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Impact of Information Technology on Employee Attitudes: A Longitudinal Field Study

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Keywords

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Abstract

This longitudinal study examined the impact of an information technology system on the job and employee attitudes in a parts distribution center for a Fortune 500 company. Data were collected prior to, during, and following the implementation of an automated information technology system. Results of both the within subjects (N=24) and between subjects (N=58) analyses indicated that the automated technology reduced motivational and increased mechanistic aspects of the job as well as reduced employee attitudes.

Information technology (IT) increasingly affects virtually every aspect of work. IT has been hailed as one of the most important technological developments in recent history (Franz, Robey, & Koeblitz, 1986). It has been argued that advances in automation and IT will result in increased productivity and product quality (London & Bassman, 1989) as well as increased market share for the United States in the global economy (Cascio & Zammuto, 1987). These hoped-for outcomes have resulted in spending on IT in organizations doubling as a percent of revenues over the past decade (Benjamin & Blunt, 1992).

The prevalence and importance of information technology to the design and structuring of work in today's competitive environment speaks for understanding how such technology impacts the workers who must use it. Woodman (1989) suggested that the study of information technology is emerging as an important area of interest from a change process perspective. He stated that if information technology is "treated solely as a technological innovation, and its impact on the social fabric of the system ignored, then we will relearn the harsh lessons from sociotechnical systems theory. That is, information technology initiatives will fail, or at least fail to perform most effectively, if their human consequences are ignored" (p. 209).

In spite of the importance and prevalence of IT in work organizations, little empirical research exists about how IT impacts the attitudes of those who must use the technology. In 1966, Hill 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. Thus, research to date seems mixed in its understanding of the effects of information technology on work and workers. Most researchers agree that the research is not convincing in that it lacks clear conceptualization and rigorous experimental research designs, and consequently, has left many basic questions unanswered (Attewell & Rule, 1984; Beard, 1991). Therefore, the question remains: what is the impact of information technology on workers and the jobs they perform? The purpose of this study is to trace over time how the implementation of an IT system to replace a manual one affected the nature of the jobs and the attitudes of employees in a warehouse operation.

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). Two basic opposing views exist with regard to the impact of information technology on individuals. First, some argue that 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. On the other hand, some argue that the computer liberates people (Mesthene, 1970). From this perspective, information technology helps to remove the monotony and make jobs more enriched and satisfying.

Zuboff (1988) developed a typology of information technology that reflects these opposing viewpoints. According to Zuboff, IT tools fall into two types: Automated or informated. An automating technology seeks to deskill the processes that make up the work. With this type of technology, greater control and continuity over the work process can be achieved through substituting technology for human labor (Zuboff, 1988). An informating technology, on the other hand, is designed to upgrade or enrich the work processes. Through removing the most boring, repetitious, dangerous and mindless tasks from the work, human labor is left to perform the creative, challenging, intellectual and satisfying aspects of the work (Orlikowski, 1988).

A similar typology has been proposed by Clegg and Corbett (1986) with regard to advanced manufacturing technology. According to their classification scheme, a "specialist control" system entails giving engineers the responsibility for maintaining and repairing the technology and giving computer specialists the responsibility for writing, editing, and fine tuning the computer programs. Operators, or those that use the technology, are restricted to loading, monitoring, and unloading the machine, and alerting other specialists in the event of a malfunction. "Operator control" on the other hand, consists of delegating additional responsibilities to the operator, including those elements of maintenance and programming that permit fixing operational problems as they occur.

It is important to note that both Zuboff's (1988) and Clegg and Corbett's (1986) typologies regarding the impact of information technology on people describe the effects primarily in terms of how the technology changes the nature of the work that individuals must perform. The work (or job) design literature provides a vast amount of data that can shed some light on the underlying processes through which IT impacts workers. Thus, in order to understand how technology impacts employee attitudes, it is necessary to examine how technology impacts work design.

Approaches to Work Design

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, 1995). 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.

In probably the most comprehensive model of work design to date, Campion and Thayer (1985) introduced what they termed an "interdisciplinary approach" to job design. These authors argued that there are actually four different approaches to studying jobs, and that these approaches focus on different aspects of the work, stem from different academic disciplines, and differentially emphasize a variety of work outcomes. They argued that these different approaches actually result in 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 they defined 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. The motivational approach is exemplified by the job characteristics model offered by Hackman and Oldham (1976, 1980). This approach focuses on the motivational aspects of work and emphasizes employee intrinsic motivation and satisfaction as the primary goals of job design.

The mechanistic approach draws primarily from the literature on industrial engineering (Taylor, 1911; Gilbreth, 1911). It calls for designing jobs with fewer, narrower, and simpler tasks in order to maximize human efficiency and minimize training requirements. The biological approach has its roots in the field of ergonomics. This approach seeks to design jobs in a way that minimizes the frequency and amount of physical ailments, and reduces the physical requirements of jobs. Finally, the perceptual/motor approach is grounded in the human factors literature. This approach focuses on the cognitive limitations of workers, and seeks to design work to ensure that it will not exceed employee's mental capabilities and limitations.

Campion and his colleagues conducted a series of studies aimed at exploring the relationships among these different approaches to job design by identifying a dimension of jobs consistent with each approach. Then, these dimensions were explored in terms of the tradeoffs among various outcomes associated with jobs favoring one dimension over another. For example, Campion (1988) studied 213 different jobs and found that the motivational attributes of jobs were positively related to the mental-ability requirements of those jobs whereas the mechanistic attributes were negatively related to those requirements. Campion and McClelland (1991) found that enlarging jobs in a group of clerical jobs resulted in workers being more satisfied, less bored, more proficient at catching errors, and better at providing customer service. However, they also found that these enlarged jobs also required higher compensation as assessed on job evaluation dimensions, higher training requirements, and higher basic skill requirements.

Using Campion's (1988) typology of job design approaches, McMahan (1993) explored the impact of information technology on jobs in a laboratory setting. His study examined how the presence or absence of information technology (computers) and high or low discretion impacted the motivational dimension (using Campion's MDJQ) of the task. He found that providing workers discretion positively impacted the motivational nature of the job, and that using information technology negatively impacted the motivational nature of the job. In addition, he observed an interaction indicating that the negative impact of the information technology was accentuated when paired with a lack of discretion. Thus, it appears that Campion's interdisciplinary framework might be useful to add to our understanding of how information technology impacts work and workers.

Impact of Information Technology on Work and Workers

This study presents two general research issues. First, and most obviously, we wanted to examine the impact of the implementation of a new information technology on worker's attitudes in a longitudinal quasi-experiment. Given the importance and increasing prevalence of IT in organizations coupled with the relative lack of rigorous empirical research, the setting and events presented us with an opportunity to explore this issue. Second, we wanted to determine if Campion's interdisciplinary approach to job design (Campion & Thayer, 1985) provides a useful framework for exploring the impact of information technology on the design of jobs. Research so far has demonstrated that this presents a more holistic and thorough approach to studying the design of work, and the setting and sample provided us with an opportunity to explore if this framework might generalize to the study of information technology.

As will be described below, these research questions were addressed in a longitudinal study with measures before and after the implementation of a new information technology system in a warehouse. Management at the warehouse claimed that the new technology was going to liberate workers from the monotony of their previous job. However, their description of both the technology and their reasons for implementing it led us to believe that the new technology was meant to heighten the control and continuity of the work processes consistent with an automated technology (Zuboff, 1988). In fact, the technology, as described by management, definitely resembled a "specialist control" application within the typology of Clegg and Corbett (1986) as the users of the technology (warehousers) would have no responsibility for either the development of the coding, nor for the maintenance of the technology. Thus, we expected that the new technology would result in deskilled jobs as well as an increased level of control over the work processes. Thus, we focus the rest of our discussion and our hypotheses on the impact of an automated technology.

Hypotheses

As can be gleaned from the descriptions of the four dimensions of jobs, Zuboff's (1988) automated technology seems to be defined in terms that are quite consistent with the mechanistic and perceptual motor approaches to job design and run directly counter to the motivational approach. Automated technologies seek to increase the efficiency with which work is performed as well as to reduce the errors in work outputs. These goals are accomplished without regard to (and at the direct cost of) the motivating nature of the work. Thus, theoretically, it is clear that an automated technology should strongly influence the design characteristics of the job.

Empirical research on IT supports this suggestion. Using a sociotechnical systems perspective, Pierce (1984) found that employees perceived and described their jobs as routine when they interacted with a system-controlled technology. In addition, in a laboratory study comparing a task performed with or without information technology and with either high or low discretion, McMahan (1993) found that merely the presence of the information technology had a significant negative effect on an individuals' perceived motivational level of the task they were performing independent of the level of discretion. However, he found that the technology increased the efficiency of the work as subjects with the technology outperformed subjects without it.

Similarly, Wall, Corbett, Martin, Clegg and Jackson (1990) examined the use of a stand-alone advanced manufacturing technology. These authors found that change from a "specialist control" system to an "operator control" system resulted in higher intrinsic job satisfaction and lower psychological stress for operators, as well as lower machine down time. In a later study, Wall, Jackson, and Davids (1992) found that increased operator control over a robotics line led to a consistent improvement in machine uptime. This was attributed to operators first reducing lost time per fault, and then later to improved fault prevention, evidencing an increased use of a wider variety of operator skills than under the specialist control system.

Because the IT intervention examined here was best described as an "automated" technology or a "specialist control" system, we propose the following hypothesis:

> **Hypothesis 1**: The implementation of the new information technology system will result in deskilling of the warehouser job. This will be evidenced by (a) increased scores on the mechanistic and perceptual/motor dimensions, (b) decreased scores on the motivational dimension using Campion's job dimensions.

Because most of the physical aspects of the task (i.e., picking parts off shelves, packing parts in boxes) remained the same, we made no predictions regarding changes in the biological dimension. However, we did subject this variable to exploratory analyses.

Campion and his colleagues (Campion, 1988; Campion & McClelland, 1991; Campion & Thayer, 1985) have explored the outcomes that are associated with the different design dimensions of jobs. This line of research has demonstrated that the motivational dimension is positively related to skill requirements while the mechanistic dimension is negatively related to these requirements. They also found the perceptual/motor dimension most strongly related to the mental attentional demands of the job, and the biological approach most strongly related to the physical demands of the job. Thus, we propose the following hypothesis:

> **Hypothesis 2**: The implementation of the new technology will result in (a) lower skill requirements and (b) lower mental demands of the job.

Given this emphasis on deskilling of the work, it is highly likely that automated technologies result in the negative outcomes hypothesized by Attewell and Rule (1987). Research on job design has consistently found that the job characteristics identified by Hackman and Oldham (1976, 1980) are correlated with such primary outcome variables as satisfaction, motivation, job involvement, absenteeism, and job performance (Griffin & McMahan, 1995; Loher, Noe, Moeller, & Fitzgerald, 1985). In addition, as was previously discussed, research by Wall et al. (1990) found that the specialist control system was associated with lower intrinsic job satisfaction and increased psychological job pressure. Because the technology requires highly efficient and repetitive activities and takes away the potential for high levels of mental activity on the part of the worker, one would expect that individuals would express less job satisfaction and involvement, lower organizational commitment, and lower motivation to perform well on the job. Thus, we propose the following hypothesis:

> **Hypothesis 3**: The implementation of the new technology will result in negative attitudinal outcomes as evidenced by (a) reduced job satisfaction, job involvement, organizational commitment, and motivation to perform and (b) increased intent to leave.

Method

Description of the Implementation

The study was conducted at the parts distribution center of a Fortune 500 appliance manufacturing company. Management at the facility were planning to implement an IT intervention that they referred to as an "automated warehouse." The research team was brought in by management and mandated to conduct a skill assessment of the existing warehouse employees (job title of "warehouser) to identify which individuals might need basic skills training (i.e., reading and writing) in order to be able to successfully complete the training for the new IT systems. Thus all 330 employees (management, clerical, and hourly warehouse employees, only the latter of which were to be impacted by the new technology) were given a battery of basic skills and cognitive ability tests reported in Wright, Kacmar, McMahan, & Deleeuw (1995).

A second goal of the study was suggested by the research team. This goal was to assess how the new technology might affect the nature of the work as well as the attitudes of those employees who would be impacted by the technology. The skill assessment and technology implementation assessment were approved and supported by both management and the union at the site. However, it was agreed that while the technology assessment questionnaires could be distributed on-site during working hours, participation was entirely voluntary on the part of the hourly employees.

Prior to the automation, all of the jobs were performed manually without the aid of any computerized equipment. There were two main jobs in the warehouse: order picker and order packer. An order picker would be assigned a stack of cards which would instruct him or her where to go in the facility to locate the parts. The warehouser would drive an electric cart with a flatbed attached to it to the appropriate warehouse location. Upon arrival the warehouser would read the card to determine the correct number of parts to select, staple the card to one of the parts, place the selected parts on the flatbed, and continue this process until all of the cards had been selected. At this point the flatbed would be driven to a packing station and dropped off. The warehouser then would be assigned a new stack of cards, attach a clean flatbed, and repeat the picking sequence.

The other job was an order packer. The flatbeds delivered to a packing station contained at least one complete order, and often more than one order. The packers would locate the paperwork (e.g., invoice and shipping papers) that was to accompany the order, select and construct the shipping boxes for the order, and then pack the appropriate parts. The packed orders were placed back on the flatbed which was pulled to the shipping dock.

Due to the fact that the pickers were free to drive just about anywhere in the warehouse, this job was characterized by workers and management as providing significant autonomy. In fact, one of the reasons for going to the automated warehouse was to reduce the autonomy, given the suspicion that some employees might be completing unauthorized personal business (e.g., going to the credit union, taking breaks, etc.) on company time out of the sight of supervision.

The new technology consisted of a variety of information technology systems. For the picking jobs, three different designs were used. The first system was called a light activated picking system. In essence, parts were stored in bins with red lights underneath each bin. A computerized system controlled the lights. When a part was to be picked from a specific bin, the light under the bin came on and a small LCD monitor would indicate the number of parts to select. The operator selected the appropriate number of parts from the bin and placed them in a plastic crate that was moving by on a take-away conveyor belt. A similar light system was used for a second picking device called the carousel. One worker was stationed in the middle of four large carousels full of parts. The computer would spin the carousels and each would stop on the part that needed to be picked. The operator would read the computer screen to determine how many parts to pick and into which take-away basket to place the selected parts. The third automated picking job required the use of a hand held computer that was mounted to an electric cart or carried in a holster around the waist. Like the cards, the computer would indicate where the picker was to go in the warehouse and upon arrival, which parts to select. Bar codes on each part took the place of the manual cards.

All packing was directed through a computer located at each work station. The computer indicated which size box to use, the order in which to pack the parts, and printed all shipping labels and paperwork for the order.

Procedure

In October of 1991 the skill assessment was conducted on all employees in the warehouse (management, clerical, and hourly). In addition to the mandatory skill assessment, employees were given the voluntary questionnaire to complete in return for a payment of $10. At the time of the skill assessment and round one of the data collection management planned to have the automated system in place within 4-6 months. The skill assessment data was fed back to employees in February of 1992, and employees needing remedial training went through the basic skills training in March-June of 1992. All employees began receiving training in the new technology around April of 1992, and this training was conducted for approximately 6 months. During this time employees attended, on average, two to three training classes a month, each of which lasted approximately one hour.

The design of the automated system took much longer than expected (the site ran a full year behind on the originally scheduled implementation of August, 1992), thus we felt it necessary to collect a second round of pre-intervention data approximately 22 months after the first data collection in early July of 1993. It was at this time that we first assessed the job design and work outcomes of the work using Campion's (1985) MJDQ. In addition, because the workforce was notified of impending layoffs as a result of the new technology, there was significant turnover between the time of the skill assessment and the second round of data collection. Thus, because of the availability of the Campion measures, the loss of subjects and the considerable time lag between the skills assessment and actual implementation, for the purpose of this study, this round of data collection serves as Time 1. An attempt at implementing the automated system was made in late August of 1993. The IT system was physically in place, and the entire plant changed over to the system at the beginning of the work day. Within one hour the system had crashed and was dismantled.

Following the debacle, it was decided to implement the IT system in stages, with different parts of the facility implementing the technology on a staggered schedule. The entire system was up and running by August of 1994. This gave us an opportunity to conduct a mini-quasi-experiment within the larger study. In March of 1994 one of the researchers visited the site and administered a questionnaire to the individuals whose jobs had been automated, as well as to a group of individuals who were not yet working under the automated system. This constituted the Time 2 data.

Finally, in December of 1994 we went in to collect the last round of data. Thus, our study consists of a pre-intervention assessment approximately 2 months before the implementation of the new technology (Time 1), a partial sample assessment in the midst of the automation approximately 9 months after the first data collection (Time 2), and one post-intervention assessment conducted approximately 4 months after the entire IT system was implemented (Time 3) and approximately 9 months after the second data collection. Our analyses consisted of treating Times 1 and 3 as a within subjects design, and Time 2 as a between subjects design.

Measures

Job Dimensions. The design of the job was assessed using two established measures of job design dimensions. First, Campion's (1985) Multimethod Job Design Questionnaire

(MJDQ) assessed four interdisciplinary job design dimensions at Time 2 and Time 3. The **Motivational** dimension was assessed with 20 items exhibiting coefficient alpha reliabilities of .90, .83 and .90 at Times 1, 2 and 3, respectively. The **Mechanistic** dimension was assessed with 9 items exhibiting coefficient alpha reliabilities of .71, .49, and .73 at Times 1, 2 and 3, respectively. The **Biological** dimension was assessed with 9 items exhibiting coefficient alpha reliabilities of .74, .63, and .78 at Times 1, 2 and 3, respectively. Finally, the **Perceptual/Motor** dimension was assessed with 10 items exhibiting coefficient alpha reliabilities of .80, .85, and .80 at Times 1, 2 and 3, respectively.

Job Outcomes. Consistent with Campion's framework (Campion & Thayer, 1985) we assessed three basic outcomes of jobs with these measures coming from the MDJQ. **Job Requirements** were assessed with 5 items covering the skill, education, and training that it would take to learn the job. This scale exhibited reliabilities of .69, .40, and .63 at times 1, 2 and 3, respectively. Campion and McClelland (1991) referred to this scale as "training requirements." **Physical Demands** were assessed with four items tapping the amount of fatigue experienced and number of physical experienced physical aches and pains as a result of performing the job. This scale exhibited alphas of .77, .51, and .64 at times 1, 2 and 3, respectively. Campion and McClelland (1991) called this scale "physical comfort." Finally, **Mental Demands** were assessed with a 5 item scale covering the amount of mental fatigue experienced as well as the amount of attention the individual must pay to performing the job. This scale was similar to what Campion and McClelland (1991) referred to as "mental overload." This scale exhibited reliabilities of .55, .61, and .61 at times 1, 2 and 3, respectively.

Employee attitudes. Five basic employee attitudes were assessed as outcome measures. **Job satisfaction** was measured using the Minnesota Satisfaction Questionnaire (Weiss, Davis, England, & Lofquist, 1967). This scale consists of 20 items that tap a variety of facets of job satisfaction, and exhibited coefficient alpha reliabilities of .90, .78, and .96 at times 1, 2, and 3 respectively. **Organizational Commitment** or the degree to which an individual believes in the goals of the organization and wants to see the organization succeed was measured using the Organizational Commitment Questionnaire (Mowday, Steers, & Porter, 1979). This measure contained 8 items and exhibited coefficient alpha reliabilities of .85, .89, and .58 at times 1, 2, and 3 respectively. **Intent to leave**, or the extent to which the respondents were contemplating leaving the organization, was measures using an 8-item scale of withdrawal cognitions (Hom & Griffeth, 1991). A sample item was "There are employment opportunities available to me that are at least as good as my current job." This measure exhibited coefficient alpha reliabilities of .75, .70, and .87 at times 1, 2, and 3 respectively.

Motivation to perform was assessed with a 10 item self assessment of the individual's performance developed by the authors. A sample item of this measure was "On my job, I exhibit zeal about the job and a consequent willingness to work hard and energetically." This measure exhibited coefficient alpha reliabilities of .83, .85, and .90 at times 1, 2, and 3 respectively. Finally, **Job Involvement** was assessed with the 6-item scale measuring one's psychological attachment to the job itself. A sample item was "The most important things that happen to me involve my work." The scale exhibited reliabilities of .78, .76, and .79 at times 1, 2 and 3, respectively.

Results

Each of the hypotheses was tested with two types of analyses; a within subjects approach using the sample of individuals for whom we had data at Time 1 (pre intervention) and Time 3 (post intervention), and a between subjects approach comparing the responses of the subjects who were working under the automated system with those who were not at Time 2.

With regard to the within subjects analyses, not all subjects responded to the questionnaire at the two data collection points. Some attrition occurred due to employees leaving the organization, and some due to their lack of desire to participate at later stages of the study. Thus, in an effort to maximize the power of the study, we tested the hypotheses with a series of paired t-tests. The average N for the Time 1 vs. Time 3 comparisons was 24. This number is somewhat low, but not unsurprising considering the high amount of turnover (both voluntary and involuntary) over the almost 18 months between the two data collection points. However, by using the matched pairs, each individual serves as his/her own control and increases statistical power (Kerlinger, 1978). This ensures that the comparisons between pre- and post-assessments are on samples that do not differ on demographic characteristics.

Second, as previously discussed, during the implementation process we were able to collect data to explore differences between workers who were working with the automated system and those who were working under the manual system. Thus a second set of analyses was used to test each hypothesis consisted of a series of t-tests, but in this case it was between group t-tests comparing the responses of individuals working under the new IT system (n=38) with those who were working under the old system (n=20).

Tables 1, 2, and 3 present the means, standard deviations, and intercorrelations among the measured variables at Times 1, 2, and 3, respectively.

Table 1 - Intercorrelations of Variables at Time 1

Variable	Mean	s.d.	alpha	1	2	3	4	5	6	7	8	9	10	11	12
1. Motivation (job design)	3.20	.57	.90	--											
2. Mechanistic (job design)	3.27	.53	.71	.01	--										
3. Biological (job design)	2.94	.57	.74	.08	.26*	--									
4. Perceptual/Motor (job design)	3.18	.56	.80	.05	.58**	.48**	--								
5. Job Requirements	2.25	.74	.69	.42**	-.54**	-.20	-.29*	--							
6. Physical Demands	2.70	.87	.77	.07	-.10	-.52**	-.32**	.16	--						
7. Mental Demands	2.49	.77	.55	-.06	-.28*	-.37**	-.50**	.34**	.39**	--					
8. Job Satisfaction	5.43	.96	.85	.44**	.18	.27*	.33**	.06	-.14	-.20	--				
9. Org. Commitment	3.41	.54	.90	.61**	.19	.35**	.38**	.19	-.19	-.29*	.71**	--			
10. Intent to Leave	2.16	.67	.75	-.22	-.27*	-.02	-.11	.03	.01	.23	-.42**	-.27	--		
11. Motivation to Perform	4.03	.53	.82	.28*	-.16	-.27*	-.12	.20	.14	-.04	.38**	.49**	-.26**	--	
12. Job Involvement	3.63	.60	.78	.48**	.04	-.02	.04	.32**	.11	.05	.65**	.57**	-.32**	.45**	--

* p < .05   ** p < .01

Table 2 - Intercorrelations of Variables at Time 2

Variable	Mean	s.d.	alpha	1	2	3	4	5	6	7	8	9	10	11	12
1. Motivation (job design)	3.04	.55	.83	--											
2. Mechanistic (job design)	3.15	.51	.49	.19	--										
3. Biological (job design)	2.86	.49	.63	.19	.50**	--									
4. Perceptual/Motor (job design)	2.92	.64	.85	.24	.63**	.68**	--								
5. Job Requirements	2.33	.58	.40	.37**	-.24**	-.05	-.01	--							
6. Physical Demands	2.70	.75	.51	-.14	-.27*	-.39**	-.40**	.03	--						
7. Mental Demands	2.77	.79	.61	-.28*	-.50**	-.51**	-.66**	.06	.60**	--					
8. Job Satisfaction	3.24	.48	.78	.57**	.40**	.34**	.56**	.13	-.24	-.42**	--				
9. Org. Commitment	5.17	.98	.89	.55**	.29*	.35**	.48**	.25	-.23	-.38**	.61**	--			
10. Intent to Leave	2.16	.55	.70	-.32*	-.16	-.17	.42**	-.18	.05	.32*	-.43**	-.38**	--		
11. Motivation to Perform	3.83	.41	.85	.24	.24	.04	.29*	.18	.00	-.18	.51**	.28*	-.24	--	
12. Job Involvement	3.29	.59	.76	.40**	.22	.17	.38**	.17	-.15	-.25	.74**	.57**	-.48**	.50**	--

* p < .05
** p < .01

Table 3 - Intercorrelations of Variables at Time 3

Variable	Mean	s.d.	alpha	1	2	3	4	5	6	7	8	9	10	11	12
1. Motivation (job design)	3.16	.60	.87	--											
2. Mechanistic (job design)	3.38	.51	.66	.06	--										
3. Biological (job design)	2.57	.62	.72	.29**	.34**	--									
4. Perceptual/Motor (job design)	3.09	.55	.77	.25*	.62**	.53**	--								
5. Job Requirements	2.28	.77	.63	.15	-.37**	.06	-.29**	--							
6. Physical Demands	3.04	.99	.64	-.06	-.06	-.32**	-.02	-.04	--						
7. Mental Demands	2.61	.77	.61	-.10	-.31**	-.19	-.35**	.25*	.38**	--					
8. Job Satisfaction	5.21	1.05	.84	.47**	.18	-.03	.13	-.12	-.11	-.29**	--				
9. Org. Commitment	3.26	.53	.88	.66**	.06	.15	.18	-.03	-.12	-.32**	.60**	--			
10. Intent to Leave	2.29	.75	.73	-.40**	-.21*	-.15	-.31**	.13	.09	.31**	-.55**	-.37*	--		
11. Motivation to Perform	3.86	.57	.83	.40**	.19*	.25**	.24*	.07	-.10	-.11	.48**	.35**	-.22*	--	
12. Job Involvement	3.32	.71	.79	.67**	.23*	.30**	.33**	.13	-.11	-.11	.54**	.57**	-.41**	.49**	--

* $p < .05$
** $p < .01$

Hypothesis 1 focused on the deskilling impact of the technology on the warehousers' job and predicted (a) increased scores on the mechanistic and perceptual/motor dimensions, (b) decreased scores on the motivational dimension using Campion's job dimensions (Campion & Thayer, 1985). With regard to the within subjects analyses, Paired T-tests comparing the pre-intervention data collection to the post intervention data collection indicated little support for the hypothesis. Consistent with the hypothesis, the motivational dimension decreased and the mechanistic dimension increased, however, this increase was not significant. In addition, although not significant, the perceptual motor dimension actually decreased, a result contrary to the hypothesis. With regard to the between subjects analyses from the data at Time 2, as can be seen in Table 5, the results indicated that automated subjects described their jobs as being significantly lower on the motivational dimension but not significantly higher for both the mechanistic and perceptual/motor dimensions.

Table 4 - Comparison of Within-Subject Means Between Time 1 and Time 3

Variable	Time 1	Time 3
1. Motivation (job design)	3.10	3.03
2. Mechanistic (job design)	3.21	3.26
3. Biological (job design)	2.84	2.77
4. Perceptual/Motor (job design)	3.06	2.94
5. Job Requirements	2.23	2.55**
6. Physical Demands	2.69	2.68
7. Mental Demands	2.70	2.62
8. Job Satisfaction	3.31	3.26
9. Org. Commitment	5.36	4.94*
10. Intent to Leave	2.33	2.39
11. Motivation to Perform	3.99	3.86
12. Job Involvement	3.53	3.19**

* $p < .05$ ** $p < .01$

Table 5 - Comparison of Between-Group Means at Time 2

Variable	Control Group	Automated Group
1. Motivation (job design)	3.24	2.93*
2. Mechanistic (job design)	3.22	3.11
3. Biological (job design)	2.89	2.84
4. Perceptual/Motor (job design)	3.14	2.81
5. Job Requirements	2.23	2.39
6. Physical Demands	2.65	2.74
7. Mental Demands	2.78	2.76
8. Job Satisfaction	3.37	3.15+
9. Org. Commitment	5.57	4.95*
10. Intent to Leave	2.21	2.14
11. Motivation to Perform	3.94	3.77+
12. Job Involvement	3.35	3.26

+ $p < .10$
* $p < .05$
** $p < .01$

Hypothesis 2 stated that the information technology would result in lower job requirements and lower mental demands. Results of the within subjects analyses indicated that the mental demands at Time 3 did decrease relative to Time 1 (although not significantly), but the job requirements actually significantly increased. The between subjects analyses at Time 2 indicated that there were no significant differences in the descriptions of jobs on any of the three outcome measures between those working under the automated system relative to those working under the old system. Thus, only partial support is demonstrated for this hypothesis.

Finally, Hypothesis 3 focused on the negative impact of the technology on employee attitudes and predicted (a) reduced job satisfaction, organizational commitment, job involvement, and motivation to perform and (b) increased intent to leave. Within subjects analyses consisting of paired T-tests comparing each of the pre-intervention measures to the post intervention measures indicated significant differences in organizational commitment, and job involvement in the hypothesized direction. The between subjects analyses at Time 2 indicated that subjects working under the automated system expressed significantly lower job satisfaction, organizational commitment, and motivation to perform relative to individuals working under the old system. Thus, some support was shown for this hypothesis.

Discussion

This study examined the impact of implementing an automated information technology on the nature of jobs and employee attitudes in a parts distribution center. Somewhat consistent with the hypotheses, we found that the automation resulted in less motivational jobs in terms of their design characteristics. The changes in the design characteristics of the jobs was accompanied by lower employee attitudes such as organizational commitment, job satisfaction, job involvement, and motivation to perform. These results were somewhat consistent across both within subjects analyses exploring changes occurring after the implementation and between subjects analyses observed during the implementation.

It is interesting to note that most studies on changes in jobs have been guided by the motivational approach (Campion & McClelland, 1991). It is the motivational basis of job design that gives the area of study its essential identity and focus (Griffin & McMahan, 1995). 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, 1995; 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.

However, the increasing prevalence of information technology has often been driven by assumptions entirely contradictory to the motivational approach (Zuboff, 1988). Many information technology interventions are similarly aimed at motivating employees to work harder, to do higher quality work, and to do more work, but the means for achieving these goals are quite different from motivational interventions. Automation seeks to increase control and continuity in work, achieved through structuring work consistent with the mechanistic (efficiency) and perceptual/motor principles of job design.

Our results indicated that the automation resulted in lower scores on the motivational dimension, and higher scores on both the mechanistic and perceptual/motor dimensions (albeit not significantly in the latter cases). This seems to indicate that the automated IT system was aimed at increasing the efficiency and quality of the work. However, the lower scores on the motivational dimension reveal that this increased quantity and quality of work was to be achieved through extrinsic, rather than intrinsic controls. Thus, they support Attewell and Rule's (1984) view that the computerized workplace can rob jobs of their enriching elements.

We should note that our results did indicate that the training requirements increased as a result of the automation. This illustrates the complexity of job design interventions such as implementation of information technology. Although the technology itself might have been aimed at increasing the mechanistic aspect of the job, most of the employees in the sample were older and had little experience with any type of information technology. Thus, they would have required significant training in how to use the new system even if the system was decreasing the overall skill requirements. Management also chose to cross train all individuals in each of the jobs because they allowed employees to bid on the jobs, but could only do so after the training was complete. Thus, all of the employees had to go through between 12 and 20 hours of formal in-class training in addition to the amount of on-the-job training that they experienced in learning the new system. This might explain why even though each of the individual components of the job were deskilled because of the technology, training requirements increased.

One interesting result was with regard to the decrease in a number of employee attitudes following the automation. Employees indicated lowered motivation, job involvement, and organizational commitment as well as an increased intent to leave the organization. Clearly the employees who worked under both the old and the new systems expressed less positive attitudes about their job, and these attitudes generalized to the organization as they became less committed and more likely to leave. These seem to be the human costs associated with the automated information technology (Attewell & Rule, 1984).

This supports Woodman's (1989) observation that information technology efforts that neglect to attend to their impact on workers might fail. In fact, we asked the operations manager of the site if he thought the new technology was worth the cost, and his answer was quite revealing. He said that he didn't think it was. He reasoned that it would take quite some time for the system to become cost effective because of all of the unforeseen costs associated with problems they experienced in trying to implement it. When asked how those might have been avoided, he stated flatly, "We didn't pay enough attention to the people aspect of the system. If we had focused more on how it would impact them early on, then the system might have been well worth the cost."

Another important implication of this study is that it demonstrates the usefulness of Campion and Thayer's (1985) interdisciplinary approach to job design for studying the impact of information technology on jobs. The dimensions proposed by these authors and tapped by Campion's (1985) MJDQ provided a broader approach to exploring the effects of this particular IT on jobs. While the approach and measure have both been used to examine the relationship between job design and a number of outcomes such as pay (Campion & Berger, 1988), mental requirements (Campion, 1988) and customer service (Campion & McClelland, 1991), this is the first time it has been used to examine information technology. Given the increasing prevalence of IT and the efficacy of the approach for assessing its effects as demonstrated here, it appears that the MJDQ might be quite useful for future research into the impact of IT on jobs.

In addition, examination of Tables 1, 2, and 3 reveals that the relationships between the job dimensions and the outcome variables seemed to be consistent with past research on Champion's MultiDisciplinary Job Design approach. Consistent with the theory, the motivational approach was positively related to the job requirements, the Mechanistic approach was negatively related to job requirements and mental demands, the biological approach was negatively related to physical demands, and the perceptual motor approach was negatively related to job requirements and mental demands. Thus, this study demonstrates further support for using the MDJQ for gaining an broader understanding of job design principles.

As with any study, some limitations must be addressed. First, the sample size for the within subjects analyses is relatively small. However, this is not surprising given the nature of the intervention. Employees knew that a downsizing was going to occur as a result of the new technology, and thus many left in anticipation of this. In addition, there was an actual reduction of the workforce as anticipated. Given even a response rate of 30% at both time periods, we would expect to only have matching surveys for 9% of the employees, quite close to what we actually observed. In addition, the major problem with a low N is statistical power, and we observed some significant results in spite of that.

A second problem might be with regard to the internal validity of the study, particularly with regard to the threat of history (Campbell & Stanley, 1963), a major potential problem with a one-group pre-post design. For example, the downsizing that occurred in advance of the implementation of the technology might have impacted job attitudes. We attempted to eliminate this threat by including the Time 2 data (a between subjects design). Thus, it is unlikely that downsizing (or any other historical event) could have occurred which would result in both the changes between pre and post measures **and** only affect the subjects working under the automated system at Time 2.

Finally, our study only examined the impact of an automated IT system on jobs and individuals' attitudes, thus, we were unable to shed any light on the impact that upskilling or informated technologies might have on these variables. This limitation was an inherent tradeoff in performing a field study in a real organization undergoing an actual change in technology. The managers in charge of the new technology had very specific ideas regarding how the technology would be used, and were not open to allowing us any latitude in varying the intervention itself. Certainly we call for future research to explore both approaches to the use of IT systems in organizations.

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. However, our study indicates that the design of information systems without significant attention to the system - employee interface could critically decrease the benefits of the system. Therefore, we hope that future investigations of questions concerning the impact of information technology will be enhanced by the research results summarized above.

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