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THE EFFECTS OF INFORMATION TECHNOLOGY: AN INVESTIGATION OF THE MOTIVATIONAL IMPACT OF INFORMATION TECHNOLOGY

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ABSTRACT

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An Investigation of the Motivational Impact of Information Technology on Jobs.

The results of this research support the notion that there are at least two distinct types of information technology that affect the motivational level of a task. Results also support the hypothesis that task discretion moderates the relationship between information technology and task motivation.

The Effects of Information Technology:
An Investigation of the Motivational Impact of Information Technology on Jobs

Many researchers have stated that information technology (IT) may well be one of the most important and interesting areas of inquiry of the decade (Gerstein, 1987; Porter, 1985). IT has been hailed as one the most important technological developments in recent times (Franz, Robey, & Koeblitz, 1986). Additionally, information technology spending has doubled as a percent of revenues throughout the last decade (Benjamin & Blunt, 1992). In spite of this fact, little is known about the effects of this new technology in the workplace.

Two basic, opposing views exist with regard to the impact of information technology. First, the computerized workplace is inhumane and workers' jobs are robbed of enriching elements (Attewell & Rule, 1984). These deskilled jobs produce dissatisfaction, alienation, and reduced motivation to perform. Or, contrarily, the computer is viewed as a liberator (Mesthene, 1970). The machine helps to remove monotony and make jobs more enriched and satisfying.

Research efforts have been too inconsistent and sparse to support either scenario strongly (Attewell & Rule, 1984). Hill (1966) reported that few empirical studies have identified or described the effects of computerized information system use. Twenty-two years later, Parsons (1988) reported that empirical research on job changes due to computerization is surprisingly sparse. Therefore, the question remains: what is the impact of information technology on workers and the jobs they perform? The purpose of this study was to attempt to answer this question by examining the effects of information technology on the motivational nature of jobs.

Types of Information Technology

Information technology refers to computer-mediated work where a task is accomplished through the medium of the information system rather than through direct physical contact with the task (Zuboff, 1985). According to Zuboff (1988) two types of information technology exist. First, an automating technology is designed and implemented to lessen or deskill the processes which make up the work. By substituting technology for human labor, greater control and continuity over the work process can be

achieved (Zuboff, 1988). Second, information technology can be designed and implemented to upgrade or enrich the processes which define the work. The objective of an informated technology is to remove the most boring, repetitious, dangerous and mindless tasks from the work, leaving human labor to perform the creative, challenging, intellectual, and satisfying work (Orlikowski, 1988).

While this typology of information technology is useful, little empirical research exists as to its validity and as to the effects of each on employee reactions. We propose that the work design literature provides a foundation for examining these effects.

Work Design and Motivation

Work design is the study of jobs, tasks, and constellations of tasks that encompass properties, perceptions, and responses to properties and/or perceptions (Griffin & McMahan, in press). Because information technology affects workers primarily through impacting the way that work is performed, the work design literature has great potential for examining the effects of IT on worker motivation.

Hackman and Oldham (1976; 1980) formulated a theory which relates the restructuring of work content to psychological processes that form the foundation for must studies of work design. The authors hypothesized that three critical psychological states determine an individual's motivation and satisfaction on the job, which in turn affect performance, absenteeism, and turnover. These three states are a) experienced meaningfulness, b) experienced responsibility, and c) knowledge of results. Hackman and Oldham (1976; 1980) argued that these states are present when the work content is high on the five core job dimensions of Skill Variety (i.e., the opportunity to use a number of different skills on the job), Task Identity (i.e., the opportunity to complete a meaningful, whole piece of work), Task Significance (i.e., the opportunity to perform a job that affects the well being of other people, Autonomy (i.e., the opportunity to make decisions relating to the work process), and Feedback (i.e., the opportunity to learn how well one is performing the job).

In an effort to expand our knowledge of jobs, Campion and his associates (e.g., Campion & Thayer, 1985; Campion, 1988) introduced an interdisciplinary approach to job design. Campion has argued that there are actually several distinct dimensions to studying jobs. Each of these dimensions is

supported by a separate discipline with its own literature. The four distinct dimensions, which together comprise what he defines as the interdisciplinary perspective, are the motivational dimension, the mechanistic dimension, the perceptual-motor dimension, and the biological dimension.

As described and defined by Campion and Thayer (1985), the motivational dimension to job design is that view most similar to the conceptualizations of job design developed from the organizational psychology perspective. Grounded in the earlier work on job enrichment, job enlargement, and various characteristics of jobs, the motivational dimension has primarily been developed within the domain and scope of organizational behavior and organizational psychology. Research on motivation has generally searched for job design constructs that will be correlated with such primary outcome variables as satisfaction, motivation, involvement, absenteeism, and job performance.

The mechanistic dimension to job design draws primarily from the literature on industrial engineering. The early foundation of this dimension was developed by Taylor (1911) and Gilbreth (1911) and includes basic ideas and arguments from scientific management, time and motion study, and work simplification practices (Campion, 1988). The emphasis of this perspective has generally been on improving the efficiency with which jobs can be performed.

The perceptual-motor dimension is derived from research on human factors engineering. This dimension has its roots in experimental psychology, which tends to focus on job skills levels and information processing requirements. Job design from the perceptual-motor dimension emphasizes the limitations and capabilities of job incumbents in their person-machine interactions.

The biological dimension stems from research on work physiology, ergonomics, biomechanics (body movements), and anthropometry (body sizes) (Campion, 1989). Job design that emphasizes the biological dimension focuses on designing jobs that have low levels of physical stress and physical discomfort.

It is the motivational basis of job design that gives the area of study its essential identity and focus (Griffin & McMahan, in press). Regardless of how it is presented, the basic thrust of most job design theory and research has rested on the premise that job design and motivation are linked (Griffin,

1982; Griffin & McMahan, in press; Hackman & Lawler, 1971; Lawler, 1969; Turner & Lawrence, 1965). The implicit belief that has guided work in this area has been that the design of jobs can be altered so as to motivate job incumbents to work harder, to do higher quality work, to do more work, and to be more satisfied as a result of having worked. Thus, the job design literature provides a necessary foundation for examining the effects of information technology on motivation.

Hypotheses

Figure 1 is presented as an attempt to define the causal relationships between the types of information technology and job design dimensions that may influence a job incumbent's perceptions and work outcomes. This model depicts the hypotheses to be tested in this paper.

We contend that Zuboff's automate/informate distinction, in large part describes a low v. high discretion distinction. However, a challenge inherent in research on information technology is to separate the technology from the job design characteristics. Thus, the design of the study allowed us to manipulate the technology (computer v. manual) and the job characteristics (low v. high discretion). The hypotheses are built upon the separation of these independent effects.

Years of job design research have shown that greater motivational potential is associated with tasks which are more enriched or have greater discretion (e.g., Rousseau, 1977; Wall & Martin, 1987). Both the job characteristics model (Hackman and Oldham, 1971) and the interdisciplinary approach (Campion and Thayer, 1985) propose that jobs that are high in individual discretion are more motivating in nature. It is safe therefore to assume that a task which involves higher levels of discretion should produce a higher perceived level of motivation from an individual performing a task (Hackman & Oldham, 1976; 1980) regardless of the type of information technology. Hence, hypothesis one:

HYPOTHESIS 1: In a task which involves discretion, subjects will express a significantly higher level of perceived motivation than they would in a task with little or no discretion.

As discussed earlier, there are mixed results on the impact of information technology. Pierce (1984), using a sociotechnical systems perspective, noted that employees perceived and described their jobs as routine when they interacted with a system-controlled technology. Additionally, Zuboff's (1988) theoretical argument of an automated technology is congruent with the above finding. Therefore, if an information technology system is applied to work processes alone, with no discretion or enrichment enhancement efforts, the information technology would solely increase control and continuity over those associated work processes. In this case, motivational properties would decrease due to the increase in system control. Hence, hypothesis two:

HYPOTHESIS 2: In a task which involves the use of information technology, subjects will express a significantly lower level of perceived motivation than they would in a task which does not involve the use of information technology.

Based on the hypotheses above, it is obvious that the level of discretion inherent in a task is a critical issue in answering the question of the impact of information technology on the motivational dimensions of a job (Rousseau, 1977). We contend that the relationship between information technology and perceived motivational level of the task is moderated by the level of task discretion inherent in the task. Hence, hypothesis three:

HYPOTHESIS 3: The relationship between information technology and the perceived motivational dimension of a task is moderated by the level of task discretion such that information technology will have a negative relationship with subjects' perceived motivational dimension of the task when discretion is low relative to when discretion is high.

By definition, an informated technology is a more enriched way of using information technology capacities (Zuboff, 1985; 1988). Therefore, an automated technology, which is focused solely on control and continuity properties, would differ from an informated technology on the discretion dimension. Alternatively, an informated technology focuses not only on the control and continuity features inherent in a system controlled technology (Pierce, 1984), but also possesses the comprehensibility dimension

which allows for the use and understanding of task information (Zuboff, 1985). Also, a direct empirical test of Zuboff's (1985) typology has never occurred. Hence, hypothesis four:

> **HYPOTHESIS 4**: In a task involving an informated technology, subjects will express a significantly higher level of perceived motivation than they would in a task involving an automated technology.

METHOD

Subjects

Participants were 375 students enrolled in an undergraduate principles of management course at Texas A&M University. The students received extra course credit for participating in this research.

Task

The task used in this study was a scholarship award task. Subjects, regardless of condition, reviewed a list of fifteen scholarship candidates and the performed an operation which calculated point totals for each candidate. They applied a cut-off score to the point totals to determine the ten scholarship recipients. The subject then processed a Scholarship Diversity Form for each scholarship group, noting the ethnic and gender mix of the scholarship recipient group. Subjects then went on to the next group of fifteen scholarship candidates.

Design

The manipulations involved in this experiment were information technology (computer present or absent) and discretion (high or low). This 2X2 design resulted in four conditions. These conditions are described below.

The automated task. In this condition the information technology was present but discretion was absent. This task required the subject to look over the list of fifteen scholarship candidates displayed on the computer screen in front of them. The subject was allowed to see the weights assigned to the three candidate variables: Scholastic Aptitude Test (SAT), grade point average (GPA), and Activities (ACT). The subject then pushed a button which advanced to the next screen and displayed a blank scholarship recipient box. The subject then pushed two buttons simultaneously which calculated the total points for

each candidate and applied the cut-off score which produced the ten recipients. These ten recipients were displayed in the scholarship recipient box. Then, the subject hand processed a Scholarship Diversity Form for the group of recipients and moved on to the next group of candidates.

The informated task. In this condition both information technology and discetion were present. This task required the subject to look over the list of fifteen scholarship candidates displayed on the computer screen in front of them. The subject determined the weights assigned to the three candidate variables: SAT, GPA, and Activities. The subject then pushed a button to advance to the next screen which displayed a blank scholarship recipient box. The subject then pushed two buttons simultaneously which calculated the total points for each candidate and applied the cut-off score which produced the recipients. If ten recipients were not selected, the subject had to return to the first screen and adjust the weights and/or the cut-off score. Also, because all subjects were given instructions that there was a policy of diversity for this scholarship, the subjects could also return to the first screen and adjust weights and cut-off scores to produce a better ethnic and gender mix. Once ten satisfactory recipients were displayed in the scholarship recipient box, the subject processed a Scholarship Diversity Form for the group of recipients and moved on to the next group of candidates.

The manual with discretion task. This condition had information technology absent and discretion present. This task required the subject to look over the list of fifteen scholarship candidates displayed on a form in front of them. The subject determined the weights assigned to the three candidate variables: SAT, GPA, and Activities. The subject then hand-calculated the total points for each candidate and applied the cut-off score which produced the ten recipients. If ten recipients were not selected, the subject had to go back and adjust the weights and/or the cut-off score. Also, because the subjects were given instructions that there was a policy of diversity for this scholarship, the subjects could also adjust weights and cut-off scores to produce a better ethnic and gender mix. Once ten satisfactory recipients were selected, the subject processed a Scholarship Diversity Form for the group of recipients and moved on to the next group of candidates.

The manual task. In this condition both technology and discretion were absent. This task required the subject to look over the list of fifteen scholarship candidates displayed on a form in front of

them. The subject was able to see the weights assigned to the three candidate variables: SAT, GPA, and Activities. The subject then hand-calculated the total points for each candidate and applied the assigned cut-off score which produced the ten recipients. Then, the subject hand processed a Scholarship Diversity Form for the group of recipients and moved on to the next group of candidates.

Procedure

Subjects were randomly assigned to one of the conditions. Each subject entered the laboratory and was trained to perform the randomly selected task for Time 1. At this point in the experiment the subjects were together in the training room with the experimenter. The three subjects were not allowed to speak to each other. After the ten minute training session, each subject was assigned an individual workstation. The individual workstations were separate rooms where they could not see or hear any other subject. The subjects then worked on Trial 1 for twenty minutes and then completed a measurement instrument. The subjects were then trained to perform the task for Trial 2. After the subjects performed the second twenty minute trial, the subjects completed the final measurement instrument. Subjects were individually debriefed and excused from the laboratory.

Measures

Job Dimensions. An adapted version of the Multidisciplinary Job Design Questionnaire (MJDQ) (Campion, 1988) was administered. The adapted questionnaire was designed to assess the motivational dimension of the tasks. Prior research suggested the measure has favorable psychometric qualities (Campion, 1988), and convergent and discriminant validity (Campion, Kosiak, & Langford, 1988) with the popular Job Diagnostic Survey (Hackman & Oldham, 1976). The self-report MJDQ has provided evidence of convergent validity ($r = .76$) between the motivational score and the total score of the JDS.

RESULTS

Manipulation Checks

A manipulation check was conducted for each subject after they completed both the Time 1 and Time 2 task. A single question assessed if subjects realized they had task discretion. At Time 1, 94% of the subjects correctly answered the manipulation question. At Time 2, 94% of the subjects correctly answered the manipulation question. In sum, the manipulation of the discretion characteristic of the task was quite strong. The information technology manipulation (i.e., computer v. manual) did not require a manipulation check.

Tests of Hypotheses

For the purposes of the regression analyses, the discretion variable was dummy coded 1, 0 for the groups with and without discretion, respectively. In addition, the technology variable was coded 1, 0 for the computer and manual groups, respectively. Table 1 contains the cell means, standard deviations, and intercorrelations for the dependent variable for both the Time 1 and Time 2 Discretion by Technology design. A hierarchical regression was used to test hypotheses 1-3. Hypotheses 1 and 2 were tested in Step 1 and Hypothesis 3 was tested in Step 2. Hypotheses 1 and 2 are supported if their respective beta weights are significant. Hypothesis 3 is supported if a significant amout of variance is explained in Step 2 and if the beta weight of the interaction term is significant.

Hypothesis 1 stated that a task which involves discretion would positively affect subjects' perceived motivation relative to a task with little or no discretion. This hypothesis was tested by regressing subjects' perceived motivation level on the dummy coded discretion variable. Table 2 displays the regression results. This test was conducted at both Time 1 and Time 2. The fact that both tests were significant argues strong support for this hypothesis.

Hypothesis 2 stated that a task which involves the use of information technology would negatively affect subjects' levels of perceived motivation when compared to a task performed without information technology. This hypothesis was tested by regressing

subjects' perceived motivation level on the dummy coded technology variable. Table 2 displays the regression results. This test was also conducted at both Time 1 and Time 2. The fact that both tests were significant suggests strong support for this hypothesis.

Hypothesis 3 stated that the relationship between IT and the perceived motivational dimension of a task is moderated by the level of task discretion such that information technology will have a negative relationship with subjects' perceived motivational dimension of the task when discretion is low relative to when discretion is high. This hypothesis was tested using multiple regression where subjects' perceived level of motivation was regressed on the dummy coded discretion variable, the dummy coded technology variable, and the discretion by technology interaction term. Table 2 displays the regression results. This test was conducted at both Time 1 and Time 2 and was significant at both time conditions. The significant interaction term, at both Time 1 and Time 2, provides strong support for the notion that task discretion moderates the relationship between information technology and subjects' perceived motivation level.

As can be seen in Table 2, at Time 1, discretion and information technology explained 28% ($p<.01$) of the variance and the discretion by information technology interaction explained an incremental 2% ($p<.01$) of the variance in task motivation. At Time 2, discretion and information technology explained 30% ($p<.01$) of the variance and the discretion by information technology interaction explained an additional 2% ($p<.01$) of the variance in task motivation. The nature of these interactions are plotted in Figure 2 and Figure 3, respectively. These interactions indicate that when task discretion is high, there is no significant impact of information technology on motivation. However, when discretion is low, there is a significant negative impact of information technology on task motivation.

Hypothesis 4 stated that subjects performing a task involving an informated technology will report higher levels of perceived motivation than they would performing the same task involving an automated technology. This hypothesis was tested using a Pairs t-test procedure. Tables 3 and 4 display the results. The significant results at both Time 1 and Time 2 provides strong support for this hypothesis.

DISCUSSION

The results of this research strongly support the notion that there are at least two distinct types of information technology that affect the perceived motivational level of a task. At a minimum, the results of this research suggest that Zuboff's (1982; 1985; 1988) qualitative case analyses of different types of information technology holds true in a controlled laboratory experiment using empirical analyses. Beyond the formal testing of the automate and informate distinction, it may be argued that closer examination reveals a potential answer to "why" there is a qualitative and a quantitative difference between these two types of information technology.

First, hypothesis 1 was used to replicate the widely accepted theory of job design which states that the more enriched a job, the greater the level of motivational potential inherent in a task (Hackman & Oldham, 1976; 1980). This test was conducted to show that the laboratory manipulations were adequate. The significant result of this test supported job design theory as it exists today (Griffin & McMahan, in press).

Secondly, hypothesis 2 was specifically concerned with the impact of information technology on the task. As Pierce (1984) argued, individuals will perceive and describe their jobs as routine and boring when they interact with an information system technology. The test of this hypothesis strongly supports this contention. Information technology, applied unaltered, had a significant negative effect on an individuals' perceived motivational level of the task they were performing.

Finally, hypothesis 3 suggested that the relationship between information technology and the motivational job dimension was moderated by task discretion. When task discretion was high, there was no significant impact of information technology on motivation as both manual and information technology conditions reported equal levels of motivation. However, when discretion was low, there was a significant negative impact of information technology on task motivation.

Taken together, these three hypotheses support the argument that different types of information technology can have different effects on an individual's perceived level of motivation while performing a task. Additionally, hypothesis 4 directly tested the difference between an automated information technology and an informated information technology. The automated information technology was

defined as a task which uses an information technology and has little or no discretion. The informated technology was defined as a task which uses an information technology and has a high level of task discretion (Zuboff, 1985; 1988). Significant results at both Time 1 and Time 2 provides strong support for the empirical difference between the two types.

Thus, by independently manipulating both the technology and discretion, we showed that Zuboff's (1988) automate/informate distinction is in large part a high vs. low discretion distinction. Thus, these results imply that it may not be the technology itself, but how it is used (i.e., the discretion) that has the largest impact on task motivation.

The continued investment in and use of new information technologies seems to be a certainty in the future production of goods and services. The "reengineering" (Hammer & Champy, 1993) of American business is arguably well underway and a critical component of this concept is the effective use of information systems. Therefore, through the research results summarized above, future investigations of questions concerning information technology will be enhanced.

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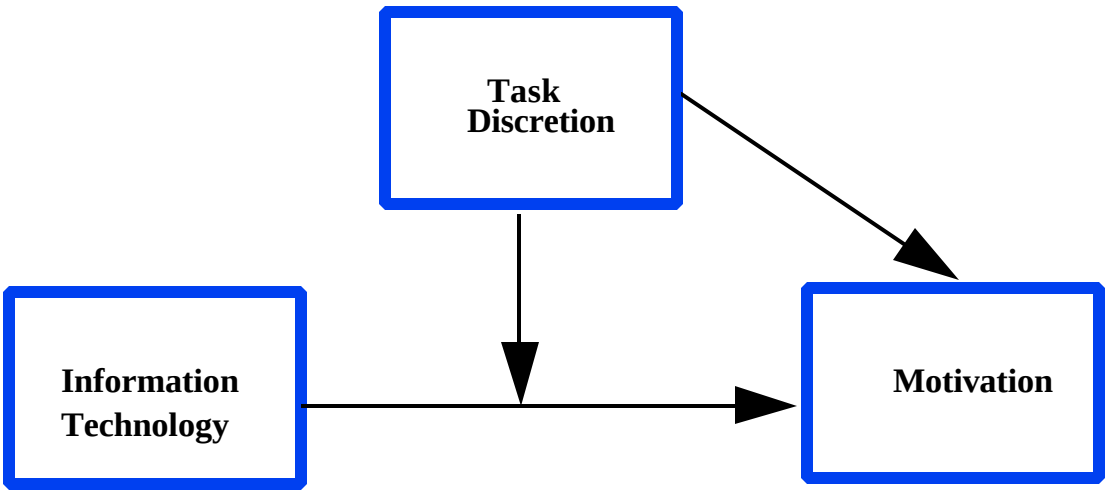

Figure 1: Basic Conceptual Model of the Relationships Among Information Technology, Task Discretion , and Motivation

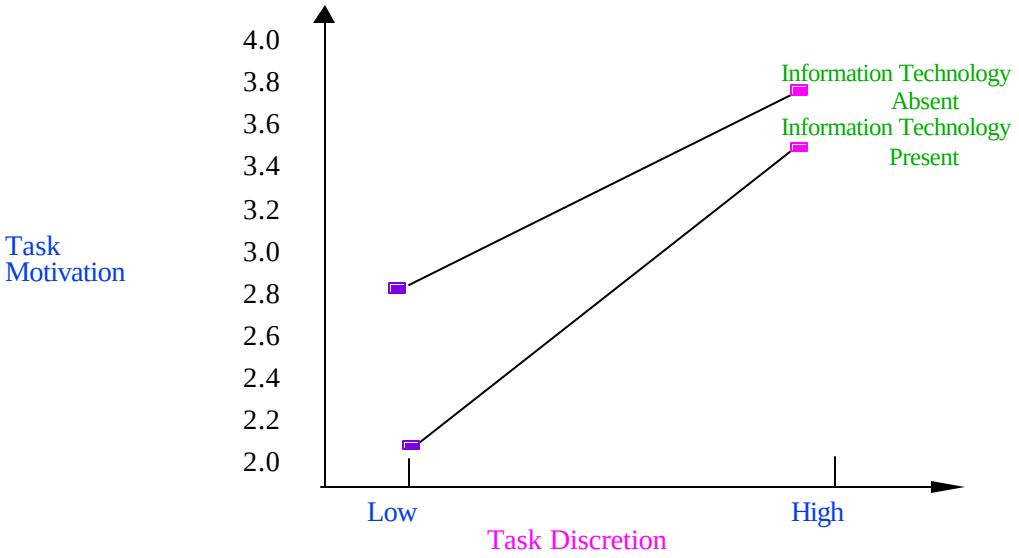

Figure 2: Depiction of the Interaction Between Information Technology and Discretion in Determining Perceived Level of Task Motivation at Time 1.

93GM5.PPT (Slide 2)

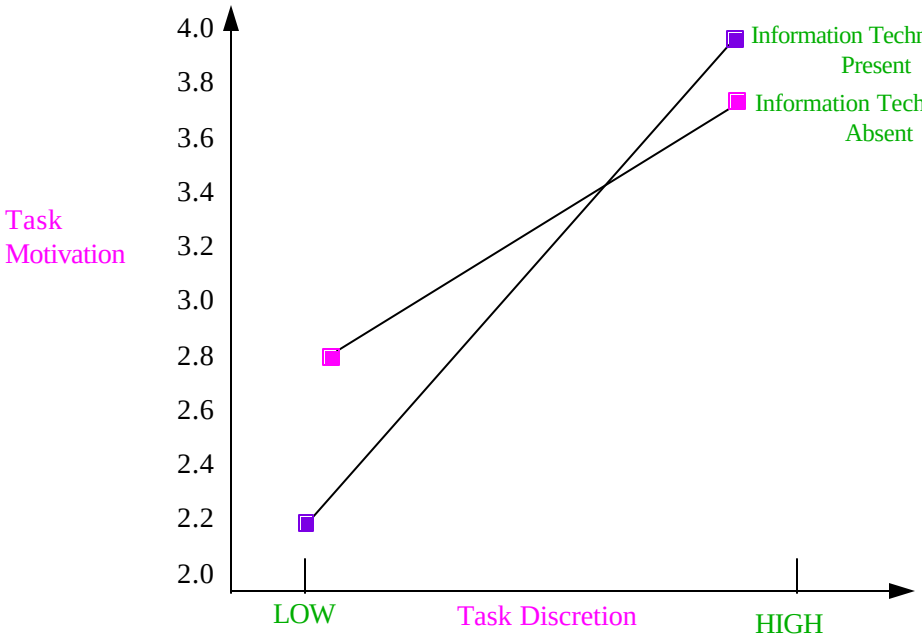

Figure 3: Depiction of the Interaction Between Information Technology and Discretion in Determining Perceived Level of Task Motivation at Time 2.

93GM3(SLIDE 1).ppt

Table 1
Means, Standard Deviations, and Inter
correlations Among the Experimental Variables

Variable	M	SD	1	2	3	4	5
1. Motivation (T1)	2.96	1.17	(.88)				
2. Information Technology (T1) [a]	.50	.50	-.18	-			
3. Discretion (T1) [b]	.50	.50	.51	-.01	-		
4. Motivation (T2)	3.13	1.21	.34	-.06	-.10	(.89)	
5. Information Technology (T2) [a]	.50	.50	-.04	.13	-.01	-.12	-
6. Discretion (T2) [b]	.50	.50	.01	-.01	.01	.54	-.01

Note: N= 375. $r \geq .12$, $p < .05$; $r \geq .18$, $p < .01$. (T1) = Time One. (T2) = Time Two
[a]Dummy coded, with technology = 1, without = 0.
[b]Dummy coded, with discretion = 1, without = 0.
Internal consistency reliabilities are shown in parentheses on the diagonal.

93GM3(SLIDE 3).PPT

Table 2

Regression Results from Regressing Motivation T1 and Motivation T2 on Discretion and Information Technology

Variable	Motivation (T1)			Motivation (T2)		
	Δr^2	β^a	F	Δr^2	β^a	F
Step 1	.28*			.30*		
1. Discretion		1.18*	131.06*		1.29*	150.87*
2. Information Technolgy		-.42*	16.48*		2.28*	7.70*
Step 2	.02*			.02*		
3. Discretion X Information Technology		.56*	7.59*		.75*	12.98*
Total	r^2=.30*			r^2=.32*		

Note: N = 367.
(TI) = Time One. (T2) = Time Two.
Δr^2 = change in r-squared
[a]Beta Weights and their significance are reported for the steps in which they entered.
* p<.01.

93GM3 (slide 5).ppt

Table 3

Direct Test Results at Time 1 of the Motivational Difference Between An Automated and Informated Type of Information Technology

Variable	M	dF	t-value
Motivation (Automate)	2.05	182	9.89*
Motivation (Informate)	3.51		

Note. N = 183
* p<.001

93GM4.PPT(Slide 1)

Table 4

Direct Test Results at Time 2 of the Motivational Difference Between An Automated and Informated Type of Information Technology

Variable	M	dF	t-value
Motivation (Automate)	2.15	186	11.79*
Motivation (Informate)	3.82		

Note. N = 187
* p<.001

93GM4.PPT(Slide 2)