nine, eleven, seventeen, eighteen and nineteen, and inquired about the following:

9. Maintenance of a separate and independent accounting information system

11. Mandatory usage of FRS

17. Length of experience with FRS

18. Frequency of use of FRS

19. Length of experience with similar application systems

The results from regression analysis for managers within the controllers' offices indicated that there is no relationship between experience and user satisfaction ($R^2 = 0.0272$, p = 0.4303). Stepwise regression was also performed and no variables entered the model for controller's office managers as having a significant relationship with overall satisfaction. The results of these analyses, however, may be somewhat misleading for this user group. One reason to believe that the results are misleading is that the only two questions pertaining to experience that were significantly related to satisfaction for the academic users could not enter the regression model because they were answered the same by virtually all of the users in this group. The first question asked whether usage of FRS was mandatory, and was consistently answered 'yes'. The second question pertained to how frequently FRS is used by the respondents and was consistently answered 'daily' by the users in this group.

Another reason to believe that the results for users in the controllers' offices may be misleading is that the mean response to overall satisfaction is higher than the mean response to overall satisfaction for academic users. The evidence that overall satisfaction is higher for the managers in the controller's offices coupled with the evidence that these users have more experience with FRS via greater frequency of use suggests that there could be a positive correlation between satisfaction and experience.

The results from regression analysis performed for academic users are simpler to interpret. At the alpha = .05 level, there appears to be a significant positive correlation between experience as measured by the five variables and overall sat-

isfaction (R^2 = .1980, p = 0.0265). The R^2 is fairly low, but it is reasonable that experience alone would only account for a small portion of overall satisfaction. Variables that had significant relationships with overall satisfaction include responses to questions eighteen (p = 0.0072) and eleven (p = 0.0348). Plots of responses to each question with overall satisfaction indicated that mandatory usage and a higher frequency of use are positively correlated with greater satisfaction. Responses to question nineteen also appear to be marginally significant (p = 0.0842). Stepwise regression confirmed these results with responses to eighteen entering the model first (R^2 = 0.066, p = 0.0427), followed by responses to eleven (R^2 = 0.122, p = 0.0213) and finally responses to nineteen (R^2 = 0.174, p = 0.0107).

Tests of Hypotheses 4A, 4B and 4C

Prior to discussing the relationships between satisfaction and the demographic variables, the hypotheses will be restated and the inferences which can be drawn from the rejection of, or failure to reject, these hypotheses will be briefly discussed. The relationships between all demographic variables and satisfaction were tested at the same time using a measure of overall user satisfaction as a dependent variable in a regression model. As with the other hypotheses, hypotheses 4A, 4B and 4C were tested separately for each user group.

Hypothesis 4A states that "there is no relationship between a user's age and a user's satisfaction with an information system." In a meta-analysis of the literature, Zmud[89] observed that older individuals tend to exhibit less positive attitudes toward MIS. Similarly, it was observed that individuals with longer tenure tend to be less satisfied with a MIS. One potential explanation for this behavior is that older individuals in our current society have not had relatively much exposure to computer technology and may be resistant to change. As generations with greater exposure to computer technology age, future research in this area may not reveal similar relationships.

Rejection of hypothesis 4A would suggest that a relationship between age and satisfaction does exist at the present time. This observation could perhaps lead to a better understanding of motivational and training requirements for users of different ages at least for the present time. Failure to reject this hypothesis might suggest that all users have had more time to adjust to the relatively sudden appearance of computerized technology in the work force. As the adjustment period passes there may be less resistance to computerization and thus potentially higher levels of satisfaction.

Hypothesis 4B states that "there is no relationship between a user's sex and a user's satisfaction with an information system." In the same meta-analysis by Zmud, it was observed that males tend to exhibit less positive attitudes toward

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[89] Robert Zmud, "Individual Differences and MIS Success: A Review of the Empirical Literature," *Management Science*, Vol. 25, No. 19, 1979.

MIS. This observation is based primarily on a study conducted by Mann and Williams[90]. One potential explanation for this finding relates to the time period in which the study was conducted. Until very recently there have been relatively few women in managerial positions. Typically women have held jobs where they relied upon some degree of technical skill. Also, until very recently MIS was used primarily to support data processing, and individuals in managerial positions have had little need for a technical understanding of MIS. Therefore, managers, and thus males, may have been less motivated to become involved with MIS.

Rejection of hypothesis 4B would suggest that there is, in fact, some relationship between a user's sex and a user's satisfaction. Failure to reject this hypothesis would suggest that no such relationship exists, perhaps reflecting a higher integration of both women and technology into the managerial work force.

Hypothesis 4C states that "there is no relationship between a user's level of education and a user's satisfaction with an information system." Zmud observed that there have been conflicting results in this area. Specifically, the results of some empirical research suggests that less educated individuals are less satisfied with a MIS while other research suggests that individuals characterized by more education tend to be less satisfied with a MIS. Both findings are theoretically arguable. Individuals with less education may have had less formal training to help them understand and utilize a MIS most effectively. On the otherhand, individuals with a higher level of education may be at a level where they understand a MIS or their personal needs from a MIS well enough to know of changes

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[90] F. C. Mann and L. K. Williams, "Observations on the Dynamics of a Change to Electronic Data Processing Equipment," *Administrative Science Quarterly* Vol. 5, 1960, pp. 217-256.

that need to be made to the system in order for them to receive the optimum benefit.

Rejection of hypothesis 4C in this study would suggest that a relationship does exist between satisfaction and level of education. A significant negative correlation would support research stating that individuals with a high level of education tend to be less satisfied with a MIS. A significant positive correlation would support research stating that individuals with a low level of education tend to be less satisfied with a MIS. Failure to reject hypothesis 4C would suggest that there is no relationship between level of education and user satisfaction. It should be noted that the majority of individuals surveyed in this study have at least a bachelor's degree and that the majority of academic users have a doctorate degree. Therefore, the a priori expectation would be to find a negative relationship between satisfaction and level of education if a relationship does exist.

Analysis of Hypotheses

The question pertaining to overall satisfaction was used to test the relationships between satisfaction and the demographic variables instead of using the measures of satisfaction on specific factors. This was done to be consistent with previous studies analyzing similar relationships. Also, as previously mentioned, all of the demographic variables were entered at once as independent variables. These variables are responses to questions thirteen, fourteen and fifteen in part B of the questionnaire.

Results from analysis of responses from users within the controllers' office indicated that there is no relationship between overall satisfaction and any of the demographic variables (R^2 = 0.0133, p = 0.7590). Stepwise regression analysis confirmed these results as none of the demographic variables entered into the regression equation.

From the analysis of responses from academic users there appear to be moderately significant relationships between overall satisfaction and demographics (R^2 = 0.1363, p = 0.0556). Specifically, the strongest relationship appears to be between overall satisfaction and sex (p = 0.1031) (46 males and 31 females) although this relationship is quite weak. Plotting the relationship between overall satisfaction and sex revealed that males seem to be slightly less satisfied with FRS than females. This finding is consistent with the previous research performed by Mann and Williams. Stepwise regression analysis confirmed these results, with sex entering the regression equation first (R^2 = 0.04, p = 0.0993), followed by age (R^2 = 0.0753, p = 0.0755), both of which have a marginal significance level.

Chapter Summary

This chapter has presented the analysis of the data collected during this research project and has stated the inferences which may be drawn from the results of the hypothesis testing. A summary of the hypotheses findings is given in Table 22.

Table 22. Summary of Hypotheses Rejected and Not Rejected

	Rejected	Not Rejected	Rejected Only for Academic Users
H1A: No relationship between satisfaction and perceptions of decision-making quality (academic users)	****		
H1B: No relationship between satisfaction and perceptions of decision-making quality (controller' office)	****		
H2: No relationship between satisfaction and objective productivity measures (controller's office)	****		
H3: No relationship between satisfaction and length of experience			****
H4A: No relationship between satisfaction and age of user		****	
H4B: No relationship between satisfaction and sex of user			****
H4C: No relationship between satisfaction and education level of user		****	

The tests of hypotheses 1A and 1B produced substantial evidence that user satisfaction is related to perceptions of decision-making quality for managers in the controllers' offices and for academic users. Specifically, within the controller's office, satisfaction with computer processing appears to be related to helping users make better operating budget decisions and to making their jobs easier to perform. Also, satisfaction with how well FRS facilitates problem finding appears to be correlated with making jobs easier to perform and to elimination of steps taken prior to installation of FRS by users in the controllers' offices.

Results of the analyses show that the significant relationships between satisfaction and perceptions of decision-making quality for academic users are moderately stronger than those found for managers. The strongest correlation for academic users appears to be primarily between satisfaction with problem finding and helping users keep track of activity in research accounts, as well as giving them the feeling that they have benefitted overall from the existence of FRS in the university. The second relationship for academic users appears to be between satisfaction with computer processing and helping users make better operating budget decisions, keep track of activity in research accounts and keep track of activity in grant and designated gift accounts.

The findings on the tests of hypothesis 2 indicated that there is also a significant relationship between user satisfaction and productivity as measured by administrative accounting ratios. The strongest relationship found was between a weighted satisfaction with inputs and problem finding, and financial transactions per full time employee equivalents, late internal reports per total number of

internal reports and the number of ledger accounts per full time employee equivalents. No other statistically significant relationships appear to exist.

The evidence from tests of hypothesis 3 indicates that overall, there appears to be a relationship between user satisfaction and frequency of system use. Managers use FRS on a daily basis while academic users tend to use the system on a monthly or occasionally on a weekly basis. Also, the mean response on a question pertaining to overall satisfaction for managers was 5.038, while the mean response on the same question by academic users was 3.863. There also seems to be a positive correlation between satisfaction and mandatory usage of FRS for academic users.

Finally, tests of hypothesis 4A, 4B and 4C indicate that there are no relationships between satisfaction and sex, age, or level of education for users in the controllers' offices. There does appear to be, however, a marginal relationship between user satisfaction and sex. Specifically, males seem to be less satisfied with FRS than females.

Chapter 5

Summary, Conclusions, and Recommendations for Additional Research

This chapter will summarize the research, present the conclusions reached, and suggest some possibilities for extension of the research.

Summary

User satisfaction with an information system has often been proposed as a surrogate measure for the success of an information system. Specifically, it has been proposed that a user who is satisfied with an information system will be more productive, and therefore the system will be a success. Additionally, it has been assumed until very recently that the productivity of white collar workers is too difficult to measure. As a result, several attempts have been made to develop instruments that will accurately measure the satisfaction of users with an information system, and have been advocated as surrogate measures of white collar productivity.

Some of the critics of this area of research state that there is no evidence to support the measurement of satisfaction as a surrogate for productivity. While satisfaction may be important for a system to gain acceptance in a particular environment, there is no empirical evidence to suggest that satisfaction is linked to productivity. In fact, these opponents refer to research in organizational behavior which indicate that there is no relationship between job satisfaction and productivity. Meanwhile, several developments have been made in the area of directly measuring white collar productivity, yet there have been no known attempts to tie white collar productivity to user satisfaction.

In this study, the relationship between user satisfaction and white collar productivity was investigated. One information system, FRS, was chosen for this study for several reasons. The system is well documented and is used by approximately 260 institutions, consisting primarily of colleges and universities in the United States. This provided a mature and stable environment for testing the hypotheses. Also, choosing a sample from a wide cross section of homogeneous users is preferable to trying to test the hypotheses with users of a variety of dissimilar information systems.

Two user groups were chosen for this study because of the vast differences in the ways that the two groups utilize the system. Specifically, there are academic users who employ FRS primarily to support budgetary decisions. Typically these users rely on reports generated by FRS and are not involved with inputs to the system. The second group of users are managers within the controllers' offices of universities. These users employ outputs to support decisions, but are also in-

volved with inputs to the system, and use the system much more frequently than the academic users.

Included in the limitations of this study is the fact that no attempt to examine the underlying constructs of UIS or improve its measurement is made. Also, no attempt was made to assess changes in individual satisfaction. Other limitations include the exploratory nature of white collar productivity measurement, the use of subjects in a nonprofit environment, and a potential bias between satisfaction and perceived decision-making quality.

The objectives of this research were to provide empirical evidence concerning: (1) the relationship between user satisfaction and the quality of decisions made by managers within controllers' offices of universities, and of academic department heads in the same universities; (2) the relationship between user satisfaction of the same managers and objectively measured productivity for departments within the controllers' offices; (3) the relationship between a user's length of experience with an information system and their satisfaction with that system; and (4) the relationship between a user's age, sex, or level of education and their satisfaction with an information system.

To direct the research toward accomplishment of its objectives the following null hypotheses were established and tested:

Hypothesis 1A

There is no relationship between user satisfaction and perceptions of decision-making quality for academic department heads. User satisfaction was measured in this study by using pertinent parts of the Jenkins and Ricketts questionnaire.

Decision-making quality was assessed by having the participants complete a section of a questionnaire designed to measure how they feel the use of FRS has affected the quality of the related decisions they must make. Rejection of this hypothesis supports the conclusion that the satisfaction of at least one type of user group is somehow related to productivity, as measured by the decision-making quality of the participants. Indication of a positive correlation between user satisfaction and decision-making quality would lend support for the surrogation argument in situations where the system related productivity of a user relates to the quality of decisions made using information and reports obtained from use of the system.

Hypothesis 1B

There is no relationship between user satisfaction and perceptions of decision-making quality for managers within the controller's office. The same instruments were used to test this hypothesis that were used to test hypothesis 1A. Since there are large differences in the ways that the two user groups employ FRS, a comparison of similarities and differences from the results of testing hypotheses 1A and 1B is more meaningful than an evaluation of the results for just one group. Rejection of hypothesis 1B alone would support the conclusion that the satisfaction of at least one type of user group is somehow related to productivity for this group. However, rejection of hypotheses 1A and 1B would lend the strongest support to the surrogation argument, since this would indicate a correlation between satisfaction and decision-making quality for more than one type of user group.

Hypothesis 2

There is no relationship between user satisfaction and objectively measured productivity for managers within the controller's office. Satisfaction was measured with the same responses to the Jenkins and Ricketts questionnaire mentioned above. The objective measures of productivity consisted of ratios that were calculated from responses to a list of administrative accounting variables. Rejection of hypothesis 2 alone supports the surrogation argument in situations where the system related productivity of a user can be measured in terms of objectively measured administrative accounting variables. The strongest support is given to the surrogation argument by the rejection of hypotheses 1A, 1B and 2. This indicates that a relationship exists between satisfaction and productivity, as measured subjectively and objectively, for more than one type of user group.

Hypothesis 3

There is no relationship between a user's length of experience with an information system and a user's satisfaction with a system. A nondirectional rejection of this hypothesis indicates that users with either more or less experience with a system have higher satisfaction. Users with less experience might be more satisfied because they know less about the problems with the system. On the other hand, an individual with a large amount of experience might feel more comfortable with the system, and might be more likely to report a high level of satisfaction with the system.

Hypothesis 4A

There is no relationship between a user's age and a user's satisfaction with an information system Rejection of hypothesis 4A suggests that a relationship between the age of a user and satisfaction exists. To be consistent with previous research, a negative correlation would be expected between satisfaction and the age of a user. However, as generations with greater exposure to computer technology get older, future research in this area may not reveal similar relationships.

Hypothesis 4B

There is no relationship between a user's sex and a user's satisfaction with an information system Rejection of this hypothesis indicates that user satisfaction is related to the sex of the user. Previous research in this area suggests that males tend to exhibit less positive attitudes toward management information systems. One potential explanation is that until very recently women have typically held jobs where they had to rely on a technical skill instead of holding managerial positions. Also, until very recently MIS has been used primarily to support data processing, a typically secretarial function. Therefore, managers, and thus males, may have been less motivated to become involved with MIS.

Hypothesis 4C

There is no relationship between a user's level of education and a user's satisfaction with an information system. Research in this area has uncovered mixed results. The finding of a significant negative correlation in this study would support research stating that individuals with a high level of education tend to be less satisfied with an MIS. On the otherhand, a significant positive correlation would support research stating that individuals with a low level of education tend

to be less satisfied with an MIS. Since the majority of users surveyed in this study had at least a bachelor's degree, the apriori expectation was to find a negative relationship between satisfaction and level of education.

Previous research

A broad range of research has been conducted to develop approaches to measuring the effectiveness or productivity of information systems. Approaches which have been advocated include MIS usage estimation, user satisfaction, incremental performance in decision making effectiveness, cost-benefit analysis, information economics, utility analysis, the analytic hierarchy approach, and information attribute examination. However, leading researchers involved in a roundtable discussion at the 1985 International Conference on Information Systems concurred that the emphasis in research is shifting from efficiency to user effectiveness, and that the focus has been on either MIS usage or user perceived effectiveness.

The perceived effectiveness approach uses measures of effectiveness as perceived by users of the system. Examples of such measures include user satisfaction and perceived system quality. The research on user information satisfaction (UIS) may be classified into two areas: (1) development and measurement of the UIS concept, and (2) identifying the proper role of UIS in research. This research pertained primarily to the latter classification, although the conceptualization of

UIS was discussed to clarify why the Jenkins and Ricketts characterization and questionnaire were employed.

This research reviewed the various conceptualizations of UIS, as well as the most prominent instruments which have been developed to measure user satisfaction. Perhaps the most frequently cited instruments are the Bailey and Pearson and the Ives, Olson and Baroudi questionnaires. This fact, combined with the fact that the Bailey and Pearson questionnaire tests user satisfaction with the most complete list of factors, the Bailey and Pearson questionnaire was used for the original pilot test during the research efforts involved here. From the pilot study, however, it was learned that many users found the questions confusing and difficult to answer. There was also indication that system users at the academic level were only able to evaluate the output quality aspects of the information system, while users in the controllers' offices were best qualified to answer questions pertaining to output, input and processing quality.

For these reasons, the Jenkins and Ricketts questionnaire, which focuses on the information system product alone, appeared to be the best choice for conducting the primary study. A second pilot study was conducted and this decision was confirmed. While this instrument may not be the most frequently cited in the literature, it is increasing in popularity, and its advocates believe that it is the most rigorously developed and theoretically sound instrument.

In addition to user satisfaction, current developments in measuring white collar productivity were discussed. Most noteworthy, are the developments by the American Productivity Center (APC) of objective white collar productivity

measurement tools. A copy of the measures developed by the APC was obtained and circulated among select controller's office personnel and several of the measures were approved as appropriate and available for measuring productivity in this study. Additionally measures were also listed by some of the members who participated. Subjective measures of decision-making quality were selected through a review of the literature and from additional suggestions made by deans, department heads and principle investigators at Virginia Polytechnic Institute and State University.

Methodology and Analysis of the Data

The data for the research were acquired through a set of six questionnaires mailed to the controller of 100 colleges and universities that use FRS. The controller was instructed to distribute the questionnaires to the managers of general accounting, accounts payable and financial reporting within the controller's office, and to the heads of the Biology, Accounting and Chemistry academic departments. It was established through informal interviews that most controllers believe the results of this study can help them understand more clearly the needs of those using FRS. Therefore, it was reasoned that the controller would be more motivated to get the questionnaires completed and returned than anyone else on campus. In addition, the controller was asked to complete the list of administrative accounting variables.

The final questionnaire consisted of two parts. Questions in Part A of the questionnaire were taken from the Jenkins and Ricketts questionnaire. The first half of Part B consisted of questions pertaining to how decision-making quality has been influenced by the utilization of FRS. The second half of the questionnaire consisted of demographic variables.

The primary study questionnaires were mailed out on May 19, 1989. A first follow-up letter was mailed to nonrespondents on June 12, 1989 and a second follow-up mailing was made on July 12, 1989. Telephone calls were made to the controllers of all the universities from whom no response had been received during the last week of July. A second packet of questionnaires was sent to 13 schools agreeing to participate. These questionnaires were mailed on August 8, 1989. Attempts, including additional letters and telephone calls, were made to obtain as many responses as practical.

Factor analysis was performed on responses to the user satisfaction portion of the questionnaire. The varimax rotation method was used to verify the factors obtained by Jenkins and Ricketts. Canonical correlation was used to test the relationships stated in hypotheses 1A, 1B and 2. The factors obtained from factor analysis were used as input for user satisfaction, while the raw data were used as input for decision-making quality, demographics, and administrative productivity measures. Regression analysis was used to further explore and confirm these relationships.

Hypothesis 3 that there is no relationship between length of experience and satisfaction was tested with regression analysis. Plots of data and stepwise were used in addition to regular regression to explore this relationship.

Hypotheses 4A, 4B and 4C that there are no significant relationships between user satisfaction and the demographic variables age, sex and education were also tested with regression analysis. Plots of data and stepwise were utilized to explain relationships for these hypotheses as well. Each of the user groups were tested independently.

The test of hypotheses 1A and 1B produced substantial evidence that user satisfaction is related to perceptions of decision-making quality for managers in the controllers' offices and for academic users. Specifically, within the controller's office, satisfaction with computer processing appears to be related to helping users make better operating budget decisions and to making their jobs easier to perform. Also, satisfaction with how well FRS facilitates problem finding appears to be correlated with making jobs easier to perform and to elimination of steps taken prior to installation of FRS by users in the controllers' offices.

Results of the analyses show that the significant relationships between satisfaction and perceptions of decision-making quality for academic users are moderately stronger than those found for managers. The strongest correlation for academic users appears to be primarily between satisfaction with problem finding and helping users keep track of activity in research accounts, as well as giving them the feeling that they have benefitted overall from the existence of FRS in the university. The second relationship for academic users appears to be between

satisfaction with computer processing and helping users make better operation budget decisions, keep track of activity in research accounts and keep track of activity in grant and designated gift accounts.

The findings on the tests of hypothesis 2 indicated that there is also a significant relationship between user satisfaction and productivity as measured by administrative ratios. The strongest relationship found was between a weighted satisfaction with inputs and problem finding, and financial transactions per full time employee equivalents, late internal reports per number of internal reports and number of general ledger accounts per full time employee equivalents. No other statistically significant relationships appear to exist.

The evidence from the tests of hypothesis 3 involving multiple regression failed to indicate a relationship between user satisfaction and experience for the managers in the controller's offices. However, two experience variables which were significantly related to satisfaction for academic users (frequency of use and mandatory usage), were not in the regression model for managers in the controller's offices. This was due to the fact that the questions were answered the same by all of the users in this group. Managers use FRS on a mandatory, daily basis while academic users tend to use the system on a monthly or perhaps weekly basis. This information combined with the fact that the mean overall satisfaction was 5.038 for managers and 3.863 for academic users indicates that there is a positive correlation between satisfaction and frequency of use.

Tests of hypotheses 4A, 4B, and 4C failed to uncover significant relationships between satisfaction and sex, age, or level of education for users in the controllers'

office. Results of the tests for academic users, however, revealed a marginal re-

lationship between user satisfaction and sex. Specifically, males seem to be less

satisfied with FRS than females.

Conclusions

The results of the research suggest the following conclusions:

1. Use of the Jenkins and Ricketts questionnaire to measure user satisfaction

    was confirmed for several reasons. First of all, the results of the factor anal-

    ysis were very similar to the results obtained by Jenkins and Ricketts. Ex-

    actly the same results would not be expected since the factor analysis was

    performed using different groups of participants. More importantly, the

    percentage of variance explained by the factors for academic users (69.52)

    was more than twice that explained in the Jenkins and Ricketts study (32.08),

    and nearly twice that explained by Jenkins and Ricketts for the managers in

    the controllers' offices (58.97). It should also be noted that the 32.08 percent

    explained by Jenkins and Ricketts included the fourth factor pertaining to

    satisfaction with problem solving, which was inappropriate for use in this

    study. Finally, the use of the Jenkins and Ricketts questionnaire was con-

    firmed because virtually none of the respondents had difficulty understanding

    the questions asked on the instrument.

2. While the Bailey and Pearson questionnaire may include the most complete list of variables, the questions appear to be vague and difficult to answer for many users, at least in the research conducted here. The length of the questionnaire also seems to discourage responses. This was determined from making telephone calls to nonrespondents and inquiring as to why they had not completed the questionnaires. The primary response was that the questionnaire takes too long to fill out. The second most frequent response was that the users had difficulty understanding what the questions were asking.

3. There is an association between user satisfaction and perceptions of decision-making quality for both academic users and managers in the controllers' offices. Satisfaction with procedures for inputs did not seem to be related to decision-making quality for the managers. Similarly, satisfaction with the timeliness of outputs did not seem to be related to perceptions of decision-making quality for academic users. However, significant relationships were found between satisfaction with computer processing and decision-making quality, and satisfaction with how well FRS facilitates problem finding and perceptions of decision-making quality for both user groups.

Satisfaction with computer processing appears to be related to helping both user groups make better operating budget decisions. This is logical, since the reliability and availability of the computer system would be important to make timely and accurate decisions pertaining to the operating budget. In addition, satisfaction with computer processing was associated with helping managers feel like their jobs were easier to perform. This asso-

ciation may be even easier to understand, because if the managers were responsible for the accuracy of both inputs to and outputs from the system, being able to rely on the computer system would be assuring. Finally, satisfaction with computer processing is correlated with helping academic users keep track of activities in research, grant, and designated gift accounts. This finding is consistent with the association between computer processing and operating budget decisions, and exists only for academic users because managers are not engaged in such activities.

Satisfaction with how well FRS facilitates problem finding is correlated with elimination of steps and generally making jobs easier to perform for managers. This association is intuitively appealing because if the system facilitates problem finding, then steps previously taken to solve the same problem should be eliminated. The result of eliminated steps would be to make jobs easier to perform. Satisfaction with problem finding was associated with helping the academic users keep track of activity in research accounts, as well as giving them the feeling that they have benefitted overall from the existence of FRS in the university. This relationship is also logical, since facilitation of problem finding should help the user keep track of pertinent activities. Additionally, if the user believes that the system has helped them identify problems, then they should feel like they have benefitted from the existence of the system.

4. A stronger relationship between user satisfaction and decision-making quality exists for the academic users in this study. This finding is not surprising since

the first four of the decision-making questions asked in this survey were tailored toward the types of decisions made by academic users. This was done because the types of decisions made by the academic users were more readily identifiable than the decisions made by managers, and because budgetary decision-making is the only type of FRS-related activity that academic users are involved in. Therefore, assessing the affects of FRS on decision-making quality was the only way of measuring the system-related productivity of the academic users.

5. There is a significant relationship between user satisfaction and productivity as measured by the administrative ratios. The strongest relationships found were between a weighted satisfaction with inputs and problem finding, and financial transactions per full time employee equivalents, late internal reports per total internal reports and the number of ledger accounts per full time employee equivalents.

6. Perhaps one of the most important conclusions from this research is that a case for measuring satisfaction as a surrogate for productivity has not been established. While certain relationships were observed between satisfaction and objective productivity measures in the controllers' offices, and satisfaction and decision-making quality for both user groups, much stronger relationships would be desirable to imply that one could be used as a surrogate for the other.

7. There is evidence that a 'satisfaction curve' exists, and that more frequent users are more satisfied. Managers in the controllers' offices use FRS on a daily basis and their mean response to question pertaining to overall satisfaction with FRS was 5.038. At the same time, academic users tend to use the system on a monthly or occasionally a weekly basis and their mean response to the same question was 3.863. This may indicate that individuals who use the system more frequently are more satisfied. A significant relationship was also found between satisfaction and frequency of use for academic users. In other words, the academic users that utilize FRS the most appear to be more satisfied with the system than academic users who use the system less frequently. This finding acts to confirm the existence of a satisfaction curve.

8. A positive correlation between satisfaction and mandatory usage appears to exist. No such relationship was revealed for managers from the statistical analysis because virtually all of the managers must use FRS. Therefore there was no variance to analyze for this group of users. However, as mentioned above, the managers appear to be overall more satisfied than the academic users, and approximately half of the academic users do not consider usage of FRS to be mandatory. There was, in fact, a significant positive correlation between overall satisfaction and mandatory usage for academic users.

9. A stronger (but marginal) relationship exists between user satisfaction and sex than exists between satisfaction and any of the other demographic vari-

ables. There were no relationships between satisfaction and demographic variables for users in the controllers' offices, and only a marginal relationship between sex and user satisfaction for the academic users. Specifically, the males surveyed appear to be less satisfied with FRS than the females surveyed. One potential explanation for satisfaction not being related to demographics in the controllers' offices is that all of the managers have similar educational backgrounds and similar training. Therefore, age and sex should not make that much difference.

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Recommendation for Future Research

In order to justify the measurement of one phenomenon as a surrogate measure for another, it is obvious that more than one study must be conducted to examine relationships that exist between the two phenomena. An extensive review of the literature has uncovered no other studies examining the relationship between user satisfaction and white collar productivity. If user satisfaction is to be used as a surrogate for productivity these relationships should be tested and re-tested using different user groups and measures of productivity which are appropriate for each particular group.

Replications of the research in a for-profit environment could also uncover different types of relationships between user satisfaction and productivity. The university system, FRS, was chosen for several reasons. The primary reasons were that it is well documented and provided a large base of homogeneous users.

It was also chosen, however, because there appeared to be a great willingness to participate among FRS users with whom preliminary discussions were held. If another system with a large base of homogeneous users could be identified in a competitive industry, and the users were willing and able to participate, the results could be very interesting.

Another recommendation for future research would be to perform a laboratory experiment where the users were given a task to perform using particular information from a system. Once the user had performed the task, the relationship between their satisfaction with the system and their performance on the task could be measured.

Future research should focus on identifying appropriate measures of knowledge worker productivity. This is a relatively new concept, and as new measures of productivity are developed, the relationships between these measures and satisfaction can be more closely examined.

Future research should also focus on identifying the appropriate instrument to measure user satisfaction. While the Jenkins and Ricketts questionnaire was considered to be the best instrument to use in this research, other instruments might be more appropriate in studies with different types of users. Research should also continue to be conducted to further refine the user satisfaction instruments that exist and to develop instruments which may be better than the ones that are currently available.

Finally, research similar to the research conducted here should continue to include questions related to demographics and experience. These questions do

not take much time for the user to complete, and could provide valuable insights

for increasing user acceptance and designing user training techniques.

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Appendix A
First Pilot Test

First Pilot Test Preliminary Letter
First Pilot Test Cover Letter
First List of Administrative Accounting Variables
First Pilot Test Questionnaire
First follow-up Letter to First Pilot Test ·
Second follow-up Letter to First Pilot Test

First Pilot Test Preliminary Letter (March 16, 1989)

SALUTATION

In a few days you will be receiving a packet of questionnaires which is part of an important research project involving the satisfaction and productivity of FRS users. Your name was selected from a list of FRS users obtained through Information Associates using a random sample selection technique. Under this method, the views of participants in the study are considered representative of all other FRS users. The results of this study may be very valuable to you and others who share your interest in improving the productivity and satisfaction of FRS users.

In this packet you will find a set of brief user satisfaction questionnaires along with instructions and a list of simple variables needed to complete the study, such as FTEs. The motivation of this study is to test the theory that the satisfaction of information system users is a good surrogate measure for the productivity of those users. By participating in this study, you will facilitate important research on the relationship between user satisfaction and user productivity.

Each participant in this study will receive a summary of the research findings. Your contribution to this research effort is sincerely appreciated. If you have any questions or suggestions in the mean time feel free to write or call at 703-231-6591.

First Pilot Test Cover Letter (March 21,1989)

SALUTATION

As part of an important research effort, I would like to ask your assistance in having the enclosed questionnaires completed. This study is designed to examine the relationship between user information satisfaction and user productivity.

Because this survey is being conducted on a sampling basis, responses from all participants at your university are particularly important. The number on the return envelope will be used to send you an analysis of the survey results as well as to reduce unnecessary follow-ups. The processing of responses from all participants will be entirely anonymous.

Three of the questionnaires should be given to the managers of General Accounting, Accounts Payable and Financial Reporting within the Administrative Accounting Office. The remaining three questionnaires should be given to the heads of the Biology, Accounting, and Chemistry academic departments. If your college or university does not have one or more of the academic departments mentioned, please distribute the questionnaires to another department, and **make a note of the participating department as well as the department it is replacing.**

While academic FRS users' productivity is related to decision-making effectiveness, the productivity of users within the Accounting Office are more directly related to measures of technical efficiency. Therefore, in order to study the relationship between satisfaction and productivity at this level, I would like to ask you to return with the questionnaires the list of variables attached to this letter for the most recent fiscal year.

I welcome any questions or comments you may have. Please feel free to write or call at 703-231-6591. If you choose not to participate, please note your reason on a sheet of paper and return it with the unmarked questionnaires in the enclosed prestamped envelope. This will avoid unnecessary follow-ups and help explain nonresponse.

I hope you will find this project interesting and worthwhile. While I realize this project will take a few extra minutes of your valuable time, those working with me at Virginia Tech and Information Associates feel the results will be valuable to each participant as well as to the academic community. Please accept my thanks for your attention and very kind cooperation.

First List of Administrative Accounting Variables

LIST OF ADMINISTRATIVE ACCOUNTING VARIABLES
Fiscal Year Ending 19____
(Please use most recent fiscal year)

_____ Number of Transactions

_____ Full Time Equivalent Employees in Accounting Office

_____ Number of Active Accounts

_____ Number of Reject Transactions

_____ Number of Report Due Dates Missed

_____ Total Number of Report Due Dates

_____ Number of Transaction Errors

_____ Number of Reports Filed

_____ Number of Reports Timely Filed

PART A

BAILEY AND PEARSON QUESTIONNAIRE FOR USER SATISFACTION

To Participants:

The purpose of this study is to measure how *you* feel about certain aspects of the computer-based information products and services that are provided to you in your present position.

On the following pages you will find different factors, each related to some aspect of your computer-based support. You are to rate each factor on the descriptive scales that follow it, based on your evaluation of the factor.

A separate scale is provided for you to express how *important or unimportant* each factor is to you.

The scale positions are defined as follows:

adjective X   :__:__:__:__:__:__:__: adjective Y
            (1) (2) (3) (4) (5) (6) (7)

(1) extremely X   (5) slightly Y

(2) quite X   (6) quite Y

(3) slightly X   (7) extremely Y

(4) neither X nor Y; equally X or Y; does not apply

INSTRUCTIONS

1. Check each scale in the position that describes *your* evaluation of the factor being judged.

2. Check *every* scale, do not omit any.

3. Check *only one* position for each scale.

4. Check in the space, not between spaces.   THIS, NOT THIS
                                                :_X_: :__X__:

5. Work rapidly. Rely on your first impressions.

The final page is provided for any comments that you wish to make. Thank you very much for your cooperation. Return this booklet via the enclosed envelope.

JUDGE THE FACTORS

BASED ON

<u>YOUR</u>

FEELINGS

How long have you personally been using FRS?

_____ years _____ months

How frequently do you use FRS?

_____ daily _____ weekly _____ monthly

_____ yearly _____ other _____

How much experience do you personally have with similar application systems, excluding FRS?

_____ years _____ months

How similar was this previous application system to FRS?

very similar :___:___:___:___:___:___:___: not similar

1	Relationship with the EDP* staff

harmonious :___:___:___:___:___:___:___: dissonant

good :___:___:___:___:___:___:___: bad

cooperative :___:___:___:___:___:___:___: uncooperative

candid :___:___:___:___:___:___:___: deceitful

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

---

*EDP: Electronic Data Processing

| 2 | Processing of requests for changes to existing systems |

fast   :__:__:__:__:__:__: slow
timely   :__:__:__:__:__:__: untimely
simple   :__:__:__:__:__:__: complex
flexible   :__:__:__:__:__:__: rigid
satisfactory :__:__:__:__:__:__: unsatisfactory

| To me, this factor is |

important :__:__:__:__:__:__: unimportant

| 3 | Means of input/output with the EDP center |

convenient :__:__:__:__:__:__: inconvenient
clear   :__:__:__:__:__:__: hazy
efficient :__:__:__:__:__:__: inefficient
organized :__:__:__:__:__:__: disorganized
satisfactory :__:__:__:__:__:__: unsatisfactory

| To me, this factor is |

important :__:__:__:__:__:__: unimportant

| 4 | Interdepartmental competition with the EDP unit |

productive :__:__:__:__:__:__: destructive
rational   :__:__:__:__:__:__: emotional
low   :__:__:__:__:__:__: high
harmonious :__:__:__:__:__:__: dissonant
satisfactory :__:__:__:__:__:__: unsatisfactory

| To me, this factor is |

important :__:__:__:__:__:__: unimportant

| 5 | Confidence in systems |

high	:__:__:__:__:__:__:	low
strong	:__:__:__:__:__:__:	weak
definite	:__:__:__:__:__:__:	uncertain
good	:__:__:__:__:__:__:	bad
satisfactory	:__:__:__:__:__:__:	unsatisfactory

| To me, this factor is |

important	:__:__:__:__:__:__:	unimportant

| 6 | Timeliness of output information |

timely	:__:__:__:__:__:__:	untimely
reasonable	:__:__:__:__:__:__:	unreasonable
consistent	:__:__:__:__:__:__:	inconsistent
punctual	:__:__:__:__:__:__:	tardy
satisfactory	:__:__:__:__:__:__:	unsatisfactory

| To me, this factor is |

important	:__:__:__:__:__:__:	unimportant

| 7 | Charge-back method of payment for services |

just	:__:__:__:__:__:__:	unjust
reasonable	:__:__:__:__:__:__:	unreasonable
consistent	:__:__:__:__:__:__:	inconsistent
known	:__:__:__:__:__:__:	unknown
satisfactory	:__:__:__:__:__:__:	unsatisfactory

| To me, this factor is |

important	:__:__:__:__:__:__:	unimportant

8	Perceived utility (worth versus cost)

high	:___:___:___:___:___:___:___:	low
positive	:___:___:___:___:___:___:___:	negative
sufficient	:___:___:___:___:___:___:___:	insufficient
useful	:___:___:___:___:___:___:___:	useless
satisfactory	:___:___:___:___:___:___:___:	unsatisfactory

To me, this factor is

important	:___:___:___:___:___:___:___:	unimportant

9	Vendor support of hardware and software

skilled	:___:___:___:___:___:___:___:	bungling
sufficient	:___:___:___:___:___:___:___:	insufficient
eager	:___:___:___:___:___:___:___:	indifferent
consistent	:___:___:___:___:___:___:___:	inconsistent
satisfactory	:___:___:___:___:___:___:___:	unsatisfactory

To me, this factor is

important	:___:___:___:___:___:___:___:	unimportant

10	Computer language used to interact with systems

simple	:___:___:___:___:___:___:___:	complex
powerful	:___:___:___:___:___:___:___:	weak
easy	:___:___:___:___:___:___:___:	difficult
easy-to-use	:___:___:___:___:___:___:___:	hard-to-use
satisfactory	:___:___:___:___:___:___:___:	unsatisfactory

To me, this factor is

important	:___:___:___:___:___:___:___:	unimportant

| 11 | Expectations (expected versus actual level of computer-based support) |

pleased	:__:__:__:__:__:__:	displeased
high	:__:__:__:__:__:__:	low
definite	:__:__:__:__:__:__:	uncertain
optimistic	:__:__:__:__:__:__:	pessimistic
satisfactory	:__:__:__:__:__:__:	unsatisfactory

| To me, this factor is |

important	:__:__:__:__:__:__:	unimportant

| 12 | Correction of errors |

fast	:__:__:__:__:__:__:	slow
superior	:__:__:__:__:__:__:	inferior
complete	:__:__:__:__:__:__:	incomplete
simple	:__:__:__:__:__:__:	complex
satisfactory	:__:__:__:__:__:__:	unsatisfactory

| To me, this factor is |

important	:__:__:__:__:__:__:	unimportant

| 13 | Security of data |

secure	:__:__:__:__:__:__:	unsecure
good	:__:__:__:__:__:__:	bad
definite	:__:__:__:__:__:__:	uncertain
complete	:__:__:__:__:__:__:	incomplete
satisfactory	:__:__:__:__:__:__:	unsatisfactory

| To me, this factor is |

important	:__:__:__:__:__:__:	unimportant

14	Degree of EDP training provided to users

complete	:___:___:___:___:___:___:	incomplete
sufficient	:___:___:___:___:___:___:	insufficient
high	:___:___:___:___:___:___:	low
superior	:___:___:___:___:___:___:	inferior
satisfactory	:___:___:___:___:___:___:	unsatisfactory

To me, this factor is

important	:___:___:___:___:___:___:	unimportant

15	Understanding of systems

high	:___:___:___:___:___:___:	low
sufficient	:___:___:___:___:___:___:	insufficient
complete	:___:___:___:___:___:___:	incomplete
easy	:___:___:___:___:___:___:	hard
satisfactory	:___:___:___:___:___:___:	unsatisfactory

To me, this factor is

important	:___:___:___:___:___:___:	unimportant

16	Feeling of participation

positive	:___:___:___:___:___:___:	negative
encouraged	:___:___:___:___:___:___:	repelled
sufficient	:___:___:___:___:___:___:	insufficient
involved	:___:___:___:___:___:___:	uninvolved
satisfactory	:___:___:___:___:___:___:	unsatisfactory

To me, this factor is

important	:___:___:___:___:___:___:	unimportant

17	Currency (up-to-dateness) of the output information

good : __ : __ : __ : __ : __ : __ : bad

timely : __ : __ : __ : __ : __ : __ : untimely

adequate : __ : __ : __ : __ : __ : __ : inadequate

reasonable : __ : __ : __ : __ : __ : __ : unreasonable

satisfactory : __ : __ : __ : __ : __ : __ : unsatisfactory

To me, this factor is

important : __ : __ : __ : __ : __ : __ : unimportant

18	Attitude of the EDP staff

user-oriented : __ : __ : __ : __ : __ : __ : self-centered

cooperative : __ : __ : __ : __ : __ : __ : belligerent

courteous : __ : __ : __ : __ : __ : __ : discourteous

positive : __ : __ : __ : __ : __ : __ : negative

satisfactory : __ : __ : __ : __ : __ : __ : unsatisfactory

To me, this factor is

important : __ : __ : __ : __ : __ : __ : unimportant

19	Reliability of output information

consistent : __ : __ : __ : __ : __ : __ : inconsistent

high : __ : __ : __ : __ : __ : __ : low

superior : __ : __ : __ : __ : __ : __ : inferior

sufficient : __ : __ : __ : __ : __ : __ : insufficient

satisfactory : __ : __ : __ : __ : __ : __ : unsatisfactory

To me, this factor is

important : __ : __ : __ : __ : __ : __ : unimportant

20	Top management involvement in EDP activities

strong : __ : __ : __ : __ : __ : __ : weak

consistent : __ : __ : __ : __ : __ : __ : inconsistent

good : __ : __ : __ : __ : __ : __ : bad

significant : __ : __ : __ : __ : __ : __ : insignificant

satisfactory : __ : __ : __ : __ : __ : __ : unsatisfactory

To me, this factor is

important : __ : __ : __ : __ : __ : __ : unimportant

21	Format of output

good : __ : __ : __ : __ : __ : __ : bad

simple : __ : __ : __ : __ : __ : __ : complex

readable : __ : __ : __ : __ : __ : __ : unreadable

useful : __ : __ : __ : __ : __ : __ : useless

satisfactory : __ : __ : __ : __ : __ : __ : unsatisfactory

To me, this factor is

important : __ : __ : __ : __ : __ : __ : unimportant

22	Response/turnaround time

fast : __ : __ : __ : __ : __ : __ : slow

good : __ : __ : __ : __ : __ : __ : bad

consistent : __ : __ : __ : __ : __ : __ : inconsistent

reasonable : __ : __ : __ : __ : __ : __ : unreasonable

satisfactory : __ : __ : __ : __ : __ : __ : unsatisfactory

To me, this factor is

important : __ : __ : __ : __ : __ : __ : unimportant

23	Determination of priorities for allocation of EDP resources

fair	:___:___:___:___:___:___:	unfair
consistent	:___:___:___:___:___:___:	inconsistent
just	:___:___:___:___:___:___:	unjust
precise	:___:___:___:___:___:___:	vague
satisfactory	:___:___:___:___:___:___:	unsatisfactory

To me, this factor is

| important | :___:___:___:___:___:___: | unimportant |

24	Convenience of access (to utilize the computer capability)

convenient	:___:___:___:___:___:___:	inconvenient
good	:___:___:___:___:___:___:	bad
easy	:___:___:___:___:___:___:	difficult
efficient	:___:___:___:___:___:___:	inefficient
satisfactory	:___:___:___:___:___:___:	unsatisfactory

To me, this factor is

| important | :___:___:___:___:___:___: | unimportant |

25	Relevancy of output information (to intended function)

useful	:___:___:___:___:___:___:	useless
relevant	:___:___:___:___:___:___:	irrelevant
clear	:___:___:___:___:___:___:	hazy
good	:___:___:___:___:___:___:	bad
satisfactory	:___:___:___:___:___:___:	unsatisfactory

To me, this factor is

| important | :___:___:___:___:___:___: | unimportant |

26	Volume of output information

concise   :___:___:___:___:___:___:___: redundant

sufficient   :___:___:___:___:___:___:___: insufficient

necessary   :___:___:___:___:___:___:___: unnecessary

reasonable   :___:___:___:___:___:___:___: unreasonable

satisfactory   :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important   :___:___:___:___:___:___:___: unimportant

27	Personal job effects resulting from the computer-based support

liberating   :___:___:___:___:___:___:___: inhibiting

significant   :___:___:___:___:___:___:___: insignificant

good   :___:___:___:___:___:___:___: bad

valuable   :___:___:___:___:___:___:___: worthless

satisfactory   :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important   :___:___:___:___:___:___:___: unimportant

28	Accuracy of output information

accurate   :___:___:___:___:___:___:___: inaccurate

high   :___:___:___:___:___:___:___: low

consistent   :___:___:___:___:___:___:___: inconsistent

sufficient   :___:___:___:___:___:___:___: insufficient

satisfactory   :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important   :___:___:___:___:___:___:___: unimportant

29	Precision of output information

sufficient	:__:__:__:__:__:__:	insufficient
consistent	:__:__:__:__:__:__:	inconsistent
high	:__:__:__:__:__:__:	low
definite	:__:__:__:__:__:__:	uncertain
satisfactory	:__:__:.__:__:__:__:	unsatisfactory

To me, this factor is

| important | :__:__:__:__:__:__: | unimportant |

30	Communication with the EDP staff

harmonious	:__:__:__:__:__:__:	dissonant
productive	:__:__:__:__:__:__:	destructive
precise	:__:__:__:__:__:__:	vague
meaningful	:__:__:__:__:__:__:	meaningless
satisfactory	:__:__:__:__:__:__:	unsatisfactory

To me, this factor is

| important | :__:__:__:__:__:__: | unimportant |

31	Organizational position of the EDP function

appropriate	:__:__:__:__:__:__:	inappropriate
strong	:__:__:__:__:__:__:	weak
clear	:__:__:__:__:__:__:	hazy
progressive	:__:__:__:__:__:__:	regressive
satisfactory	:__:__:__:__:__:__:	unsatisfactory

To me, this factor is

| important | :__:__:__:__:__:__: | unimportant |

32	Time required for new systems development

short	:__:__:__:__:__:__:	long
dependable	:__:__:__:__:__:__:	undependable
reasonable	:__:__:__:__:__:__:	unreasonable
acceptable	:__:__:__:__:__:__:	unacceptable
satisfactory	:__:__:__:__:__:__:	unsatisfactory

To me, this factor is

important	:__:__:__:__:__:__:	unimportant

33	Personal control of EDP service received

high	:__:__:__:__:__:__:	low
sufficient	:__:__:__:__:__:__:	insufficient
precise	:__:__:__:__:__:__:	vague
strong	:__:__:__:__:__:__:	weak
satisfactory	:__:__:__:__:__:__:	unsatisfactory

To me, this factor is

important	:__:__:__:__:__:__:	unimportant

34	Schedule of recurring output products and services

good	:__:__:__:__:__:__:	bad
regular	:__:__:__:__:__:__:	irregular
reasonable	:__:__:__:__:__:__:	unreasonable
acceptable	:__:__:__:__:__:__:	unacceptable
satisfactory	:__:__:__:__:__:__:	unsatisfactory

To me, this factor is

important	:__:__:__:__:__:__:	unimportant

| 35 | Documentation |

```
clear        :___:___:___:___:___:___:___: hazy
available    :___:___:___:___:___:___:___: unavailable
complete     :___:___:___:___:___:___:___: incomplete
current      :___:___:___:___:___:___:___: obsolete
satisfactory :___:___:___:___:___:___:___: unsatisfactory
```

| To me, this factor is |

```
important    :___:___:___:___:___:___:___: unimportant
```

| 36 | Completeness of the output information |

```
complete     :___:___:___:___:___:___:___: incomplete
consistent   :___:___:___:___:___:___:___: inconsistent
sufficient   :___:___:___:___:___:___:___: insufficient
adequate     :___:___:___:___:___:___:___: inadequate
satisfactory :___:___:___:___:___:___:___: unsatisfactory
```

| To me, this factor is |

```
important    :___:___:___:___:___:___:___: unimportant
```

| 37 | Technical competence of the EDP staff |

```
current      :___:___:___:___:___:___:___: obsolete
sufficient   :___:___:___:___:___:___:___: insufficient
superior     :___:___:___:___:___:___:___: inferior
high         :___:___:___:___:___:___:___: low
satisfactory :___:___:___:___:___:___:___: unsatisfactory
```

| To me, this factor is |

```
important    :___:___:___:___:___:___:___: unimportant
```

38	Flexibility of systems

flexible	:	:	:	:	:	:	:	rigid
versatile	:	:	:	:	:	:	:	limited
sufficient	:	:	:	:	:	:	:	insufficient
high	:	:	:	:	:	:	:	low
satisfactory	:	:	:	:	:	:	:	unsatisfactory

To me, this factor is

important	:	:	:	:	:	:	:	unimportant

39	Integration (automated sharing of information) of system data bases

complete	:	:	:	:	:	:	:	incomplete
sufficient	:	:	:	:	:	:	:	insufficient
successful	:	:	:	:	:	:	:	unsuccessful
good	:	:	:	:	:	:	:	bad
satisfactory	:	:	:	:	:	:	:	unsatisfactory

To me, this factor is

important	:	:	:	:	:	:	:	unimportant

40	Overall satisfaction with the EDP center and information system

satisfactory	:	:	:	:	:	:	:	unsatisfactory

PART B

1. To what extent does the information available through FRS affect your personal productivity related to operating budget decisions?

　　　　positively affects　　:___:___:___:___:___:___:___: negatively affects

2. To what extent does the information available through FRS affect your personal productivity related to keeping track of activity in research accounts?

　　　　positively affects　　:___:___:___:___:___:___:___: negatively affects

3. To what extent does the information available through FRS affect your personal productivity related to keeping track of activity in grant and designated gift accounts?

　　　　positively affects　　:___:___:___:___:___:___:___: negatively affects

4. To what extent does the information available through FRS affect your personal productivity related to keeping track of cleared expenditures and calculating cash balances?

　　　　positively affects　　:___:___:___:___:___:___:___: negatively affects

5. Is the level of detail in the information provided to you through FRS appropriate?

　　　　very appropriate　　:___:___:___:___:___:___:___: very inappropriate

6. Is the specific information available through FRS relevant to the decisions you must make?

　　　　relevant　　:___:___:___:___:___:___:___: irrelevant

7. How difficult is it to find the information you need for decision making in the reports generated by FRS?

　　　　easy　　:___:___:___:___:___:___:___: difficult

8. Does your department maintain a separate and independent accounting information system from FRS?

　　　　yes ___　　no ___

9. If you do maintain a separate accounting system, do you rely on it more or less for decision making than you rely on FRS?

　　　　more　　:___:___:___:___:___:___:___: less

10. How has the implementation of FRS affected your overall productivity related to financial decision making?

　　　　positively affected　　:___:___:___:___:___:___:___: negatively affected

11. Were you using an online, batch or manual accounting system previous to implementation of FRS?

───────────────────────────────

COMMENTS

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First Followup Letter for First Pilot Study (April 5, 1989)

SALUTATION

About two weeks ago I sent you a packet of questionnaires as part of a study on satisfaction and productivity of information systems. If you have already returned them, please consider this a special "thank you" for your promptness. If, as I often do, you have put the questionnaires aside to be finished later, please have them filled out and returned as soon as possible. Thank you.

Second follow-up Letter for First Pilot Study (April 17,1989)

SALUTATION

This note is just a reminder that the user satisfaction questionnaires I sent you several weeks ago have not yet been received back. Since I would like to start the data analysis as soon as possible, I hope you will be able to return it immediately. I realize you are very busy now, so your assistance in having the questionnaires completed is especially appreciated. Thank you.

Appendix B
Second Pilot Test

Second List of Administrative Accounting Variables
Second Questionnaire

Second List of Administrative Accounting Variables

LIST OF ADMINISTRATIVE ACCOUNTING VARIABLES
Fiscal Year Ending 19_____
(Please use most recent fiscal year)

_____ Number of Transactions from FRS including system indirects

_____ Full Time Equivalent Employees in Accounting Office

_____ Number of Active General Ledger Accounts

_____ Number of Active Subsidiary Accounts

_____ Number of Rejected Transactions

_____ Number of Monthly Report Due Dates Missed

_____ Total Number of Monthly Report Due Dates

_____ Number of Transaction Errors

_____ Number of Vouchers Processed Each Month

_____ Number of Checks Produced Each Month

_____ Number of Reports Prepared/Processed for Internal Use

_____ Number of Reports Prepared/Processed for External Use

_____ Number of Financial and Other Regulatory Reports Filed

_____ Financial and Other Regulatory Reports Timely Filed

Second Questionnaire

USER SATISFACTION AND DECISION MAKING EFFECTIVENESS QUESTIONNAIRE

TO PARTICIPANTS:

Please react to the following statements about FRS. There are no right or wrong answers; this is not a test. I am interested in your opinions of how well FRS supports your needs.

A separate scale is provided for you to express how strongly you feel about each factor. The scale positions are defined as follows:

This room is very cold today.

Strongly disagree   :___:___:___:___:___:___:___: Strongly agree
                    (1) (2) (3) (4) (5) (6) (7)

(1) very hot   (5) cool

(2) hot   (6) cold

(3) warm   (7) very cold

(4) indifferent

INSTRUCTIONS

1. Check each scale in the position that describes *your* evaluation of the factor being judged.

2. Check *every* scale, do not omit any.

3. Check *only one* position for each scale.

4. Check in the space, not between spaces.
   THIS, NOT THIS
   :_X_: :__X__:

5. Work rapidly. Rely on your first impressions.

Thank you very much for your cooperation.

PART A

1. The contents of the reports from FRS are very accurate.

Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

2. The reports from FRS are very easy to understand.

Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

3. The procedures and instructions for inputting data are very easy to use.

Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

4. The reports from FRS are very useful for identifying and defining problems.

Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

5. The reports delivered by FRS are very well formatted.

Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

6. The computer system supporting FRS appears to be very reliable.

Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

7. The reports delivered by FRS are available at the right time.

Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

8. The procedures and instructions for inputting data prevent many errors.

Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

9. The reports delivered by FRS contain too much information.

Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

10. FRS always delivers reports in the best mode (CRT, Hardcopy, etc.).

Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

11. The procedures for inputting data are easy to understand.

Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

12. The reports delivered by FRS are very relevant.

Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

13. The reports from FRS are delivered in the best sequence.

Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

14. The computer supporting FRS is available all of the time.

Strongly disagree   :___:___:___:___:___:___:___: Strongly agree   N\A___

15. The reports from FRS contain exactly the right type of information.

Strongly disagree   :___:___:___:___:___:___:___: Strongly agree   N\A___

16. The instructions for inputting data are easy to understand.

Strongly disagree   :___:___:___:___:___:___:___: Strongly agree   N\A___

17. The reports delivered by FRS contain too little information.

Strongly disagree   :___:___:___:___:___:___:___: Strongly agree   N\A___

18. The response time from FRS is very good.

Strongly disagree   :___:___:___:___:___:___:___: Strongly agree   N\A___

19. My overall satisfaction with FRS is best described as:

Very dissatisfied   :___:___:___:___:___:___:___: Very satisfied.

Part B *The purpose of this section is to find out how much you rely on FRS for decision making, regardless of your satisfaction with the attributes of the system. Please keep this in mind as you complete this section. Thank you.*

1. Utilization of FRS has enabled me to make much better operating budget decisions.

   Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

2. Utilization of FRS has enabled me to keep track of activity in research accounts much better than I could before utilization.

   Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

3. Utilization of FRS has enabled me to keep track of activity in grant and designated gift accounts much better than I could before utilization.

   Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

4. Utilization of FRS has enabled me to keep track of cleared expenditures and calculate cash balances much better than I could before utilization.

   Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

5. Utilization of FRS has allowed me to eliminate many steps previously taken to arrive at similar decisions.

   Strongly disagree   :___:___:___:___:___:___: Strongly agree

6. Overall, utilization of FRS has greatly improved the quality of the decisions I have made.

   Strongly disagree   :___:___:___:___:___:___: Strongly agree

7. The services performed by FRS have made it much easier to perform my job well.

   Strongly disagree   :___:___:___:___:___:___: Strongly agree

8. I personally have greatly benefitted from the existence of FRS in this university.

   Strongly disagree   :___:___:___:___:___:___: Strongly agree

9. Does your department maintain a separate and independent accounting information system from FRS?

   yes ___   no ___

10. If you do maintain a separate accounting system, how much do you rely on FRS for decision making (as opposed to the alternative system)?

   _____   N\A___

11. Is usage of FRS mandatory?

   yes ___   no ___

12. Were you using an online, batch or manual accounting system previous to implementation of FRS?

_____

13. Please indicate your sex: Male___   Female___

14. Please indicate your age: _____

15. Please indicate your level of education:

   High School___   Associate___   Bachelor___   Master___   Doctorate___

16. Please indicate your functional level:

   Administrator___   Department Head___   Secretary___   Technical Assistant___

   General Accounting Manager___   Accounts Payable Manager___

   Financial Reporting Manager___   Other_____

17. How long have you personally been using FRS?

                years_____   months_____

18. How frequently do you use FRS?

                daily_____   weekly_____   monthly_____

                yearly_____   other_____

19. How much experience do you personally have with similar application systems, excluding FRS?

                years_____   months_____

20. How similar was this previous application system to FRS?

           very similar   :___:___:___:___:___:___:___: not similar   N\A___

Appendix C
Primary Study

Preliminary Letter for Primary Study
Cover Letter for Primary Study
List of Administrative Accounting Variables for Primary Study
Primary Study Questionnaire
First Follow-up Letter for Primary Study

Preliminary Letter for Primary Study (May 12, 1989)

SALUTATION

In a few days you will be receiving a packet of questionnaires which is part of an important research project involving the satisfaction and productivity of FRS users. Your name was selected from a list of FRS users obtained through Information Associates using a random sample selection technique. Under this method, the views of participants in the study are considered representative of all other FRS users. The results of this study may be very valuable to you and others who share your interest in improving the productivity and satisfaction of FRS users.

In this packet you will find a set of brief user satisfaction questionnaires along with instructions and a list of simple variables needed to complete the study, such as FTEs. The motivation of this study is to test the theory that the satisfaction of information system users is a good surrogate measure for the productivity of those users. By participating in this study, you will facilitate important research on the relationship between user satisfaction and user productivity.

Each participant in this study will receive a summary of the research findings. Your contribution to this research effort is sincerely appreciated. If you have any questions or suggestions in the mean time feel free to write or call at 703-231-6591.

Cover Letter for Primary Study (May 19, 1989)

SALUTATION

As part of an important research effort, I would like to ask your assistance in having the enclosed questionnaires completed. This study is designed to examine the relationship between user information satisfaction and user productivity.

Because this survey is being conducted on a sampling basis, responses from all participants at your university are particularly important. The number on the return envelope will be used to send you an analysis of the survey results as well as to reduce unnecessary follow-ups. The processing of responses from all participants will be entirely anonymous.

Three of the questionnaires should be given to the managers of General Accounting, Accounts Payable and Financial Reporting within the Administrative Accounting Office. The remaining three questionnaires should be given to the heads of the Biology, Accounting, and Chemistry academic departments. If your college or university does not have one or more of the academic departments mentioned, please distribute the questionnaires to another department, and **make a note of the participating department as well as the department it is replacing.**

While academic FRS users' productivity is related to decision-making effectiveness, the productivity of users within the Accounting Office are more directly related to measures of technical efficiency. Therefore, in order to study the relationship between satisfaction and productivity at this level, I would like to ask you to return with the questionnaires the list of variables attached to this letter for the most recent fiscal year.

I welcome any questions or comments you may have. Please feel free to write or call at 703-231-6591. If you choose not to participate, please note your reason on a sheet of paper and return it with the unmarked questionnaires in the enclosed prestamped envelope. This will avoid unnecessary follow-ups and help explain nonresponse.

I hope you will find this project interesting and worthwhile. While I realize this project will take a few extra minutes of your valuable time, those working with me at Virginia Tech and Information Associates feel the results will be valuable to each participant as well as to the academic community. Please accept my thanks for your attention and very kind cooperation.

List of Administrative Accounting Variables for Primary Study

LIST OF ADMINISTRATIVE ACCOUNTING VARIABLES
Fiscal Year Ending 19_____
(Please use most recent fiscal year)

_____ Number of Transactions from FRS including system indirects

_____ Full Time Equivalent Employees in Accounting Office

_____ Number of Active General Ledger Accounts

_____ Number of Active Subsidiary Accounts

_____ Number of Rejected Transactions

_____ Number of Monthly Report Due Dates Missed

_____ Total Number of Monthly Report Due Dates

_____ Number of Transaction Errors

_____ Number of Vouchers Processed Each Month

_____ Number of Checks Produced Each Month

_____ Number of Reports Prepared/Processed for Internal Use

_____ Number of Reports Prepared/Processed for External Use

_____ Number of Financial and Other Regulatory Reports Filed

_____ Financial and Other Regulatory Reports Timely Filed

NOTE It is crucial to this study that you return this list with the questionnaires even if some of the items must be left blank. Feel free to make any notes on this sheet that you feel will help explain your responses. Once again, thanks for your time and cooperation.

Primary Study Questionnaire

USER SATISFACTION AND DECISION MAKING EFFECTIVENESS QUESTIONNAIRE

TO PARTICIPANTS:

Please react to the following statements about FRS. There are no right or wrong answers; this is not a test. I am interested in your opinions of how well FRS supports your needs.

A separate scale is provided for you to express how strongly you feel about each factor. The scale positions are defined as follows:

This room is very cold today.

Strongly disagree :__:__:__:__:__:__:__: Strongly agree
                  (1) (2) (3) (4) (5) (6) (7)

(1) very hot   (5) cool

(2) hot   (6) cold

(3) warm   (7) very cold

(4) indifferent

INSTRUCTIONS

1. Check each scale in the position that describes *your* evaluation of the factor being judged.

2. Check *every* scale, do not omit any.

3. Check *only one* position for each scale.

4. Check in the space, not between spaces.
   THIS, NOT THIS
   :X: :__X__:

5. Work rapidly. Rely on your first impressions.

Thank you very much for your cooperation.

PART A

1. The contents of the reports from FRS are very accurate.

   Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

2. The reports from FRS are very easy to understand.

   Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

3. The procedures and instructions for inputting data are very easy to use.

   Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

4. The reports from FRS are very useful for identifying and defining problems.

   Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

5. The reports delivered by FRS are very well formatted.

   Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

6. The computer system supporting FRS appears to be very reliable.

   Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

7. The reports delivered by FRS are available at the right time.

   Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

8. The procedures and instructions for inputting data prevent many errors.

   Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

9. The reports delivered by FRS contain too much information.

   Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

10. FRS always delivers reports in the best mode (CRT, Hardcopy, etc.).

   Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

11. The procedures for inputting data are easy to understand.

   Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

12. The reports delivered by FRS are very relevant.

   Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

13. The reports from FRS are delivered in the best sequence.

   Strongly disagree   :___:___:___:___:___:___: Strongly agree   N\A___

14. The computer supporting FRS is available all of the time.

Strongly disagree   :___:___:___:___:___:___:___: Strongly agree   N\A___

15. The reports from FRS contain exactly the right type of information.

Strongly disagree   :___:___:___:___:___:___:___: Strongly agree   N\A___

16. The instructions for inputting data are easy to understand.

Strongly disagree   :___:___:___:___:___:___:___: Strongly agree   N\A___

17. The reports delivered by FRS contain too little information.

Strongly disagree   :___:___:___:___:___:___:___: Strongly agree   N\A___

18. The response time from FRS is very good.

Strongly disagree   :___:___:___:___:___:___:___: Strongly agree   N\A___

19. My overall satisfaction with FRS is best described as:

Very dissatisfied   :___:___:___:___:___:___:___: Very satisfied.

Part B *The purpose of this section is to find out how much you rely on FRS for decision making, regardless of your satisfaction with the attributes of the system. Please keep this in mind as you complete this section. Thank you.*

1. Utilization of FRS has enabled me to make much better operating budget decisions.

     Strongly disagree   :___:___:___:___:___:___: Strongly agree N\A___

2. Utilization of FRS has enabled me to keep track of activity in research accounts much better than I could before utilization.

     Strongly disagree   :___:___:___:___:___:___: Strongly agree N\A___

3. Utilization of FRS has enabled me to keep track of activity in grant and designated gift accounts much better than I could before utilization.

     Strongly disagree   :___:___:___:___:___:___: Strongly agree N\A___

4. Utilization of FRS has enabled me to keep track of cleared expenditures and calculate cash balances much better than I could before utilization.

     Strongly disagree   :___:___:___:___:___:___: Strongly agree N\A___

5. Utilization of FRS has allowed me to eliminate many steps previously taken to arrive at similar decisions.

     Strongly disagree   :___:___:___:___:___:___: Strongly agree

6. Overall, utilization of FRS has greatly improved the quality of the decisions I have made.

     Strongly disagree   :___:___:___:___:___:___: Strongly agree

7. The services performed by FRS have made it much easier to perform my job well.

     Strongly disagree   :___:___:___:___:___:___: Strongly agree

8. I personally have greatly benefitted from the existence of FRS in this university.

     Strongly disagree   :___:___:___:___:___:___: Strongly agree

9. Does your department maintain a separate and independent accounting information system from FRS?

                yes ___   no ___

10. If you do maintain a separate accounting system, how much do you rely on FRS for decision making (as opposed to the alternative system)?

                _____   N\A___

11. Is usage of FRS mandatory?

                 yes ___   no ___

12. Were you using an online, batch or manual accounting system previous to implementation of FRS?

_____

13. Please indicate your sex: Male___   Female___

14. Please indicate your age: _____

15. Please indicate your level of education:

   High School___   Associate___   Bachelor___   Master___   Doctorate___

16. Please indicate your functional level:

   Administrator___   Department Head___   Secretary___   Technical Assistant___

   General Accounting Manager___   Accounts Payable Manager___

   Financial Reporting Manager___   Other_____

17. How long have you personally been using FRS?

                    years_____   months_____

18. How frequently do you use FRS?

                    daily_____   weekly_____   monthly_____

                    yearly_____   other_____

19. How much experience do you personally have with similar application systems, excluding FRS?

                    years_____   months_____

20. How similar was this previous application system to FRS?

          very similar   :___:___:___:___:___:___:___: not similar   N\A___

First Follow-up Letter for Primary Study (June 12, 1989)

SALUTATION

A few weeks ago I sent you some questionnaires as part of a study on satisfaction and productivity of information systems. If you have already returned them, please consider this a special "thank you" for your promptness. If as I often do, you have put the questionnaires aside to be finished later, please have them filled out and returned as soon as possible.

At this time, I would also like to point out two issues which have raised the most questions since distribution of the questionnaires. First, if your institution has been using FRS for a year or less than a year, and exact figures for the list of Administrative Accounting variables which accompanied the questionnaires are not available, then estimates are perfectly acceptable. However, if you do use estimates, please make a note of it in order to distinguish between estimates and actual figures in the analysis.

The second issue I would like to address is the use of FRS in this study. The purpose of this study is to look at the relationship between user satisfaction and user productivity, not to evaluate FRS. To obtain comparable data, the subject of the study must be a single system. FRS was chosen because many institutions use it. While Information Associates and each institution participating can benefit from the results of this study, I want to emphasize again that individual responses will remain anonymous, and that responses from satisfied and dissatisfied, and experienced and inexperienced users are necessary to obtain the richest final results.

If you have any other questions, please feel free to call at 703-231-6591. Thank you again for your help.

Second Follow-up Letter for Primary Study (July 12, 1989)

SALUTATION

This note is just a reminder that the questionnaires pertaining to satis-faction and productivity of information systems that I sent you several weeks ago has not yet been received back. Since I would like to start the data analysis as soon as possible, I hope you will be able to return them imme-diately. I realize you are very busy now, so your assistance in completing the questionnaires is especially appreciated. Thank you.

Memo to Regional IA Offices by Sherry Amos (July 7, 1989)

You may receive some inquiries from FRS customers regarding a satisfaction survey that is being circulated by Ms. Amy Gating from Virginia Polytechnic Institute & State University.

Ms. Gatian obtained IA's permission and we have assisted her by providing customer contact names in the FRS area. She is conducting the survey as research for her doctoral thesis and is going to share the results with us upon completion.

Sherry Amos in the Reston office was Ms. Gatian's direct contact and will handle any questions you may have or receive.

We anticipate this project will provide us with some very valuable market research.

Appendix D
Confirmatory Variable List and Corresponding Letters

Confirmatory List of Administrative Accounting Variables
Cover Letter to Participants Previously Submitting a List
Cover Letter to Expected Participants
First Follow-up Letter to Previous Participants
First Follow-up Letter to Expected Participants

Confirmatory List of Administrative Accounting Variables

LIST OF ADMINISTRATIVE ACCOUNTING VARIABLES
Fiscal Year Ending 19____
(Please use most recent fiscal year)

_____ Does your institution use the FRS/Accounts Payable system?

_____ Does your institution use the FRS/Financial Accounting system?

_____ Number of system direct transactions input during the most recent fiscal year to the FRS/Accounts Payable system (Reference to VBM 020 reports may be helpful - Use a *typical* month's transaction count times 12, if you do not retain all monthly reports)

_____ Number of system direct transactions input during the most recent fiscal year to the FRS/Financial Accounting system, including inputs from feeder systems (Reference to FBM 015 reports may be helpful - Use a *typical* month's transaction count times 12 if you do not retain all monthly reports)

_____ Number of rejected transactions and transactions sent to suspense that were originally input to the FRS/Accounts Payable system during the most recent fiscal year

_____ Number of rejected transactions and transactions sent to suspense that were originally input to the FRS/Financial Accounting system during the most recent fiscal year

_____ Number of vouchers processed during the most recent fiscal year

_____ Average full time equivalent employees in the Accounts Payable section of the accounting office during the most recent fiscal year

_____ Average full time equivalent employees in the General Accounting section of the accounting office during the most recent fiscal year

_____ Average number of active general ledger (Ledger 0) accounts

_____ Average number of active subsidiary accounts (Ledgers 1-9)

_____ Total number of internal monthly reports processed during the most recent fiscal year

_____ Number of internal monthly reports processed late during the most recent fiscal year

_____ Number of external financial and other regulatory reports processed during the most recent fiscal year

_____ Number of external financial and other regulatory reports processed late during the most recent fiscal year

Cover Letter to Participants Previously Submitting a List (August 29, 1989)

SALUTATION

A few weeks ago you participated in a research study examining the relationship between user information satisfaction and user productivity. A preliminary analysis has been conducted with the data collected thus far, and there appear to be large variations in the way each of the variables in the list of Administrative Accounting Variables has been perceived.

In order to strengthen the meaningfulness of the results of this study, I would like to ask for your assistance in this project one more time. Attached to this letter you will find a copy of the list of Administrative Accounting Variables you returned with the questionnaires, along with a new list of the same variables, only in greater detail. If you can take a few minutes to break down your previous responses into the more detailed variables, it will be greatly appreciated.

I apologize for any inconvenience this may cause you. If you have any questions or comments, please feel free to write or call at 703-231-6591.

Cover Letter to Expected Participants with no Previous Response (August 29, 1989)

SALUTATION

A few weeks ago you agreed to participate in a research study examining the relationship between user information satisfaction and user productivity. A preliminary analysis has been conducted with the data collected thus far, and there appear to be large variations in the way each of the variables in the list of Administrative Accounting Variables has been perceived.

Attached to this letter you will find a new list of the same Administrative Accounting Variables originally sent to you, except the variables in the new list are in greater detail. If you have already completed the first list, it will be greatly appreciated if you can take a few minutes to break down your responses into the more detailed variables. If you have not yet completed the first list, please replace it with the new list and return the new list as soon as possible. It is crucial to the study that you return the new list even if some of the items must be left blank. Feel free to make any notes that you feel will help explain your responses.

I apologize for any inconvenience this may cause you. If you have any questions or comments, please feel free to write or call at 703-231-6591. I am eager to begin analysis, and look forward to receiving your responses back soon.

First Follow-up Letter to Previous Respondents (September 14, 1989)

SALUTATION

A few days ago I sent you a copy of the list of Administrative Accounting Variables you returned with the satisfaction questionnaires, along with a new list of the same variables, only in greater detail. If you have already returned the new list, please consider this a special "thank you" for your promptness. If as I often do, you have put the list aside to complete later, please take a few minutes to fill it out and return it as soon as possible.

Since I would like to start the data analysis as soon as possible, I hope you will be able to return the list immediately. I realize you are very busy now, but I cannot complete the study or share results until the all of the data has been collected.

If you have any questions, please feel free to call at 703-231-6591. Thank you again for your help.

First Follow-up Letter to Expected Participants (September 14, 1989)

SALUTATION

A few weeks ago I sent you some questionnaires as part of a study on satisfaction and productivity of information systems. Also, about a week ago, I sent you a revised list of the Administrative Accounting Variables. If you have already returned the questionnaires and the revised list, please consider this a special "thank you" for your promptness. If as I often do, you have put these items aside to be completed later, please have them completed and returned as soon as possible.

At this time, I would also like to emphasize the importance of both the surveys and the revised list of administrative variables to this study. If you have any questions related to the study, please feel free to write or call at 703-231-6591. Thank you again for your help.

Appendix E
Summary of Individual Responses to Each of the Categorical Questions

Controller's Office Managers
Academic Department Heads

Summary of Controller's Office Manager Responses to Each Level of Each Categorical Question

PART A

1. The contents of the reports from FRS are very accurate.

    Strongly disagree   : 1: 3: 2: 7: 14: 33: 47: Strongly agree

2. The reports from FRS are very easy to understand.

    Strongly disagree   : 0: 11: 11: 27: 27: 23: 8: Strongly agree

3. The procedures and instructions for inputting data were very easy to use.

    Strongly disagree   : 3: 8: 13: 16: 37: 20: 10: Strongly agree

4. The reports from FRS are very useful for identifying and defining problems.

    Strongly disagree   : 2: 6: 14: 19: 31: 25: 10: Strongly agree   ·

5. The reports delivered by FRS are very well formatted.

    Strongly disagree   : 2: 7: 17: 23: 33: 22: 3: Strongly agree

6. The computer system supporting FRS appears to be very reliable.

    Strongly disagree   : 3: 9: 7: 5: 30: 40: 13: Strongly agree

7. The reports delivered by FRS are available at the right time.

    Strongly disagree   : 1: 4: 5: 12: 24: 43: 18: Strongly agree

8. The procedures and instructions for inputting data prevent many errors.

    Strongly disagree   : 6: 15: 12: 21: 33: 16: 4: Strongly agree

9. The reports delivered by FRS contain too much information.

    Strongly disagree   : 19: 29: 18: 24: 6: 8: 3: Strongly agree

10. FRS always delivers reports in the best mode (CRT, Hardcopy, etc.).

    Strongly disagree   : 4: 10: 15: 28: 29: 17: 4: Strongly agree

11. The procedures for inputting data are easy to understand.

    Strongly disagree   : 3: 8: 14: 22: 31: 22: 7: Strongly agree

12. The reports delivered by FRS are very relevant.

    Strongly disagree   : 4: 2: 6: 14: 29: 46: 6: Strongly agree

13. The reports from FRS are delivered in the best sequence.

    Strongly disagree   : 3: 8: 8: 29: 28: 24: 7: Strongly agree

14. The computer supporting FRS is available all of the time.

Strongly disagree　　: 17: 12: 11: 17: 20: 26: 4: Strongly agree

15. The reports from FRS contain exactly the right type of information.

Strongly disagree　　: 4: 10: 17: 16: 40: 19: 1: Strongly agree

16. The instructions for inputting data are easy to understand.

Strongly disagree　　: 3: 9: 13:.25: 30: 21: 6: Strongly agree

17. The reports delivered by FRS contain too little information.

Strongly disagree　　: 9: 42: 26: 13: 9: 5: 3: Strongly agree

18. The response time from FRS is very good.

Strongly disagree　　: 3: 7: 10: 18: 29: 29: 11: Strongly agree　　.

19. My overall satisfaction with FRS is best described as:

Very satisfied　　: 0: 5: 5: 18: 33: 42: 4: Very dissatisfied.

Part B
1. Utilization of FRS has enabled me to make much better operating budget decisions.

Strongly disagree　　: 0: 15: 12: 15: 26: 27: 12: Strongly agree

2. Utilization of FRS has enabled me to keep track of activity in research accounts much better than I could before utilization.

Strongly disagree　　: 9: 11: 12: 15: 19: 30: 11: Strongly agree

3. Utilization of FRS has enabled me to keep track of activity in grant and designated gift accounts much better than I could before utilization.

Strongly disagree　　: 9: 9: 8: 18: 16: 34: 13: Strongly agree

4. Utilization of FRS has enabled me to keep track of cleared expenditures and calculate cash balances much better than I could before utilization.

Strongly disagree　　: 4: 10: 6: 14: 17: 37: 19: Strongly agree

5. Utilization of FRS has allowed me to eliminate many steps previously taken to arrive at similar decisions.

Strongly disagree　　: 3: 8: 11: 25: 24: 25: 11: Strongly agree

6. Overall, utilization of FRS has greatly improved the quality of the decisions I have made.

Strongly disagree　　: 2: 6: 7: 22: 33: 29: 8: Strongly agree

7. The services performed by FRS have made it much easier to perform my job well.

Strongly disagree   : 2: 6: 7: 16: 27: 33: 16:   Strongly agree

8. I personally have greatly benefitted from the existence of FRS in this university.

Strongly disagree   : 2: 11: 8: 17: 19: 32: 18:   Strongly agree

9. Does your department maintain a separate and independent accounting information system from FRS?

yes 11   no 96

11. Is usage of FRS mandatory?

yes 105   no   2

13. Please indicate your sex: Male 59   Female 48

15. Please indicate your level of education:

High School 13   Associate 10   Bachelor 59   Master 24   Doctorate 1

18. How frequently do you use FRS?

daily 105   weekly 1   monthly 1

yearly 0

Number of Academic Department Head Responses to Each Level of Each Categorical Question

PART A

1. The contents of the reports from FRS are very accurate.

> Strongly disagree : 2: 6: 11: 13: 16: 17: 12: Strongly agree

2. The reports from FRS are very easy to understand.

> Strongly disagree : 18: 18: 11: 7: 12: 11: 0: Strongly agree

4. The reports from FRS are very useful for identifying and defining problems.

> Strongly disagree : 6: 12: 11: 21: 9: 14: 4: Strongly agree

5. The reports delivered by FRS are very well formatted.

> Strongly disagree : 13: 15: 8: 12: 10: 19: 0: Strongly agree

6. The computer system supporting FRS appears to be very reliable.

> Strongly disagree : 2: 10: 5: 15: 11: 21: 12: Strongly agree

7. The reports delivered by FRS are available at the right time.

> Strongly disagree : 8: 4: 9: 17: 8: 24: 7: Strongly agree

9. The reports delivered by FRS contain too much information.

> Strongly disagree : 17: 16: 10: 14: 3: 7: 10: Strongly agree

10. FRS always delivers reports in the best mode (CRT, Hardcopy, etc.).

> Strongly disagree : 5: 4: 7: 20: 16: 14: 11: Strongly agree

12. The reports delivered by FRS are very relevant.

> Strongly disagree : 3: 7: 8: 19: 9: 17: 14: Strongly agree

13. The reports from FRS are delivered in the best sequence.

> Strongly disagree : 5: 9: 5: 27: 9: 16: 6: Strongly agree

14. The computer supporting FRS is available all of the time.

> Strongly disagree : 10: 8: 9: 12: 16: 14: 8: Strongly agree

15. The reports from FRS contain exactly the right type of information.

> Strongly disagree : 13: 14: 13: 14: 9: 9: 5: Strongly agree

17. The reports delivered by FRS contain too little information.

> Strongly disagree : 17: 20: 6: 15: 5: 11: 3: Strongly agree

18. The response time from FRS is very good.

       Strongly disagree   : 5: 8: 3: 17: 20: 18: 6: Strongly agree

19. My overall satisfaction with FRS is best described as:

       Very satisfied   : 5: 19: 10: 11: 14: 18: 0: Very dissatisfied.

Part B

1. Utilization of FRS has enabled me to make much better operating budget decisions.

       Strongly disagree   : 9: 15: 10: 13: 14: 18: 0: Strongly agree

2. Utilization of FRS has enabled me to keep track of activity in research accounts much better than I could before utilization.

       Strongly disagree   : 8: 14: 11: 11: 8: 21: 4: Strongly agree

3. Utilization of FRS has enabled me to keep track of activity in grant and designated gift accounts much better than I could before utilization.

       Strongly disagree   : 10: 11: 10: 14: 12: 13: 7: Strongly agree

4. Utilization of FRS has enabled me to keep track of cleared expenditures and calculate cash balances much better than I could before utilization.

       Strongly disagree   : 9: 11: 9: 11: 14: 18: 5: Strongly agree

5. Utilization of FRS has allowed me to eliminate many steps previously taken to arrive at similar decisions.

       Strongly disagree   : 14: 19: 9: 17: 7: 8: 3: Strongly agree

6. Overall, utilization of FRS has greatly improved the quality of the decisions I have made.

       Strongly disagree   : 13: 17: 13: 14: 8: 8: 4: Strongly agree

7. The services performed by FRS have made it much easier to perform my job well.

       Strongly disagree   : 14: 14: 10: 13: 11: 12: 3: Strongly agree

8. I personally have greatly benefitted from the existence of FRS in this university.

       Strongly disagree   : 17: 15: 6: 12: 11: 13: 3: Strongly agree

9. Does your department maintain a separate and independent accounting information system from FRS?

                yes 56   no 21

11. Is usage of FRS mandatory?

                yes 60   no 17

13. Please indicate your sex: Male 46   Female 31

15. Please indicate your level of education:

High School 10   Associate 6   Bachelor 11   Master 11   Doctorate 38

18. How frequently do you use FRS?

daily 18   weekly 15   monthly 41

yearly 3

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