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# 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 $\rho$ 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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