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ABSTRACT

Assessing the information systems (IS) function within organizations has been identified as a critical issue for both executive and IS management. Unfortunately, despite the importance of the issue, little progress has been made in agreeing on appropriate measures of the contribution of the IS function to an enterprise. There is evidence that this lack of progress in defining measures of IS performance may stem from the differing perspectives of the people performing the assessment. The research described in this paper investigates the relationship between the organizational function of an individual performing an assessment of the IS organization and (1) the types of information selected for the assessment and (2) the assessment outcome. The research results indicate that there are differences in information preferences by executive managers, IS managers, and internal auditors for performing an IS organization assessment and that the people in these organizational roles identify different types of strengths and weaknesses when assessing an IS organization.

INTRODUCTION

Assessing the information systems (IS) function within organizations has been identified as a critical issue for both executive and IS management. A 1980 poll of Society for Information Management (SIM) members (Ball and Harris 1982) found "gauging MIS effectiveness" to be their second most important concern. "Measuring and improving IS effectiveness and productivity" was found to rank fifth in a list of the most critical information systems managerial issues of the coming decade in a 1984 Delphi study (Dickson et al. 1984) of leading IS professionals. A recent follow-up to this study (Brancheau and Wetherbe 1987) indicates that "measuring IS effectiveness and productivity" and "increasing understanding of role and contribution of IS" are ranked in the top ten issues of importance by both IS executives and general managers. Several other sources have identified the importance of assessing the IS function (Davis and Olson 1985; Dickson and Wetherbe 1985; Hamilton 1982; Matlin 1977).

Unfortunately, despite the importance of the issue, little progress has been made in agreeing on appropriate measures of the contribution of the IS function to an enterprise. While there is a fairly large body of literature related to evaluation or assessment of individual application systems there appears to be a relative paucity of material dealing with assessment of the information systems organization as a whole.

Lack of progress in defining measures of IS organization performance may stem from the differing perspectives of the people performing the assessment. Matlin (1977) identifies several differences in the objectives and types of information used in a "management assessment" compared to a financial or operational audit. Hamilton and Chervany (1981) observe that IS assessments "tend to be subjective" and "are often controversial and can be sources of disagreement and conflict between different functional groups." Hall (1982, p. 267) observes that "It is now well recognized that the

various parties concerned with any single organization can have contrasting and conflicting views on its effectiveness." Shirley (1975, p. 195) states that organizationally derived values "tend to be associated with one's major role grouping within an organization [and] thus, different area personnel tend to have different 'conceptions of the desirable' for their firm." Evidence of differences in perspectives on organizational effectiveness by groups in different organizational functions has also been observed by Pennings and Goodman (1977) and Keeley (1978).

The purpose of this research is to investigate the following questions: *What is the relationship between the organizational function of an individual performing an assessment of the IS function and the types of information selected for the assessment? Further, what is the impact of individuals in different organizational functions performing an assessment of the IS function using the types of information they select on the accuracy and completeness of the assessment?*

The answers to these questions depend upon several factors. Specific relevant factors are the organizational functions being compared, the types of information available for selection, and the nature of the organization being assessed.

In this study, the organizational functions of interest are executive management, IS management, and internal auditing. These specific functions were chosen since individuals having these organizational functions have a significant role in assessment of IS organizations. Executive managers make, or influence, decisions about allocation of resources to IS organizations and hiring, retention, and termination of IS management. IS managers have the direct responsibility for the operation and performance of their IS organizations. Internal auditors are "independent evaluators" of systems, activities, and procedures within their organizations (Davis and Olson 1985).

The types of information available for selection will constrain the choices of individuals attempting to assess an IS organization. Consequently it is important in comparing information selection preferences that a fairly comprehensive range of choices is available. This study develops a set of information items which is intended to capture the relevant material which might potentially be used in performing an assessment of an IS organization. This set of information items is categorized into the following: attitudinal, financial, IS planning and priority setting, system development process, existing applications portfolio, operational efficiency, personnel evaluation, IS measurement systems, and IS organization. This set of information items and their categorizations are based on Dickson, Wells and Wilkes (1986).

The nature of the organization being assessed will clearly be a factor in the results of an assessment of the organization. An extensive case describing a hypothetical IS organization was developed for use in this study. This case portrays a typical contemporary IS organization which can be characterized as a good traditional data processing organization without any significant long-range or strategic orientation.

PROPOSITIONS AND HYPOTHESES

Propositions

The research questions posed above can be addressed through the investigation of hypotheses related to two general propositions. The first proposition relates to the types of information selection preferences of individuals in different organizational functions for performing an assessment of an IS organization. This proposition asserts *that the information selection choices of an individual will be more like the information selection choices of other individuals having the same organizational function than they will be like the information selection choices of individuals having other organizational functions.*

The second proposition relates to the dimensions of effectiveness within which strengths and weaknesses are identified. It is posited *that the areas in which strengths and weaknesses are identified by an individual will be more like the areas in which strengths and weaknesses are identified by other individuals having the same organizational function than they will be like the areas in which strengths and weaknesses are identified by individuals having other organizational functions.*

Hypotheses about Information Selection Preferences

Selected hypotheses related to the first proposition are presented below. All hypotheses are given in the null form.

H1.1 There will be no difference in the degree to which different subjects stress attitudinal data for assessing the IS organization.

We expect executive managers to stress attitudinal data more than do IS managers and internal auditors. Rockart (1979) observes that executive managers seek informal and "word of mouth" information from their trusted advisors for much of their decision making and Mintzberg (1976) reports that top managers' information inputs are largely "impressions, feelings, hearsay, gossip, and so on." Both Rockart and Mintzberg suggest that formal analytical data are not of as much concern to executive managers.

H1.2 There will be no difference in the degree to which different subjects stress personnel evaluation data for assessing the IS organization.

H1.3 There will be no difference in the degree to which different subjects stress IS organization data for assessing the IS organization.

We expect executive managers to stress both personnel evaluation and IS organization data more than do IS managers or internal auditors. It is widely held that top level managers spend more of their time on organizing and staffing than do people in other organizational roles and that the concerns of these top management personnel move toward a more organizational and administrative focus.

H1.4 There will be no difference in the degree to which different subjects stress financial performance data for assessing the IS organization.

We expect IS managers to stress financial performance data more than do executive managers or internal auditors. A survey by Hallam and Scriven (1976) found minimizing costs to be the second ranked of the top five objectives of IS managers. Also, the widely reported shift in emphasis from efficiency to effectiveness issues as managers move up the organizational hierarchy indicate that executive managers will be less concerned with purely financial issues than will other levels of managers.

H1.5 There will be no difference in the degree to which different subjects stress IS measurement systems data for assessing the IS organization.

We expect IS managers to stress IS measurement systems data more than do executive managers or internal auditors. Surveys conducted by Hallam and Scriven (1976) and Schussel (1974) found "meeting deadlines" to be the top rated concern of IS managers in terms of objectives and performance measures.

H1.6 There will be no difference in the degree to which different subjects stress applications portfolio data for assessing the IS organization.

H1.7 There will be no difference in the degree to which different subjects stress system development practices data for assessing the IS organization.

We expect internal auditors to stress both applications portfolio and system development practices data more than do executive managers and IS managers. Both Purdy (1978) and the Institute of Internal Auditors (1978) stress the importance of the existence and quality of controls in operational processes. Controls on and performance of operational systems are very important concerns of EDP audit personnel. Purdy also stresses the importance of systems design controls and the controls built into systems during the systems design process to audit personnel.

Hypotheses about Identification of Strengths and Weaknesses

Selected hypotheses related to the second proposition are presented below. These hypotheses are in pairs, relating to the accuracy and the completeness of the IS assessment by individuals in different organizational functions.

H2.1a There will be no difference in the accuracy of identification of strategic strengths and weaknesses by different subjects.

H2.1b There will be no difference in the completeness of identification of strategic strengths and weaknesses by different subjects.

We expect executive managers to be more accurate and complete in the identification of strategic strengths and weaknesses than are IS managers and

internal auditors. This expectation is supported by the conventional wisdom that executive managers have a more external rather than internal focus and consider more strategic than operational issues compared to individuals in other organizational roles.

H2.2a There will be no difference in the accuracy of identification of organizational strengths and weaknesses by different subjects.

H2.2b There will be no difference in the completeness of identification of organizational strengths and weaknesses by different subjects.

We expect executive managers to be more accurate and complete in identification of organizational strengths and weaknesses than are IS managers and internal auditors. It is generally believed that as managers move from lower to higher levels in the organizational hierarchy they are concerned more with overall administrative and organizational issues than with more parochial technical issues.

H2.3a There will be no difference in the accuracy of identification of technical strengths and weaknesses by different subjects.

H2.3b There will be no difference in the completeness of identification of technical strengths and weaknesses by different subjects.

We expect IS managers to be more accurate and complete in identification of technical strengths and weaknesses than are executive managers and internal auditors. The IS manager should be more competent in the technology than either executives or internal auditors since these IS managers have more direct responsibility for and interaction with the IS technology.

H2.4a There will be no difference in the accuracy of identification of security/integrity strengths and weaknesses by different subjects.

H2.4b There will be no difference in the completeness of identification of security/integrity strengths and weaknesses by different subjects.

We expect internal auditors to be more accurate and complete in identification of security/integrity strengths and weaknesses than are executive managers and IS managers. Existence and quality of information systems controls and exposure to risk from system operation are some of the primary concerns of audit personnel (Institute of Internal Auditors 1978; Purdy 1978).

RESEARCH METHOD

Overview

A field experiment was used to investigate the relationship between the organizational function of assessors of an IS organization and the consequent assessment. In this study, the subjects selected the information they wished to use to perform an assessment of a hypothetical IS organization and identified the strengths and weaknesses of this IS organization.

The subjects were given a one page description of the hypothetical enterprise whose IS function they were to assess. The subjects then selected 15 items which might potentially aid them in performing the assessment from 54 available types of information. Using the information provided about the selected items, the subjects identified strengths and weaknesses of the hypothetical IS organization.

The items selected by each subject were categorized into previously identified categories. Also, the list of strengths and weaknesses were compared to a definitive list of strengths and weaknesses (established in a Delphi study described in a following section) to arrive at measures of accuracy and completeness within each of several previously identified categories. Analysis of variance procedures were used to determine if there is a significant difference in the categories of types of information selected by the subjects in different organizational functions and if there is any difference in accuracy and completeness in individual assessment categories by subjects in different organizational functions.

Research Materials

Several types of research materials were developed to conduct the investigation: a case description of a hypothetical organization, a set of information items available for the assessment process, a categorization of this set of information items, a

set of data (corresponding to the set of information items) describing the hypothetical IS organization, a definitive set of identified strengths and weaknesses of the hypothetical IS organization, and a categorization of the strengths and weaknesses.

The *case description* is approximately one page long and describes the enterprise whose IS function is to be assessed. It includes information on the type, size, and performance of the enterprise. An organization in the manufacturing industry is used.

The *set of information* items consists of 54 types of information which have been identified in the literature as relevant to an assessment of the IS function. This set of items (shown in Appendix A) is derived primarily from the list of factors identified by Dickson, Wells and Wilkes (1986) plus financial performance measures. Each item in this set of information items was printed on a separate card to be used in the experiment.

Each item in the set of information items is placed in one of nine *information categories*. The information categories are: attitudinal, financial, IS planning and priority setting, system development process, existing applications portfolio, operational efficiency, personnel evaluation, IS measurement systems, and IS organization. These categories are derived from the categories suggested by Dickson, Wells and Wilkes (1986).

The *set of data* consists of quantitative measures and/or qualitative descriptions of the hypothetical IS organization. There is a measure and/or description corresponding to each of the 54 information items. The 15 item subset of this data selected by each subject in the information selection portion of the experiment is used by the subject in determining the strengths and weaknesses of the hypothetical IS organization.

The *definitive set of strengths and weaknesses* of the hypothetical IS organization was generated through a Delphi study (described below) using representatives from each of the following areas: executive management, IS management, internal audit management, internal management consulting, external consulting in management of technology, and academia. This list of strengths and weaknesses is the criteria by which assessments of all subjects are "graded" for accuracy and completeness.

Each strength and weakness identified by the Delphi group was placed in one of five *categories of strengths and weaknesses* of an IS organization. Each strength or weakness was identified as one of the following types: strategic, organizational, managerial, technical, or security/integrity. Suggestions of the Delphi group were used for categorizing the identified strengths and weaknesses.

Variables and Variable Relationships

Figure 1 shows the relationships among the major independent, controlled, and dependent variables in the experiment.

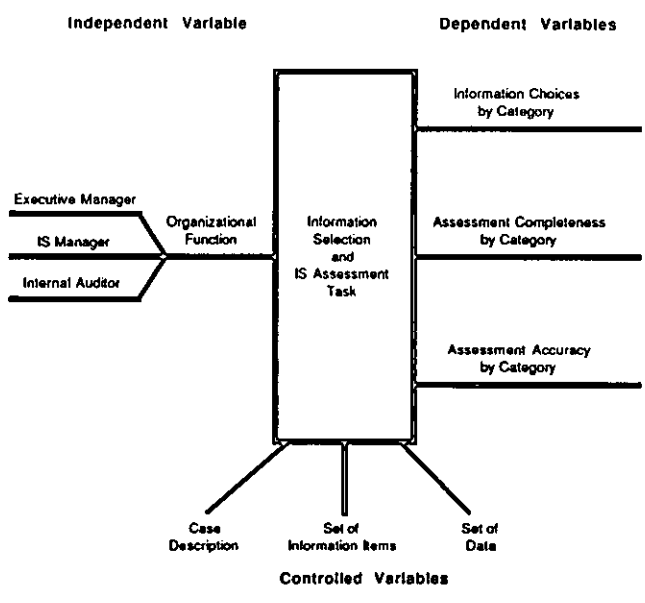

Figure 1. Variable Relationships

Independent Variable: The independent variable is the organizational function of the subject. This variable is addressed more fully in the Subjects section below.

Controlled Variables: The main controlled variables in the study are the case description of the hypothetical enterprise whose IS function is to be assessed, the set of information items available to be selected, and the set of data corresponding to

the set of information items. Each of these controlled variables is described above.

Dependent Variables: There are three sets of dependent variables in the study: the information choices by category, the assessment completeness by category, and the assessment accuracy by category.

The *information choices by category* are generated from the list of items selected by the subject from the set of information items and the previously defined information categories. The number of information item selections in each category is counted for each subject.

The *assessment completeness by category* is determined for each subject by counting the number of definitive strengths and weaknesses within each category of strengths and weaknesses correctly identified by the subject.

The *assessment accuracy by category* is determined for each subject by counting the number of strengths identified by the subject which are not in the definitive list of strengths and the number of weaknesses identified by the subject which are not in the definitive list of weaknesses by categories of strengths and weaknesses and subtracting these counts from the respective assessment completeness by category counts.

Subjects

The organizational function of the subjects is a key item of interest in the study. The types of organizational functions considered are executive manager, IS manager, and internal auditor. Individuals performing these organizational functions frequently have a significant role in assessment of IS organizations.

A total of 21 subjects from seven companies participated in the experimental part of the research. The three participants from each company were the head of the IS organization, an internal auditor, and an executive manager not associated with either the IS or the internal audit functions of the organization.

The seven participating companies were manufacturing organizations in the Atlanta and north Georgia area. Annual revenues of these firms range from just over $150 million to just over $1.5 billion. Employment in these organizations ranged from approximately 1,400 to 7,000.

The *executive managers* participating in this research were all managers within the top three hierarchical levels of their organizations. Three of these managers were Vice Presidents and four were Directors. The organizational areas represented by these managers were personnel, finance, marketing, and manufacturing. These managers had worked in their current job functions from three to ten years.

The *IS managers* who participated in this research were all corporate level managers of the total IS function. Two of these managers were Vice Presidents, four were Directors, and one was Manager of Data Processing. These subjects had held their current job position in their respective organizations from two to eight years.

The *internal auditors* participating in this study held the following titles: one Corporate Internal Audit Manager, one Internal Audit Manager, one Senior Corporate Auditor, one EDP Auditor, and three Internal Auditors. These subjects had served in an internal audit capacity in their respective organizations from two to five years.

Experiment Administration and Procedures

The investigation procedure used for each subject is described below.

1. Subjects were given a brief oral overview of the purpose and procedures of the research and invited to ask questions. Subjects were asked at this time if they had any objections to their comments being taped as they performed the task.

2. Subjects were given (1) the experimental instructions; (2) the case description; (3) a sheet describing the procedures for making their information item selections; (4) a sheet for recording their information item choices; (5) the set of category cards; and (6) the cards containing the set of information items.

3. Subjects read the experimental instructions, case description, and sheet describing how to make their information item selections. Subjects identified their information preferences using a modified Q-Sort procedure. (See Dickson and Wetherbe 1985, p. 95-115, for a

discussion of the Q-Sort procedure.) In this procedure, subjects sorted the cards containing the set of information items into five categories of usefulness for performing an assessment of the hypothetical IS organization. These categories range from most useful to average or lesser usefulness. Subjects were restricted to placing exactly three selections in the most useful category, five selections in the second highest category of usefulness, seven selections in the third, and twelve selections in the fourth. The remainder of the cards were placed in the lowest category of usefulness. Subjects recorded their selections on the sheet titled "Usefulness of Information for Assessing an Information Systems Organization" and returned this sheet to the researcher. The top 15 selections (those in the three highest categories of usefulness) were used in the formal statistical data analysis.

4. Subjects were given (1) the actual data for their top 15 information item choices identified through the modified Q-Sort procedure (all their information item choices in the top three categories of usefulness); (2) a set of sheets on which to record their assessment of the strengths and weaknesses of the IS organization described in the set of data; and (3) verbal instructions to assess the hypothetical IS organization in accordance with the written instructions they had been given.

5. Subjects read the information they were given about the hypothetical IS organization and recorded their assessment of the strengths and weaknesses of this organization on the sheets provided.

6. Subjects filled out a short questionnaire about themselves and their company's IS organization. In this questionnaire, the subjects identified the four major strengths and four major weaknesses of their own company's IS organization and rated their IS organization.

The Delphi Study

In order to determine the accuracy and completeness of the set of strengths and weaknesses identified by the experimental subjects, it was necessary to identify a "definitive" set of strengths and weaknesses of the hypothetical IS organization. This was accomplished through the use of a respected and highly qualified group of six individuals representing IS management, personnel management, internal auditing management, internal management consulting, external management consulting, and academia. All members of this group were provided with the case description and the complete set of data. This group of "experts" defined the total set of strengths and weaknesses of the hypothetical IS organization through a Delphi process. The definitive list of strengths and weaknesses of the hypothetical IS organization consists of those strengths and weaknesses agreed on (after three iterations of the Delphi process) by at least three members of the expert group.

ANALYSIS OF EXPERIMENTAL RESULTS

Statistical Methods

The statistical methods used to analyze the data gathered in the experiment are multivariate (MANOVA) and univariate (ANOVA) analysis of variance. All of the formal statistical analyses used in this study test for differences in the means of the subject populations which are significant at the .05 level. Pillai's trace was computed for each multivariate test of significance. Significant results identified through the MANOVA procedure are further analyzed through the one-way univariate ANOVA procedure and the Scheffe test as a follow-up procedure to determine the specific nature of statistically significant results.

Presentation of the Experimental Data

The results of the two major activities of the experiment -- selection of information preferences and identification of strengths and weaknesses of the hypothetical IS organization -- were counted and/or classified to produce the data for analysis. The count of information selections by type of information, developed from the information item selections, is shown in Table 1. The items selected by the subjects as being in the top three categories of usefulness for performing an analysis of the strengths and weaknesses of the hypothetical IS organization were used in developing Table 1. The use of these 15 items in the top three categories provides a small enough sample to discern preferences but a large enough sample to allow for identification of the orientation of these preferences.

Table 1. Count of Information Selections by Type (in usefulness categories 1, 2, & 3)

Org. Function	Company	Information Type 1	2	3	4	5	6	7	8	9
IS Manager	1	4	0	3	1	2	0	3	2	0
IS Manager	2	1	0	6	2	0	2	2	0	2
IS Manager	3	3	1	3	1	1	2	2	2	0
IS Manager	4	3	0	3	0	2	0	4	3	0
IS Manager	5	5	1	3	0	3	0	0	3	0
IS Manager	6	6	0	2	0	2	2	0	3	0
IS Manager	7	5	0	4	0	1	1	2	2	0
Internal Auditor	1	3	2	4	2	3	1	0	0	0
Internal Auditor	2	1	0	5	3	0	3	1	1	1
Internal Auditor	3	2	0	5	6	0	0	0	2	0
Internal Auditor	4	5	0	2	3	1	1	0	2	1
Internal Auditor	5	0	1	3	3	3	4	0	1	0
Internal Auditor	6	2	2	6	2	0	2	1	0	0
Internal Auditor	7	2	0	5	2	2	4	0	0	0
Executive Mgr.	1	0	0	7	1	3	1	2	0	1
Executive Mgr.	2	0	3	3	4	2	1	0	1	1
Executive Mgr.	3	1	2	2	0	0	1	6	1	2
Executive Mgr.	4	3	0	5	2	0	0	4	1	0
Executive Mgr.	5	3	2	5	0	0	0	2	1	2
Executive Mgr.	6	0	1	4	2	3	1	2	1	1
Executive Mgr.	7	1	1	5	0	1	1	3	1	2

LEGEND: (Information Types)
1 = Attitudinal, 2 = Financial, 3 = IS Planning & Priority Setting,
4 = System Development Process, 5 = Applications Portfolio, 6 = Operational Efficiency,
7 = Personnel Evaluation, 8 = IS Measurement Systems, 9 = IS Organization

Table 2. Assessment Completeness by Category

Org. Function	Company	Category 1	2	3	4	5
IS Manager	1	6	4	6	4	0
IS Manager	2	2	1	2	5	0
IS Manager	3	3	6	1	3	1
IS Manager	4	3	9	0	6	1
IS Manager	5	5	12	6	4	0
IS Manager	6	3	13	0	6	1
IS Manager	7	6	13	7	6	1
Internal Auditor	1	0	4	10	4	2
Internal Auditor	2	0	3	9	10	3
Internal Auditor	3	2	4	7	2	2
Internal Auditor	4	1	10	2	7	2
Internal Auditor	5	1	3	4	1	6
Internal Auditor	6	0	3	6	4	5
Internal Auditor	7	1	5	4	3	4
Executive Mgr.	1	1	3	8	3	0
Executive Mgr.	2	0	6	3	2	1
Executive Mgr.	3	2	2	3	3	0
Executive Mgr.	4	1	14	2	8	1
Executive Mgr.	5	3	5	7	0	0
Executive Mgr.	6	1	6	4	4	0
Executive Mgr.	7	2	8	3	6	0

LEGEND: (Strength & Weakness Categories)
1 = Strategic, 2 = Organizational, 3 = Managerial, 4 = Technical, 5 = Security/Integrity

The strengths and weaknesses (of the hypothetical IS organization described in the case materials) identified by each of the experimental subjects were compared to the definitive list of strengths and weaknesses developed through the Delphi process. The results of this comparison were used to produce the data in Tables 2 and 3. Table 2 shows the number of strengths and weaknesses within each of the five strength-and-weakness categories ("dimensions of effectiveness") correctly identified by each of the subjects. Table 3 shows the number of correctly identified strengths and weaknesses less the number of incorrectly identified strengths and weaknesses by category by each of the subjects.

Statistical Results

A summary of the statistical results is given in Figure 2. These results are described and interpreted in the following section.

DISCUSSION AND INTERPRETATION OF RESEARCH FINDINGS

Information Selection Preferences

A finding of differences in information preferences for assessing an IS organization among people having different organizational roles was not surprising; however, the nature of some of the identified differences were unexpected. Though executive managers were expected to stress *attitudinal* data for performing an assessment of an IS organization more than do IS managers and internal auditors, the research findings suggest that IS managers actually stress attitudinal data for performing an IS organization assessment more than do executive managers. Unlike the reported behavior of executive managers in decision making related to other areas, it appears that in assessing IS organizations executive managers are looking for

Table 3. Assessment Accuracy by Category

Org. Function	Company	Category 1	2	3	4	5
IS Manager	1	6	1	4	4	0
IS Manager	2	1	0	0	4	0
IS Manager	3	1	1	-1	1	1
IS Manager	4	2	8	-3	6	1
IS Manager	5	5	10	5	4	-1
IS Manager	6	3	10	-1	4	1
IS Manager	7	5	11	5	6	1
Internal Auditor	1	0	4	8	4	2
Internal Auditor	2	0	3	6	9	1
Internal Auditor	3	2	3	5	2	-1
Internal Auditor	4	1	10	1	3	2
Internal Auditor	5	1	2	0	-2	1
Internal Auditor	6	0	2	3	4	4
Internal Auditor	7	1	5	3	1	0
Executive Mgr.	1	1	3	5	2	-1
Executive Mgr.	2	0	5	-2	2	1
Executive Mgr.	3	2	2	-4	2	0
Executive Mgr.	4	1	10	-3	7	1
Executive Mgr.	5	3	4	6	0	0
Executive Mgr.	6	1	4	1	2	0
Executive Mgr.	7	2	6	2	6	-1

LEGEND: (Strength & Weakness Categories)
1 = Strategic, 2 = Organizational, 3 = Managerial, 4 = Technical, 5 = Security/Integrity

- Information Selections by Category (.015)
  - Attitudinal (.013) {ISM, EM}
  - Financial (.137)
  - IS Planning (.387)
  - System Development (.007) {IA, ISM}
  - Applications Portfolio (.888)
  - Operational Efficiency (.063)
  - Personnel Evaluation (.015) {EM, IA}
  - IS Measurement Systems (.013) {ISM, IA} {ISM, EM}
  - IS Organization (.018) {EM, ISM} {EM, IA}
- Assessment Completeness Within Categories (.000)
  - Strategic (.000) {ISM, IA} {ISM, EM}
  - Organizational (.223)
  - Managerial (.181)
  - Technical (.683)
  - Security/Integrity (.000) {IA, ISM} {IA, EM}
- Assessment Accuracy Within Categories (.027)
  - Strategic (.008) {ISM, IA}
  - Organizational (.677)
  - Managerial (.236)
  - Technical (.647)
  - Security/Integrity (.126)

Probabilities of equal means of groups are shown in parentheses ().
Significantly different pairs of groups are shown in braces {}.

Figure 2. Summary of Statistical Results

"harder" measures of performance. There is some anecdotal evidence that executive managers are uncomfortable with managing the technology of IS and consequently want unequivocal measures. Though it is not sufficient for statistical significance, the internal auditors in the study selected on average almost twice as many attitudinal items as did executive managers. Specific information selections and comments of subjects during the experiment indicate that these internal auditors were using the attitudinal data to identify evidence of problems as opposed to the more balanced approach of IS managers who looked at both problems and contributions.

No significant difference was found in selection of *financial* information by any of the three subject groups examined. Very few financial data items were chosen by any of the subjects -- an overall average of less than one per subject. This appears to indicate that none of the subject groups tested consider this type of information very useful for performing an IS organization assessment. Looking at the identifications of strengths and weaknesses in consideration of the financial information selections indicates that even the subjects who chose financial information items were not able to infer much from this data. This is particularly interesting since financial measures are some of the most widely discussed for determining performance.

No significant difference was found in selection of *IS planning and priority setting information* by any of the three subject groups. However, all subjects had relatively large numbers of selections in this category. This indicates that all subjects tested felt that this type of information was important in the IS organization assessment process.

The statistical results suggest that internal auditors select more *system development practices and project control information* for performing an IS organization assessment than do IS managers. While the difference in this type of information preference was not statistically significant between internal auditors and executive managers, internal auditor subjects did select more than twice as many of this type of information items for performing the assessment than did executive managers. These results are not surprising. Many of the items identified in this category described the control

type information that internal auditors were expected to select.

While it was posited that internal auditors would select more *applications portfolio information* for performing an IS organization assessment than would IS managers and executive managers, no difference was found in applications portfolio information preferences among the groups. This appears to result from an overall low level of interest in this type of information among all subject groups.

A "near" significant statistical result indicates that internal auditors may stress *operational efficiency* information more for performing an assessment of an IS organization than do IS managers and executive managers. This result was expected due to the "control" orientation generally ascribed to internal auditors.

Executive managers were expected to stress *personnel evaluation* information more than do IS managers and internal auditors. The results of the statistical findings suggest that executive managers do stress personnel evaluation information more than do internal auditors but there is no significant difference in the degree to which executive managers and IS managers stress personnel evaluation information. This finding reinforces many of the other findings of this study which indicate that IS managers may be more concerned with strategic, organizational, and managerial issues than has previously been thought.

The results of this study indicate that IS managers stress data about *IS measurement systems* for performing an IS organization assessment more than do executive managers and internal auditors. These results were expected. Failure to complete projects on time and within budget creates negative visibility for IS managers among users and executives and consequently these IS managers would be expected to stress this type of information in their own assessments.

This study finds that executive managers stress *IS organization* data for assessing an IS organization more than do IS managers and internal auditors. This result was expected due to the assumed overall more managerial orientation of executive managers compared to the other subject groups. One caveat should be given here regarding the findings related to this category of information. Only two information items were available for selection in this category: the corporate organization chart showing where IS reports and the IS organization chart. The small number of items included in this category may affect confidence in the findings related to this information category.

Identification of Strengths and Weaknesses

As was the case with information preferences of the subject groups studied in this research, some interesting and surprising findings were made about the nature of identification of strengths and weaknesses by the subject groups. The nature of these results are described below along several dimensions.

One unexpected finding was that IS managers identify more *strategic strengths and weaknesses* than do executive mangers and internal auditors. In retrospect, this should not have been a surprising finding. The finding indicates that more of the IS managers seem to be reading and listening to the many pronouncements on "strategic use of the IS resource" than are executive managers and internal auditors.

All subject groups identified a large number of *organizational strengths and weaknesses.* This parallels the finding that these subjects also identified primarily organizational information when asked to list the strengths and weaknesses of their own organizations. Thus, it appears that organizational considerations are important to all subject groups.

No difference was found in *managerial assessment completeness* among any of the subject groups. This finding may mask some meaningful results. Included in the managerial category are a wide range of items which might potentially be classified in other categories, specifically security/integrity or organizational. Subsequent studies need to analyze the most appropriate classification of items in this category. There appear to be differences in the specific items identified by the subject groups.

No difference was found in *technical assessment completeness* among any of the subject groups. IS managers were expected to identify more technical strengths and weaknesses than were either executive managers or internal auditors. While IS managers did identify a few more technical strengths and weaknesses than did executive managers and

internal auditors, the difference was not significant. Almost all of the subjects identified a large number of items in this category.

As expected, internal auditors were more complete in identifying *security and integrity strengths and weaknesses* than were either IS managers or executive managers.

The tests of *accuracy of assessment by categories of strengths and weaknesses* produced results closely paralleling the results of the tests of completeness of assessment by category. Only strategic assessment accuracy was found to be statistically significantly different among the subject groups. Specifically, IS managers were found to be more accurate in identifying strategic strengths and weaknesses than are internal auditors.

IMPLICATIONS OF THE RESEARCH

This research should be of interest to both IS practitioners and academics. The research indicates that the information desired for assessment of IS organizations is different for assessors in different organizational functions and examines the specific nature of these differences. Knowledge of what types of information are considered relevant and useful for an IS organization assessment constitutes a basis for communication among the affected parties in an assessment process. The research results should aid executive managers and IS managers in identifying and agreeing on an appropriate set of criteria (and measures) for assessing the IS function. Better understanding by IS managers of the criteria for "success" as viewed by executive managers and internal auditors should lead to improved performance by the IS manager. Hopefully, this will also lead to greater benefit for the organization.

One finding of the study which indicates both a significant problem and a significant opportunity relates to the large number of errors made by virtually all the subjects in assessing the hypothetical IS organization in the case. Almost 25% of the strengths and weaknesses identified by the experimental subjects were incorrect according to the consensus of the expert group. This indicates the need for more study to better define what constitutes a true strength or weakness of an IS organization and education of current and future IS managers, executives, and internal auditors to better identify these strengths and weaknesses.

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APPENDIX A. TYPES OF INFORMATION BY CATEGORY

Attitudinal

- Summary of a 1985 Survey of Executive Managers' Overall Attitudes about the Contribution of Information Systems to the Organization
- Summary of a 1985 Survey of Executive Managers' Perceptions of the Director of Information Systems
- Summary of a 1985 Survey of Users' and User Managers' Overall Attitudes about the Contribution of Information Systems to the Organization
- Summary of a 1985 Survey of Executive Managers' Perceptions of Information Systems Problems
- Summary of a 1985 Survey of Users' and User Managers' Perceptions of the Abilities and Performance of the Information Systems Staff
- Summary of a 1985 Survey of Users' and User Managers' Perceptions of Information Systems Problems
- Summary of a 1985 Survey of Users' and User Managers' Perceptions of Their Application Systems

Financial

- Method of Accounting/Allocating Costs of System Operation
- Total Annual Information Systems Expenditures - 1982 Through 1985
- Industry Average - Percentage Breakdown of Information Systems Expenditures by Category
- Industry Average - Data Processing Budgets as a Percentage of Revenues, by Industry
- Method of Accounting/Allocating Costs of System Development
- Percentage Breakdown of 1985 Information Systems Expenditures by Category

IS Planning and Project Selection

- Summary of a 1985 Survey of Executive Managers' Role in Determining the Organization's Information Policy
- Formal Forecast of Information Systems Capabilities
- Summary of an External Consultant's 1985 Analysis of the Balance of Risk in the Applications Development ortfolio
- Role of the Information Systems Department in the Overall Organizational Planning Process
- Information Systems Planning Process
- Description of the Information Systems Plan
- Method of Organizational Information Requirements Analysis
- Formal Forecast of Future Technology and Its Impact on the Organization
- Information Systems Project Selection and Priority Setting Process

Systems Development Practices and Project Control

- Description of Productivity Aids for System Development
- Description of System Development Methodology Used
- Description of Internal Auditors' Role in the Systems Development Process
- Description of Systems Analysis and Design Methodology Used
- Description of User Documentation
- Description of Systems Documentation
- Description of Project Control System Used
- Description of Users' Role in the Systems Development Process

Applications Portfolio

- o Age and Quality of Existing Major Application Systems
- o Application Systems Currently Under Development
- o Existing Application Systems
- o Planned Future Application Systems

Operational Efficiency

- o Description of Hardware and System Software
- o Description of Backup, Recovery, and Disaster Systems and Procedures
- o Summary of an Evaluation of System Access Controls
- o Description of Data Security and Privacy Controls
- o Summary of System Availability Information

Personnel Evaluation

- o Summary of an Assessment of the Information Systems Knowledge of System Users
- o Summary of an Assessment of the Technical Quality of Information Systems Employees
- o Report of Information Systems Employee Turnover - 1981 through 1985
- o Description of Information Systems Personnel Planning
- o Summary of a 1985 Survey of Job Satisfaction of Information Systems Employees
- o Summary of an Assessment of Training of Information Systems Users
- o Description of Information Systems Compensation and Career Planning System
- o Summary of an Assessment of the Business Knowledge of Information Systems Employees
- o Summary of an Assessment of the Staff Professionalism of Information Systems Employees

IS Measurement Systems

- o Comparison of Maintenance and Development Costs
- o Systems Development Schedule and Budget Performance
- o Summary of a 1985 Survey of Users' and User Managers' Evaluation of Responsiveness of Information
- o Systems Personnel in Fixing "Bugs" and Making Minor System Changes
- o Summary of a 1985 Survey of Users' and User Managers' Evaluation of New Systems Development

IS Organization

- o Information Systems Organization Chart
- o Corporate Organization Chart (Showing Where Information Systems Reports)

THE IMPACT OF INFORMATION TECHNOLOGY ON CONTROL: A LEADERSHIP THEORY PERSPECTIVE*

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ABSTRACT

In this paper, we explore two models of the impact of Information Technology (IT) on control based on the perspective of leadership theories. The objective is to explain how IT can enhance the control mechanisms in a work group. Review of leadership literature suggests two relevant theories: leadership behavior theory and leadership substitute theory. To explore these conceptual models, data was collected from 136 managers and professionals who use well-established information systems. The data provides support that IT's impact on control can be explained through its effects on the control factors identified from the two leadership theories. The two models are equally powerful in explaining the criterion variance of control, and the two sets of independent variables from the models are highly correlated, suggesting that either model is good for the study of IT's impact on control. In addition, the data provides support that the impact of IT on control is stronger in dynamic environments. The data also shows that the innovative ability of a work group is positively related to IT's impact on control.

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1. INTRODUCTION

A large pharmaceutical manufacturer recently installed a lap top computer system for its national sales force, but it has not had the productivity impact that was expected. Many sales representatives perceive that this system will allow management to more closely monitor and control their activities and they are resisting its use. The system has increased the amount and type of information reported from the field and has standardized some procedures that were once highly individualized. Yet, despite all of this, in a couple of districts the system has been very positively received. These sales representatives believe that the electronic mail features have substantially improved coordination within their districts and that the information contained within the system has made them less dependent upon and less controlled by corporate information. These district managers report that they are in better control of their sales representatives and that productivity has been improved.

How does one sort out these apparently contradictory results obtained by a single system installed in one organization? In part, the answer lies in the fact that information technology impacts many different aspects of the "control system" simultaneously, in both positive and negative ways.

Our focus in this study is the use of information technology as a mechanism for control in work groups and organizations. Ever since the early work of Taylor (1911), Fayol (1949), and Weber (1947), much research in organizational behavior has focused on how organizations channel individual efforts to obtain a unified goal. There are many different mechanisms for coordinating or controlling those individual entities in organizations that may have different goals. Correspondingly, there are many disciplines which study these aspects of control or coordination. Leadership theory is one area of study which concerns delimiting or encouraging organizational members to behave consistently with the goals of an organization.

In this paper, we will build a theory of the impact of information technology on control from the perspective of leadership theories. In Section 2, leadership theories and their relationships to IT's impact on control are reviewed and discussed. In Section 3, the hypotheses for the study are presented. In Section 4, the research methodology is outlined. In Section 5, the empirical data is analyzed using correlation and regression analyses. In Section 6, a discussion and the concluding remarks are presented.

2. LEADERSHIP THEORIES AND CONTROL

Recent leadership theories suggest two underlying control strategies. The first body of theory suggests that control can be accomplished through a leader's structuring/initiating behavior (*leadership behavior theory*). This strategy emphasizes that an effective leader provides some type of guidance and/or positive feelings for subordinates as they carry out their tasks (Howell and Dorfman 1981). The other body of theory arrives at the somewhat unexpected conclusion that control can be achieved by minimizing the roles of leaders (*leadership substitute theory*). A leader's role can be substituted for under certain circumstances. For example, several variables that characterize professionals such as expertise, independence, and motivation have been suggested as potential substitutes for hierarchical leadership (Kerr 1977).

Conceptualizing information technology as a control mechanism, we will use leadership behavior theory and leadership substitute theory to build a theory of IT's impact on control. Specifically, we will examine how IT can help a work group composed of individuals who may have different goals and attitudes manage tasks to achieve organizational goals. While the traditional approaches focus on the application of hierarchical controls, more recent approaches include a broader concept of control based on contingency settings of an organization (Ouchi 1979; Reeves and Woodward 1970). Therefore, we will not limit ourselves to hierarchical control but will include collegial and nonhierarchical controls.

2.1 Leadership Behavior Theory and IT's Impact on Control

Leadership behavior theory surfaced in the 1950s and generated considerable interest in training leaders to exhibit desirable behavior. Leadership behavior theory seeks to identify the process side of leadership attributes instead of focusing on the psychometric attributes of leaders.

Leadership behavior theory identifies three dimensions of instrumental behavior which clarify what is expected of subordinates in their work roles (House and Dessler 1974; House and Mitchell 1974; Schriesheim 1978): (1) task clarification--clarifying management expectations of subordinates in their work, (2) work assignment -- assigning subordinates to specific tasks, and (3) procedure specification -- enforcing rules, procedures, and work methods. IT can augment and support these leadership behaviors in controlling and coordinating a work group. Therefore, we hypothesize that task clarification, work assignment, and procedures specification are factors through which IT can affect control.

Task Clarification: Task clarification refers to the information provided by a leader on roles and tasks associated with a given position to help the subordinate understand a given job. IT can provide the work group with a comprehensive view of the business, opportunities for detailed analysis, and consideration of alternate courses of action.

Work Assignment: IT can help assign group members to specific tasks through flexible time scheduling and work distribution. Typical examples are project management tools which focus on improving organizational efficiency by automating the scheduling process. These tools reduce the costs of communications and coordination by carrying out activities in partnership with the users. Also, electronic mail can make coordination easier, especially for geographically dispersed groups.

Procedure Standardization: If procedures are explicitly defined and readily measured, effective control can be accomplished by standardizing operating procedures. Although standardization often leads to inflexibility in the work group, it can streamline work procedures, resulting in improved efficiency. In addition, the increased efficiency frees time for the work group to explore new ideas. Saunders (1981) claimed that because IT automates and routinizes simple tasks, the work group can devote more time to a variety of complex tasks through enhanced information processing capability.

2.2 Leadership Substitute Theory and IT's Impact on Control

House and Mitchell (1974) argued that under circumstances when both goals and paths to goals are clear, attempts by the leader to clarify paths and goals will be both redundant and seen by subordinates as imposing unnecessarily close control. Several variables that characterize professionals working in organizations have been suggested as potential substitutes for hierarchical leadership because professionals can often perform their jobs effectively without a leader's supportive functions (Kerr 1977). Kerr and Jermier (1978), Jermier and Berkes (1979), and Miles and Petty (1977) added task and organizational characteristics to the list of possible leadership substitutes. Howell and Dorfman (1981) further elucidated the substitutes concept and empirically tested hypotheses that match specific substitutes with a given leader behavior. They reported that although their operationalizations of leadership substitutes cannot be a strong substitute for leadership, these operationalizations may be viewed as substituting for the potentially important explanatory power of instrumental leader behaviors in the absence of any leadership.

These researchers claimed that many individual, task, and organizational characteristics have the capacity to act as substitutes for hierarchical leadership in that they often serve to neutralize or substitute for a formal leader's ability to influence satisfaction and performance for either better or worse (Kerr 1977). Information technology can play the role of these substitutes for hierarchical leadership by clarifying the purpose of goals and by suggesting paths to goals. For example, standard operating procedures introduced with an information system may be a substitute for a leader's structuring function. Also, IT can help to reduce the level of turbulence and uncertainty in organizational goals for lower level subordinates, and thus serves as a substitute for a formal leader's instrumental and participative function (Moynihan 1982).

Therefore, leadership substitute theory suggests other factors through which IT can affect control. These variables include the ability and knowledge of subordinates, task induced motivation and task-provided feedback, methodological invariance, and cohesive interaction (Kerr 1977).

Ability: Zuboff (1983) examined IT's impact on managerial jobs and reported that monitoring and decision-making based on fairly routine information was added to the jobs that had the greatest operational proximity to the relevant decision because the increased information processing capability due to IT increased the level of knowledge of lower subordinates. IT, therefore, enhances the information processing capability of an individual and thus enables him to better understand the impact of a decision. Furthermore, information systems may enable a group member to learn specific skills outside of jobs to which he is assigned. Gerrity (1971) studied the impact of portfolio management information systems on bank managers and concluded that the managers developed extended knowledge with the information systems.

Information support: The need for information support in carrying out complicated job tasks has been noted in many studies of the limitations on human cognition (Tversky and Kahneman 1974; Slovic 1976). These studies noted that computerized analytical tools can augment the capabilities of the human mind. Many empirical findings reported that interactive computer support facilitated group decision making effectiveness by providing analytical decision support tools and by increasing the number of sources of information (Adelman 1984; Kull 1982).

Intrinsic Motivation: Curry et al. (1986) reported that people who were satisfied with their jobs were more likely to remain in the organization as well as expend considerable effort for organizational performance. Thompson (1965) argued that internal commitment and a sense of intrinsic rewards are important to carry out tasks effectively. IT can affect motivation by creating challenge and making tasks meaningful (Malone 1985). Malone (1982) discussed a number of suggestions on ways to include motivational factors such as challenge, fantasy, and curiosity in a computer system so that a child could learn effectively. Early office automation projects reported that bank clerks had their jobs restructured so that they no longer performed isolated clerical steps in a process they did not understand (Matteis 1979). Since they could improve their perception of the bigger picture of the jobs with IT usage, bank clerks were motivated to handle all the steps required in dealing with customers on their own, resulting in overall better performance.

Task Feedback: Lawrence and Lorsh (1967) noted that the relatively greater uncertainty facing

research development results, in part, from the longer time span needed for definitive feedback. IT can reduce the span of task-related feedback by making goals explicit and then providing feedback on performance in relation to these goals (Moynihan 1982)

Unambiguous procedure: Van de Ven, Delbecq and Koenig (1976) claimed that under conditions of low task uncertainty and low task interdependence the most frequent and effective coordination strategy was programming through impersonal modes. In addition to making the procedures explicit, IT can make targets and achievements explicit and visible, resulting in unambiguous procedures.

Collegial Interaction: The need for better interaction is strongly supported by Allen's (1970) empirical study of a communication network in R&D laboratories. According to his study, high performers not only reported a significantly greater frequency of consultation with organizational colleagues, they also spent significantly more time in their discussions with colleagues. Furthermore, they relied on more people both within their own technical specialty and in other specialties. Information systems, especially those supported by telecommunications capabilities, can facilitate communication network build-up among experts. Recent studies of computer-based message systems or electronic mail systems (Montgomery and Benbasat 1983; Crawford 1982; Hiltz and Turoff 1981) all reported that these systems improved communications by reducing the dysfunctional features of meetings, conversations, written mail, and telephone calls.

3. HYPOTHESES

In the previous section, leadership behavior theory and leadership substitute theory were described and used to establish two models which can explain or predict IT's impact on control. We will empirically examine the two models in order to determine the extent to which the models explain the criterion variance and to identify the important variables.

We focus on two dependent variables, which relate to the use of IT as a control mechanism. First, we examine the notion of self-control. An information system can enable the work group to assume more responsibility or autonomy, because the system can provide more rapid and more comprehensive feedback on organizational and managerial performance. Thus, control by evaluation of outcome would be obtained in a more timely basis and more decision-making authority could be delegated (Pfeffer and Leblebici 1977). Second, the generic aspects of planning and control are examined. The focus will be on the short term aspects of operational planning and control.

Since IT is conceptualized as a mechanism for control, IT's impact on the control variables derived from each theory should contribute positively to self-control and to planning and control. Therefore, the first hypothesis was constructed:

H1: The greater the IT's impact on a control variable (i.e., task clarification, work assignment, procedure specification, ability, information support, intrinsic motivation, task feedback, unambiguous procedure, and collegial interaction), the greater the effect of IT usage on self-control and on planning and control.

In addition, as the leadership substitute theory mainly concerns the conditions in which leadership behavior is unimportant, we hypothesize that the leadership substitute theory version of IT impact on control model better explains the criterion variance of self control. Therefore, the second hypothesis was constructed:

H2: The leadership substitute theory can better explain IT's impact on self control than the leadership behavior theory.

House and Mitchell (1974) claimed that leader behavior would be motivational to the extent that it helped subordinates cope with environmental uncertainties. In a study of police organization, Jermier and Berkes (1979) found that when task variability was relatively high, instrumental leadership behavior contributed less significantly toward explaining the variance in subordinates' job satisfaction and organizational commitment. March and Simon (1958), Perrow (1967), and Thompson (1967) proposed that when tasks were routinized and predictable, coordination by schedule and plan was feasible, while when tasks become variable and work sequencing was difficult to predict, coordination by feedback was necessary. Therefore, we hypothesize that the leadership substitute theory better predicts effects on control when the environmental uncertainty increases. When the environment is relatively certain or predictable, the reverse holds

(i.e., the leadership behavior theory is a better predictor of IT's impact on control than the leadership substitute theory). Thus, the following hypothesis was constructed:

H3: When the environment is stable, the leadership behavior theory explain the criterion variance better; when the environment is dynamic, the leadership substitute theory explains the criterion variance better.

In addition to environmental uncertainty, innovation is examined to compare the effects of tighter control with the ability to innovate. Innovation is defined here as the conception of ideas new to the organization or individual (Lee and Treacy 1987; Damanpour and Evan 1984). In the innovation literature it is hypothesized that if more control is employed by an organization, then the individuals or work groups will innovate less. The explanation is that tightly imposed control will restrict openness in the system and will strictly enforce work procedures, resulting in greater prediction of prescribed behaviors and less innovation (Pierce and Delbecq 1977; Hage and Aiken 1967). However, since IT is a supporting tool for human information processing activities, we do not believe that the work group with more control mechanisms through IT has less ability to innovate. On the contrary, we hypothesize that the greater the IT's impact on control, the greater will be the ability to innovate. Note that IT's impact on control was conceptualized as a control device for more effective self management. Particularly, the general argument from IT's impact on control derived from leadership substitute theory suggests that, if those control variables are well supported by the information system, the work group can control their activities effectively without the presence of formal intervention from upper management. Therefore, the following hypothesis was constructed:

H4: The greater the IT impact on control, the greater will be the ability to innovate.

4. METHODOLOGY

4.1 Sample

The sample in this study consisted of information system users at seven case sites. These sites were various departments including legal support, sales support, corporate planning, legal service, engineering, purchasing, and computer support in several large manufacturing firms. In selecting the sample, only sites with extensive information system usage were considered.

4.2 Procedure

The principal instrument was a questionnaire completed by the information systems users. The users could answer questions with a Likert response format with seven response alternatives ranging from strongly disagree to strongly agree. Each user was to act as a key informant to report the perceived impact of IT on control in his or her small work group. The responses from each site were subjected to ANOVA tests and no significant differences were found to exist across case sites when we controlled for environmental complexity.

Questionnaires with attached cover letters and stamped return envelopes were mailed to 180 users of information systems at the seven case sites. Of the 180 questionnaires sent, 136 were completed and returned, representing a response rate of 75.6%. The sample size was later reduced to 126 by deleting respondents who had left an excessive number of items unanswered, and those who had responded consistently in a specific scale over a successive number of items. Pair-wise elimination was used in the treatment of individual missing data.

4.3 Measures

We wanted to measure the changes in ability to control due to IT usage. Because it was difficult to find objective measures which could be used consistently across case sites, perceptive measures were used. As discussed in the previous section, "IT's impact on control variables" was derived from two separate theories: leadership behavior theory and leadership substitute theory. The items that constituted our questionnaire to study the impact of IT on control and planning are summarized in Appendices 1, 2, and 3. The means and standard deviations of the item scores are as shown. Since the item measures were not used before, we examined the operationalizations of the independent and dependent variables to ensure that they exhibited desirable properties.

IT's Impact on Control Variables from Leadership Behavior Theory: There were three factors measured: task clarification (TC), work assignment (WA), and procedure standardization (PS). The

Cronbach alpha reliability coefficients for TC, WA, and PS were 0.82, 0.73, and 0.78, respectively. A multitrait-multimethod correlation matrix (Campbell and Fiske 1959) was used to examine convergent and discriminant validity. Convergent validity was tested by examining whether the correlations between measures of the same theoretical concept were different from zero and sufficiently large. The smallest within-variable correlation was 0.55, which was significantly different from zero ($p < 0.01$). Discriminant validity was tested by counting for each measure the number of times that it correlated more highly with a measure of another variable than with measures of its own theoretical variable. Less than 10% (four out of 42) comparisons violated the discriminant validity test. Therefore, the measures for all three factors displayed good convergent and discriminant validity.

IT's Impact on Control Variables from Leadership Substitute Theory: There were six factors measured: ability (AB), information support (IS), intrinsic motivation (IM), task feedback (TF), unambiguous procedures (UP), and collegial interaction (CI). The Cronbach alpha reliability coefficients for AB, IS, IM, TF, UP, and CI were 0.73, 0.80, 0.86, 0.80, 0.79, and 0.81, respectively. The convergent validity was significant (the smallest within-variable correlation was 0.46). Less than 10% (nine out of 270) of comparisons violated the discriminant validity test.

Dependent Variables: Two sets of questions were asked to measure changed self control, and planning and control with IT usage (see Appendix 3). The Cronbach alpha reliability coefficients were 0.79 and 0.88, respectively.

Environmental Variables: A dynamic environment is characterized by the abundance of exceptional cases encountered by the group, that is, the degree to which stimuli are perceived as unfamiliar (Perrow 1967). Based on this description, each site was classified into a stable or dynamic environment to form a 0-1 variable from interviews with system implementors and users.

IT's Impact on Innovation Variables: Two questions, "the information system allowed us to experiment with new ideas" and "in general the information system has improved our ability to innovate" were used to measure the effect of IT usage on the ability to innovate. The Cronbach alpha reliability coefficient was 0.81.

5. ANALYSIS AND RESULTS

The analysis will focus on the development of the relationships between the effect of IT usage on control and the sets of control variables identified from the two leadership theories. The normalized average scores of the item measures were used as single measures for all variables in this study. H1 states that the greater the IT impact on a control variable, the greater the effect of IT usage on self control, and on planning and control. To test the hypothesis, we performed a correlation analysis of the control variables identified from the two leadership theories with the dependent variables, self control and planning and control. The results are as shown in Tables 1 and 2. All of the correlations between control variables and the dependent variables were positive and statistically significant ($p < 0.01$). Also, there were generally stronger associations between control variables and planning and control than there were between control variables and self control.

Table 1. Correlation and Multiple Stepwise Regression Coefficients for Control Variables from Leadership Behavior Theory

Variables from Leadership Behavior Model	Self-Control		Planning and Control	
	Correlation Coefficient	Regression Beta Coefficient	Correlation Coefficient	Regression Beta Coefficient
Task Clarification (TC)	.587**	.469**	.811**	.621**
Work Assignment (WA)	.410**		.695**	.294**
Procedure Standardization (PS)	.471**	.248**	.448**	
(R-Square)		(.392)		(.708)
(Adj. R-Square)		(.379)		(.702)

*p<0.05
**p<0.01

Multiple stepwise regression analyses were used to assess the independent contribution of each control variable to the dependent variables. The regression results are incorporated with the correlation results in Tables 1 and 2. Note that each set of control variables derived from each theory had similar predictive power (similar R-Squares) for both self

Table 2. Correlation and Multiple Stepwise Regression-Coefficients for Control Variables from Leadership Substitute Theory

Variables from Leadership Substitute Model	Self-Control		Planning and Control	
	Correlation Coefficient	Regression Beta Coefficient	Correlation Coefficient	Regression Beta Coefficient
Ability (AB)	.465	.205*	.529**	
Information Support (IS)	.302		.547**	
Intrinsic Motivation (IM)	.368		.623**	.278**
Task Feedback (TF)	.395		763**	385**
Unambiguous Procedure (UP)	.624	.522**	.683**	.267**
Collegial Interaction (CI)	.342		583**	153*
(R-Square)		(.421)		(738)
(Adj. R-Square)		(.408)		(726)

*p<0.05
**p<0.01

control and planning and control. However, planning and control were better explained than self control by the control variables from both models. The tables show a remarkable difference in the relative importance of individual control variables in predicting self control and planning and control, and hence each dependent variable will be discussed separately.

Self control: The regression results in Tables 1 and 2 show that task clarification and procedure standardization were significant in the leadership behavior theory model, while ability and unambiguous procedure were significant in the leadership substitute theory model. The two models' R-Squares were 0.392 and 0.421 respectively. Since the stepwise regression analyses identified two statistically significant variables for both models, the predictive power can be easily compared.

$$1/2\ln[(1 + r)/(1 - r)] \quad (1)$$

For large samples ($n > 25$), the statistic in (1) is approximately normal with mean $1/2\ln[(1 + \rho)/(1-\rho)]$ and variance $1/(n-3)$, where n is the size of the samples, r is the sample correlation coefficient, and ρ is the population correlation coefficient (Myers 1986). The two correlations were compared using the standardized statistic in (1) and there was significant difference between each model for predictive power ($p < 0.01$). Therefore, we conclude that H2, the leadership substitute theory can better explain IT impacts on self control, cannot be rejected in our study, even though the difference in coefficients of determination was small.

Planning and control: Both models could better explain the dependent variable, planning and control, than the dependent variable, self control. R-squares for planning and control were 0.708 and 0.738 for the leadership behavior model and the leadership substitute model, respectively. Task clarification was the most significant, followed by work assignment in the leadership behavior theory model. For the leadership substitute theory model, task feedback, intrinsic motivation, unambiguous procedure, and collegial interaction were significant. There were no basic differences in predictive power in the two models, suggesting that both can be used for examining the IT's impacts on control.

Relationship between the two leadership models: If both models have the same predictive power, the two sets of control variables should correlate highly. Table 3 shows that they were indeed correlated significantly. Task clarification was highly correlated with all the control variables derived from leadership substitute theory. This is not surprising if we consider the effects of IT as clarifying the tasks the work group perform. Task clarification can be enhanced if the work group members become more knowledgeable, obtain more information and task-related feedback, understand the task procedures, and get more expert advice, which were all reflected in the control variables from leadership substitute theory.

Environmental impacts and control: Since the ultimate test of predictive validity is the model's ability to predict using the regression coefficients of Tables 1 and 2, the correlation coefficients between predicted value and the data were calculated for the stable and dynamic environment respectively as shown in Table 4. There was no significant difference between the two models. In general, however, both models could better explain criterion variances in dynamic environments, supporting H3. In addition, we performed regression analyses for the two subsamples. The general results were similar to the results obtained from the full sample, even though the beta coefficients were

Table 3. Correlation Coefficients between Control Variables from Leadership Behavior Theory and Control Variables from Leadership Substitute Theory

	Ability (AB)	Information Support (IS)	Intrinsic Motivation (IM)	Task Feedback (TF)	Unambiguous Procedure (UP)	Collegial Interaction (CI)
Task Clarification (TC)	.591**	.664**	.662**	.657**	.655**	521**
Work Assignment (WA)	.304**	.517**	.454**	.704**	.551**	.592**
Procedure Standardization (PS)	.498**	.329**	.442**	.362**	.658**	.187*

*p<0.05
**p<0.01

Table 4. Correlation Coefficients for Predicted Value and Data for Stable Environment and Dynamic Environment

	Ability (AB)	Information Support (IS)	Intrinsic Motivation (IM)	Task Feedback (TF)	Unambiguous Procedure (UP)	Collegial Interaction (CI)
Task Clarification (TC)	.591**	.664**	.662**	.657**	.655**	.521**
Work Assignment (WA)	.304**	.517**	.454**	.704**	.551**	.592**
Procedure Standardization (PS)	.498**	.329**	.442**	.362**	.658**	.187*

*p<0.05
**p<0.01

different. The only noticeable exception was that in a stable environment the model derived from leadership behavior theory identified procedure standardization instead of work assignment as significant in predicting planning and control.

Innovation and control: Self control and planning and control measures were positively correlated to innovative ability perceived with IT usage. The correlation analyses showed that planning and control was more highly correlated to innovation ($r = 0.683$) than self control ($r = 0.383$). In addition, we regressed the ability to innovate on control variables derived from leadership substitute theory, since these control variables may be relevant to the innovative ability of the work group by providing information, resources, and motivation (Lee and Treacy 1987). In the stepwise regression analysis, intrinsic motivation, information support and task feedback were statistically significant ($p < 0.01$), in that order, and R-Square was 0.72. The result provided support for H4: the greater the IT impact on control, the greater will be the ability to innovate. It also confirmed our belief that IT's impact on the control variables derived from leadership theories is positively related to a work group's ability to innovate.

6. DISCUSSION AND CONCLUSIONS

This study evaluated the models of IT's impact on control derived from leadership behavior theory and leadership substitute theory. In general, the empirical data did not allow us to reject either of the two models. The results were particularly strong with regard to explained variances for both self control and planning and control.

Since IT is conceptualized as a mechanism for control, not as a formal leader who dictates group members to follow machine-induced instructions, both the leadership behavior theory and leadership substitute model are equally powerful in explaining criterion variances of IT's impact on control. There were no significant differences between the explanatory or predictive power between the two models (the R-squares are almost identical). However, as leadership substitute theory mainly concerns the conditions in which leadership behavior is not important, the leadership substitute model explains the criterion variance of self control slightly better. Furthermore, the set of control factors from one model is significantly correlated to the set of control factors from the other. There-

fore, we may use either model in studying the impact of IT on control.

The model from leadership behavior theory identified task clarification as the most important factor of IT impact on control. In the empirical leadership behavior literature, there were consistent findings that role clarification was the most important variable in explaining criterion variance (Schriesheim, House and Kerr 1976; Schriesheim and von Glinow 1977). Jermier and Berkes (1979) studied police organizations and reported that role clarification was the only leadership behavior that explained organizational commitment when task characteristics and leadership substitute variables were controlled for. IT can provide a broad range of information on how the work group should function and make goals explicit.

Besides task clarification, procedure standardization was significant for self control and work assignment was significant for planning and control. If the organization implements standardized operating procedures, rules, and specialized roles, it can delegate much of the decision-making authority to the work group since decision making can be monitored by higher level management through enhanced MIS data. This occurs because higher level management can be more confident in letting subordinates take charge when decision rules are prescribed (Carter 1984; Pfeffer and Leblebici 1977). IT can also help the work group reduce the cost of communication and coordination through time scheduling and work distribution tools, such as project management tools, and more flexible communication media, such as computer conferencing and electronic mail.

Leadership substitute theory suggests that a number of individual, task, and organizational characteristics can act as a control mechanism for coordinating the work group's activities, reinforcing the control mechanism in existence. Ability and unambiguous procedure were the most important factors of IT impact on self control. These two factors were similar to task clarification and procedure standardization in the leadership behavior model (the correlation coefficients between task clarification and ability and between procedure standardization and unambiguous procedure were above 0.55). Task feedback was the most important factor followed by intrinsic motivation, unambiguous procedure, and collegial interaction for IT's impact on planning and control. Salancik (1977) suggested that if the goal is made explicit and feedback on the achievement of the goal is provided, an employee is induced to make a public commitment that creates salient implications for future behavior that he not only is capable of achieving the goal, but also is willing to attempt to achieve it. Increased motivation resulting from the usage of IT can also make a work group commit its efforts to the operational planning and control. This task-induced motivation was one of the factors affecting organizational commitment of an individual in the literature (Curry et al. 1986).

Even though there was no significant difference between the two models in explaining criterion variances in stable or dynamic environments, the results of empirical analysis showed that both models could explain criterion variances better in dynamic environments than in stable ones. Jermier and Berkes (1979) claimed that when tasks were unpredictable, the subordinates preferred their leader's instrumental behavior to clarify their roles and procedures. When their tasks were relatively predictable, a leader's role seemed largely unnecessary. Thus the findings in this study did not contradict their assertion in that in dynamic environments there appeared greater effects of IT as a control mechanism. In addition, IT can reduce the impact of environmental effects by reducing uncertainty and improving understanding of environmental characteristics, which in turn, may contribute to greater explained criterion variance in dynamic environments.

Planning and control measures were positively correlated to the impact of IT on innovative ability. The result contradicts the innovation literature which holds that if more control is employed by an organization, then the work group will innovate less (Pierce and Delbecq 1977; Hage and Aiken 1967). However, IT conceptualized as a supporting tool for control (not as a hierarchical control device) can enhance the work group's ability to innovate. Lee and Treacy (1987) found that IT can facilitate innovation in the work group through its impact on motivation support, resource support, and information support. These variables are similar to the control factors derived from leadership substitute theory. Furthermore, these control factors could explain the ability to innovate with IT usage. Thus, IT can increase the control ability and innovation ability of a work group by augmenting human information processing ability.

This study provides a useful model of how IT can help individuals channel their efforts so that the results are more consistent with the goals of the work group or organization. The model provides an empirical basis from which more rigorous research can be developed. The item pool in the appendices provides a useful instrument for further studies of the impact of IT on control. The instrument appears to be robust, although minor modifications could be made based on the empirical analyses that we performed. It may be useful in future studies to develop additional items for each of these scales and include other means of assessing the control factors and dependent variables. The basis of our analysis was the perception of the users. It would be especially important to go beyond users' perception of IT's impact on control and relate the scale to actual measures of control. We also need to strengthen the understanding of causality with a research design that incorporates both pre- and post-test measurements over time.

There are several potentially important task and organizational characteristics that were not directly dealt with in this investigation. For example, Jermier and Berkes (1979) and Cheng (1983) examined the link between interdependence and coordination in the work group. Their results indicated that interdependence relates to coordination. Eisenhardt (1985) and Ouchi (1979) found that the effectiveness of a control strategy depended on task and organizational characteristics. Therefore, task characteristics and organizational characteristics need to be studied to allow greater generalization of this study's results. IT can change task characteristics and environmental impacts. For example, if a task is uncertain in nature, IT can reduce uncertainty by providing forecasting data, resulting in a work group perception of low uncertainty.

Eisenhardt (1985) and Clegg (1981) claimed that there are various forms of control and coordination such as reward systems and organizational structure. IT's impacts on control might fruitfully be studied considering the various forms of control systems changed with the IT usage. It also seems possible, in light of the current contingent approaches to leadership, that both IT as a control mechanism and one or more of the traditional control variables may at times coexist -- filling in for one another as the situation dictates. Therefore, broader studies are required to ensure effective deployment of IT for better performance.

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