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UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

INFORMATION TECHNOLOGY USE AND EMPLOYEE EMPOWERMENT: AN HISTORICAL EVENT ANALYSIS APPROACH TO TESTING A THEORETICAL MODEL

A Dissertation

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

Doctor of Philosophy

By

KATHRYN MICHELLE KIMERY

Norman, Oklahoma
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A Dissertation APPROVED FOR THE
PRICE COLLEGE OF BUSINESS

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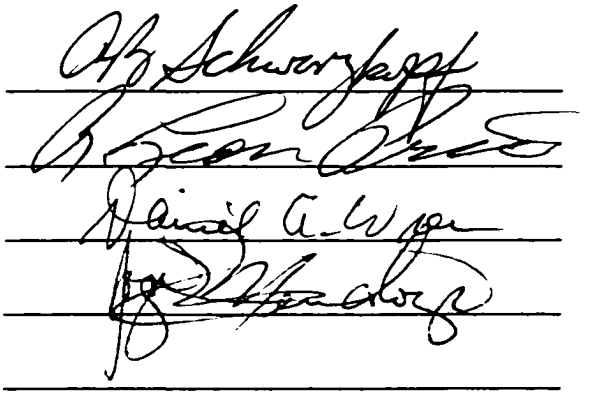

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CHAPTER ONE

INTRODUCTION

Managers today find themselves subjected to sometimes conflicting pressures to maintain efficient, reliable operations while, at the same time, preparing their organizations for transformational change. Increased international and domestic competition, stagnant economies, and heightened consumer demands for quality and value are driving both product and service providers to aggressively seek strategies for improving their ability to compete. As Pfeffer (1994a, 1994b, 1995) convincingly argues, the impact of traditional sources of competitive advantage are eroding in the face of new, dynamic political, technological, and economic environments. According to Pfeffer, how a firm succeeds in developing, organizing, and managing its employees has become the primary source of sustainable competitive advantage.

Employee empowerment has become a commonly prescribed approach to maximizing the productivity and performance of a firm's workforce, either as an isolated concept or as one component of a more comprehensive organizational remedy. A 1996 Business Week report revealed that more than half of surveyed executives anticipated greater emphasis on empowerment in their own organizations over the next ten years, as well as a shift toward more consensual management styles (Light & Saunders, 1996). An empowered workforce, made up of informed employees pursuing complementary task and decision responsibilities, is generally viewed as a desirable, if not always obtainable, goal. Management by objective, participative management, job enrichment, as well as

various approaches to "virtual" organizations, are all built upon a premise of employees empowered through training, access to information, and delegated authority to be more creative, productive, and self-managing.

Modern computerized information systems have been hailed as an important tool for empowering employees. As a tool for facilitating communication between employees, automating repetitive data processing tasks, and providing informational and analytical support to decision-makers, computers have the ability to bring more and better information to employees than ever before possible. Armed with this new resource, workers will be able to make more complex decisions within their areas of responsibility and do so with more facility and accuracy. At the same time, they will no longer depend on the organizational hierarchy for access to information related to activities in other business units, functional areas, or even other firms. Free access to broader sources of information coupled with the ability to use more sophisticated computer-based applications positions employees to better understand the business of the firm and to contribute to cross-functional process improvement and decision making (Champy, 1996; Thompson, Sarbaugh-McCall, & Norris, 1989).

The portrayal of computers as instruments of empowerment is an appealing one for workers and managers alike. It is, however, in direct opposition to results of many studies concerning the impacts of production and office automation on employee working conditions, attitudes, and job design. This considerable body of literature, which examines the impact of technological innovation in a variety of workplaces, seems to suggest that an increase in workplace computerization is associated with the deskilling of

jobs, alienation of workers, and increased centralization of decision making (e.g., Braverman, 1974; Dickson & Simmons, 1970; Klopping, 1989; Leavitt & Morgall, 1983; Mowshowitz, A., 1985; Mowshowitz, R., 1976).

Studies designed to empirically examine the impact of computerized information technology use on employee performance and attitudes are, unfortunately, limited. Research has not confirmed any claim that there is a direct and positive relationship between increased user interaction with information technology and increased employee empowerment. Moreover, researchers have largely ignored the possible intervening effects of factors such as occupational, task-technology, or organizational characteristics in such a relationship. If empowerment is accepted as a desirable means for improving both the firm's internal working environment and external competitive position, managers must be able to critically evaluate the effectiveness of any proposed empowerment strategy, including the use of information technology. The importance of better understanding the linkage between IT use and empowerment is critical given the costs associated with information systems development and implementation, the difficulties incurred in financially justifying IT expenditures in terms of direct accounting measures, and the possible opportunity costs associated with low levels of employee empowerment.

PURPOSE

The research literature addressing the social impacts of computer technology has grown considerably over the past decade. The progress made to date, however, in clarifying the relationship between the use of such technology and specific working

conditions, performance levels, and worker attitudes has been limited by predominantly descriptive research approaches, as well as inconsistent and overly simplistic methods and designs (Kraemer & Danziger, 1990). Experimental conditions have been unspecified, variables vaguely defined and inconsistently measured, mediating factors largely ignored, and little effort applied toward integrating the various research results. It is reasonable to consider the preceding decades of work as a necessary exploratory phase, but progress in this domain requires that future efforts seek to improve integration and coordination of research questions and results, increase rigor and control in empirical studies, and attempt to replicate previous findings. Efforts to explicate the social consequences of computer usage in the workplace must go beyond merely measuring and describing phenomena. Research must attempt to build theory that will explain why the observed phenomena coexist and predict what behavioral, attitudinal, and performance-related outcomes may result from the spread of information technology in the workplace.

The goal for this dissertation is to better understand the relationship between the use of workplace information technology and user empowerment. In the pursuit of this objective, a model of information technology impact on user empowerment is developed based on both functional and cognitive theories of empowerment, as well as an extensive evaluation of the pertinent research literature on the social impacts of information technology. This model is designed to address identified gaps in the existing body of scientific research by:

1. Incorporating a clearly defined, theory-based approach to the construct of empowerment;

2. Presenting a more comprehensive picture of the relationship of IT use and empowerment by identifying and modeling mediating variables in the relationship;

3. Attempting to both explain how the use of IT effects either an increase or decrease in user empowerment and to predict what changes in employee empowerment managers can expect should they choose to increase employee interaction with IT; and

4. Offering a framework around which various research findings can be organized and interpreted, and new research questions can be formed.

Next, a quasi-empirical research method, referred to as historical event analysis, is presented as a useful approach for testing this model's predictive power against historical data. Four historical events, each defined by the introduction of radical technological innovations into the workplace, are investigated as test settings for the model. The historical record is analyzed and interpreted to explain: 1) who is impacted by the innovation event and what is their level of involvement with the introduced technology (independent variable); 2) what are the specific characteristics of the users' work roles, the innovation, and its implementation in the workplace (intervening variables); 3) what empowerment-related outcomes can be observed following the innovation (dependent variables); and 4) are these outcomes consistent with the outcomes suggested by the IT-empowerment model. Finally, the application of the historical event analysis approach to interpreting contemporary data is presented to demonstrate its usefulness in dealing with various types of data.

In summary, then, the purpose of this dissertation can be detailed in the following set of general research questions:

1. How does increased interaction with computerized information technology affect user empowerment?
   (a) What factors (i.e., technology functionality, job characteristics, implementation context) mediate the relationship between information technology use and empowerment outcomes?
   (b) How can the relationship between IT use and empowerment be modeled to build a framework for integrating previous, current, and future research results?
2. How can historical data be used to test theoretical models related to IT user empowerment?
3. How might techniques developed for analysis of historical data be employed in analyzing and interpreting non-historical data collected from quasi-empirical sources?

JUSTIFICATION

Any research effort of the magnitude represented in a dissertation should be subjected to the "So what?" test of justification. In other words, why should anyone care about the results of this research? In order to be justified, the undertaking must be substantive as well as relevant for solving applied or theoretical problems in the management discipline. This dissertation is addressing a theoretical construct, empowerment, that is problematical for both researchers and practicing managers.

Empowerment is poorly understood in organizations and inconsistently defined in the research literature. This dissertation addresses this dilemma by clarifying one approach to understanding the construct as well as explaining the relationship between empowerment and technology-related managerial interventions.

The increasing commitment of organizational resources to information technology makes this research particularly relevant to managers who are struggling to maximize the performance paybacks of such investments. Considering the costs involved in IT implementation and the fact that employee effectiveness and organizational competitiveness may hang in the balance, a more critical understanding of the role of IT use and possible mediating factors in supporting employee empowerment is certainly substantive and relevant. Assumptions about the positive relationship between IT use and employee empowerment far outweigh the positive research. This lack of a significant body of scientific research support further enhances the importance of this work.

GUIDE TO DISSERTATION

This dissertation is comprised of six chapters in total. Following this introduction, Chapter 2 presents definitions of major constructs and a literature review of research addressing the relationships between these constructs. In this second chapter, the first section deals with clarifying the use of two fundamental terms, information technology, which is key to the primary independent variable, and employee empowerment, which is the dependent variable of interest. In the next section of Chapter 2, prior research addressing the impact of empowerment on employee performance and

attitudes is reviewed, followed by a summary of research on the impact of information technology use on productivity, general employee attitudes, and employee empowerment.

The proposed model of information technology's impact on user empowerment is presented in Chapter 3. Incorporated in this chapter is the research and theoretical support for the specific components and relationships in the model, as well as a set of research hypotheses derived from the model. The methodology for an initial phase of model testing of the hypotheses is explained in Chapter 4. This chapter outlines an innovative, quasi-empirical approach to the traditionally qualitative analysis of historical and contemporary data. The chapter concludes with the transformation of the model-derived research hypotheses into a set of historical proxies and a description of how this approach is applied to a contemporary data set.

Chapter 5 presents the historical event analyses of five radical technological workplace innovations. Each historical investigation is driven by the proxies defined in Chapter 4. The innovation events are addressed, first, by resolving questions about the specific innovation, its users, and its manner of implementation. After the model is informed with sufficient information about the historical event, the effect on user empowerment is proposed and compared to the historical data. The first four investigations address historical information technologies. The fifth investigation of a contemporary introduction of information technology is presented to demonstrate the applicability of the event analysis methodology to contemporary events.

Finally, Chapter 6 presents the synthesis of the test results in Chapter 5. An interpretive narrative offers conclusions concerning how the resolved proxies support (or

fail to support) the model-derived hypotheses and, by extension, the model itself. This chapter also addresses future research by discussing possible reformulations of the IT-empowerment model, additional approaches to testing the model, and potential research questions outside the scope of this dissertation.

CHAPTER TWO

DEFINITION OF CONSTRUCTS AND PRIOR RESEARCH

DEFINITION OF CONSTRUCTS

Information Technology

Information technology is a term that can be applied to a broad array of manual, mechanical, and electronic means of facilitating the collection, processing, storage, manipulation, and dissemination of information. It is important to appreciate technology's identity, in a broad sense, as a tranformative system that encompasses numerous components, including physical tools and equipment, knowledge, procedures, and people. While the term, information technology, entered the business lexicon during the age of computers, the phenomenon it describes continues to exist in many forms. This "generic" definition of technology is presented here for two reasons: first, to reinforce the understanding that computers are only one of numerous tools that can be applied to solving information-related problems, and, second, to highlight the multiple components subsumed under the term, technology.

This research project specifically targets the potential impacts of increased employee interaction with computer-based information technologies on the job. A working definition of information technology is therefore constructed that captures its computer-orientation, its multi-component structure, as well as its data, text, and teleprocessing functions. A definition originally offered by Huber (1990, p. 48) focuses somewhat exclusively on decision and communication support features of IT; therefore,

an expanded version of Huber's definition, first developed by Lynch (1993), will be used to clarify this term. For the purposes of this study, then, information technology will be defined as follows.

> Information technologies are the computer-based devices that transmit, manipulate, analyze, or exploit information, data, or text in support of users' communication, decision-making, and other tasks. The concept encompasses the hardware, including the computer and associated peripheral devices, the operating and applications software required for its use, and the procedures and work rules implemented to structure workers' interactions with the technology.

Empowerment

Empowerment is a term that has entered the common parlance of academicians and practical managers, and perhaps because of its broad acceptance, arriving at a precise definition of the term has been a challenge. Zemke and Schaaf (1989), for example, describe empowerment as a management activity that that encourage employees to develop and use initiative and creativity on the job. In their words, empowerment is the process of "turning the front line loose." Waterman (1987) also characterizes empowerment as a form of managerial intervention that encompasses increased delegation, reduced direct supervision, more generalized directions, and flexible job descriptions.

Lawler and his colleagues (1986, 1988, 1992, 1994) deconstruct empowerment into "four organizational ingredients: 1) information about the organizational performance, 2) rewards based on the organization's performance, 3) knowledge that enables employees to understand and contribute to organizational performance, and 4)

power to make decisions that influence organizational direction and performance" (Bowen & Lawler, 1992: 32). They go on to explain that whether or not management can be considered "empowering" is determined by how far down in the organization these four ingredients are transferred. Interestingly, Lawler and his associates seem to have recently adopted the term "empowerment" as a synonym for the terms "employee involvement" and "participative management".

As these descriptions illustrate, organizational authors and researchers tend to address empowerment from a functional perspective as a variety of managerial practices designed to increase employees' perceptions of general control, involvement, or choice in the workplace. This body of research has focused on outcomes associated with managerial interventions such as employee participation plans, delegation of authority, increasing access to information, gain-sharing and profit-sharing plans, and the use of teams and their relationship to improvement in various employee performance measures (Blau & Alba, 1982; Bowen & Lawler, 1992; Bushe, Havlovic, & Coetzer, 1996; Lawler, 1986; Mainiero, 1986; Neilsen, 1986). Others have attempted to further understanding of the impacts of empowerment on employee attitudes and behaviors, but have largely treated the concept as an only loosely defined latent construct lying somewhere between managerial interventions and certain observable performance outcomes (Conger & Kanungo, 1988).

During the past several decades, researchers interested in understanding employee behavior and motivation have called for a more cognitive approach to studying to the empowerment construct (Parker & Price, 1994). Roberts and Glick identify a need for

"alternative theoretical perspectives that distinguish between situational attributes...and incumbent cognitions about those attributes" (1981: 193). Thomas and Velthouse (1990) argue that an understanding of cognitions and perceptions is important for both evaluating the probable effectiveness of managerial interventions, as well as for designing new approaches to improve the effectiveness of workers.

A fairly recent and particularly insightful model of empowerment at the cognitive level has been developed and validated by Thomas and Velthouse (1990) and Spreitzer (1992, 1995, 1996). This model maintains that empowerment is a multi-faceted construct and is manifested in a set of four individual-level cognitions, which are directly shaped by the individual's task environment. These four task-related cognitions are:

1. Meaning: the individual's determination of the intrinsic value or importance of a particular work role or purpose (Hackman & Oldham, 1980);
2. Competence: self-belief in the individual's ability to successfully perform specific tasks or to achieve certain goals (self-efficacy) (Gist, 1987);
3. Self-determination: the individual's belief that they have control or autonomy over decisions concerning work-related activities and behaviors (Deci, Connell, & Ryan, 1989); and
4. Impact: the individual's belief that their actions can make a difference in terms of strategic, administrative, and operating outcomes at work (Ashforth, 1989).

These dimensions, or cognitive task assessments, are neither global orientations nor enduring personality characteristics. They are, rather, environment-specific perceptions that can be measured on a continuum from low to high, rather than as present or absent, and are combined to create a cumulative index of relative empowerment (Spreitzer, 1995, 1996). Thomas and Velthouse (1990) first argued that a additive combination of dimensions should create a meaningful construct of empowerment, and Spreitzer's (1992) tests determined that a more complicated multiplicative model did not have any greater predictive validity than a simpler additive one.

This model of empowerment has considerable intuitive and analytical appeal. The multidimensionality is consistent with many practitioner and management scholars' suggestions that the process of empowering workers is a complex undertaking requiring more than the introduction of simple delegation, decentralization, or traditional employee involvement programs (e.g., Coye & Belohlav, 1995). Three of the four dimensions of empowerment can easily be linked to multiple manifestations of an employee's personal power. Competence represents the employee's perception of power over self in terms of how the employee is able to direct effort, skill, and knowledge to successfully achieve job-related goals. Self-determination reflects freedom from the power of others in terms of how tasks are chosen, organized, or completed. Impact represents the level of power or influence an employee believes he or she is able to exert over outcomes within his or her work group and in the broader organizational environment. The contribution these three aspects of power make to intrinsic motivation is then further enhanced by the value the individual assigns to his or her particular tasks or work output. These four cognitions

combine additively to create a heightened level of intrinsic motivation directed toward achieving task-related goals.

This study adopts a perspective of empowerment that draws from both of these dominant approaches: the functional and the cognitive. The functional approach to empowerment embraces a group level of analysis and focuses attention on a wide variety of behavioral and attitudinal outcomes that have been categorized as distinguishing the "empowered" employee from the "unempowered". Further, the functional approach is keenly interested in identifying what managerially designed and implemented policies, programs, or interventions are effective at producing these desirable outcomes.

The approach taken toward empowerment in this dissertation goes beyond the function approach, however, in that: 1) it stresses the definition of empowerment as a state of an employee group rather than as a program of managerial interventions, and 2) it focuses on the role of employee attitudes in guiding behavior and ultimately affecting individual and group performance outcomes. This focus motivates a crossover into the cognitive approach, especially as developed by Thomas and Velthouse (1990) and Spreitzer (1995) in their theoretical model of empowerment. While this cognitive model is designed to explain the construct of "psychological empowerment" as the combination of the individual's cognitions concerning their specific work environment, incorporating features of this model into a functional, group-level approach can be very useful, both analytically and interpretively. For example, by defining employee empowerment as a heightened state of intrinsic motivation, it is easier to understand and explain the linkage between empowerment and performance changes at all levels of analysis. Also,

representing empowerment as a multidimensional construct and clearly identifying its constituent dimensions is particularly helpful for development in a research area that has been plagued by imprecisely and inconsistently defined constructs. Empowerment research to date has had only limited success in building clearly defined causal relationships and allowing comparison of results between studies because of such "construct confusion". Formally identifying dimensions of empowerment creates a more concrete construct that is more measurable and more comparable between studies. Observed associations between levels of empowerment and specific antecedent interventions (such as work redesign, decision delegation, or compensation plan changes) or outcomes (such as productivity, innovativeness, or turnover) can be better interpreted by considering impacts on individual construct dimensions. Also, by explicitly identifying the dimensions of empowerment, researchers interested in this complex construct can call upon a richer field of research to fit together a composite literature background. A multidimensional model of empowerment acts as a codex for translating and linking research findings in organizational, psychological, and behavioral fields.

In this study, empowerment is defined as follows:

> Empowerment is a heightened state of employee motivation that is manifested as the product of five employee cognitions concerning their perceived task environment. These cognitions, which combine additively to create the construct of empowerment, are: 1) Meaningfulness of job tasks and outcomes; 2) Competence to perform tasks; 3) Access to organizational information; 4) Self-determination over the job; and 5) Impact on organizational outcomes.

This definition represents a partial composite of critical dimensions identified by Thomas and Velthouse (1990) and those identified by Lawler and his colleagues (1986,

1988, 1992). These dimensions represent task-related environmental factors. It is suggested that generally positive evaluations across these dimensions will contribute to employee perceptions of increased authority, capacity, and energy to accomplish important work-related goals. One of Lawler's "empowerment ingredients", rewards based on organizational performance, has not been included in this model because it represents a clearly extrinsic reward. Organizational rewards are included in the IT-empowerment Model (discussed in detail in Chapter 3) as an important context factor that intervenes in the relationship between information technology use and user empowerment.

PRIOR RESEARCH

Impacts of Empowerment

Empirical research results concerning the impacts of empowerment on employee performance and attitudes are summarized in Table 1.

Performance. Thomas and Velthouse (1990) suggest that the popularity of empowerment as a managerial prescription is not founded on its proven ability to provide bottom-line improvements. Rather, they suggest that managerial interventions directed at increasing the empowerment of employees have come to represent a general turning away from the traditional paradigms of hierarchical, command-and-control management. Increased competitive pressures have driven many managers to seek new ways to improve organizational performance through increased employee innovation, risk-taking, commitment, and energy. Empowered workers are seen as experiencing high levels of intrinsic task motivation and able to exert self-control and direction, thus freeing up

OUTCOMES	CONSTELLATION	REFERENCE
High performance	Competence	Locke, et al, 1984
Low levels of perceived stress & high goal expectations	Competence	Ozer & Bandura, 1990
Increased persistence & effort	Competence	Gecas, 1989
High performance & task persistence	Impact	Ashforth, 1990
Higher motivation, affect for tasks, improved recognition of opportunities (study found negative traits associated with low impact)	Impact	Abramson, et al, 1978
High levels of commitment concentration of energy	Meaning	Kanter, 1983; Sjoberg, et al, 1983
Increased job satisfaction and emotion well-being	Autonomy	Cotton, et al, 1988; Dachler & Wilpert, 1978; Ganster & Fusilier, 1989; Hackman, 1986; Miller & Monge, 1986; Schweiger & Leana, 1986
Increased flexibility, creativity, and initiation	Autonomy	Deci & Ryan, 1985
Increased confidence and task persistence	Self-determination	Bandura, 1986; Gatchal, 1980; Miller, 1980; Lefcourt, 1980; Rodin, et al, 1980; Seligman, 1975

TABLE 1
Impact of Empowerment Dimensions on Employee Performance and Attitudes

organizational resources previously devoted to more direct supervision and extrinsic motivation. Studies of successful firms that have embraced the tenets of employee empowerment have helped establish empowerment as a valid approach for improving organizational and employee performance (e.g., Kanter, 1983; Peters & Waterman, 1982; Pfeffer, 1994b).

In the practical management press, empowerment has been given a resounding "thumbs-up" as a managerial strategy to improve employee and organizational performance levels. Employee empowerment is offered as a way of saving money on financial incentives (Hayes, 1994) and as a strategy for creating a high-performance workplace (Losey, 1995). Ransom (1992) suggests that there is profit to be made in making employees feel empowered and also prescribes empowerment as a source of competitive success (Ransom, 1994). Bushe, Havlovic, and Coetzer (1996), however, did find, in an empirical study of work teams, that empowerment was associated with improved productivity, innovation, commitment to the organization, and customer services quality. Ulrich and Lake (1990), likewise, report that empowered workers have lower absenteeism, are more punctual in reporting for work, and are less likely to seek transfers than unempowered workers.

Ford and Fottler (1995) and Bowen and Lawler (1992) point out that empowerment is not a universally optimizing strategy. Bowen and Lawler (1992) identify several significant costs associated with empowering employees, including: 1) higher investment in employee selection and training, 2) higher labor costs for qualified, committed employees, 3) inconsistent service delivery, and 4) costs of bad decisions reached by empowered employees. While Bowen and Lawler are addressing the empowerment of service workers in particular, it is easy to extend their discussion to other classes of workers. Matthes (1992) cites evidence that organizations with employee involvement programs are less efficient than similar organizations without such programs. Thorlakson and Murray (1996) suggest that the very minimal support they

found for positive impacts of empowerment in their study may have been related to the disruptive influence of corporate downsizing that occurred at the same time as the empowerment initiative. However, where the service or product provided by the organization is differentiated, relationships with customers are important and long-term, technology is complex, the environment is dynamic or uncertain, and employees have high growth needs, empowering the work force is likely to be associated with significant improvements in organizational performance (Bowen & Lawler, 1992; Ford & Fottler, 1995; Lawler, 1986).

The relationship between various dimensions of employee empowerment and individual performance effectiveness, on the other hand, has received much more attention. Competence has been found to lead to high performance (Locke, Frederick, Lee, & Bobko, 1984), as has perceived impact (Ashforth, 1990). A considerable body of psychological research has focused on the effect of autonomy, or perceptions of self-control, on task performance. This research has found that, in addition to positive effects on various individual attitudes, perceived control over environmental conditions or decision-making is positively related to high levels of task performance (Bandura, 1986; Gatchel, 1980; Lefcourt, 1980; Miller, 1980; Seligman, 1975).

Employee attitudes. There is an abundant body of literature examining the impact of empowerment and its constituent dimensions (i.e., meaning, competence, information access, self-determination, and impact) on employee attitudes. Meaning has been found to be related to high levels of commitment and concentration of energy (Kanter, 1983; Sjoberg, Olsson, & Salay, 1983). Competence has been demonstrated to lead to low

levels of perceived stress and high goal expectations (Ozer & Bandura, 1990), as well as increased persistence and high levels of effort (Gecas, 1989). High levels of impact is positively associated with task persistence (Ashforth, 1990), while low impact is associated with reduced motivation, low affect for tasks, and failure to recognize opportunities (Abramson, et al., 1978).

A considerable stream of organizational behavior research has documented the positive impacts of worker control over decision making on employee job satisfaction and emotional well-being (Cotton, Vollrath, Froggatt, Lengnick-Hall, & Jennings, 1988; Dachler & Wilpert, 1978; Ganster & Fusilier, 1989; Hackman, 1986; Miller & Monge, 1986; Schweiger & Leana, 1986). Deci and Ryan (1987) found that self-determination produces greater flexibility, creativity, and initiative. Control has also been found to be associated with increased confidence in one's ability to perform a task, as well as increased task persistence (Bandura, 1986; Gatchel, 1980; Lefcourt, 1980; Miller, 1980; Seligman, 1975).

Impact of Information Technology

Empirical research results concerning the impacts of information technology use on productivity, employee attitudes, and empowerment are summarized in Table 2.

Productivity. The IT paradox is a term coined to describe the failure of increased IT investments to result in standard economic measures of productivity improvements. Statistics show that American firms have devoted massive resources to installing advanced information technology in recent decades. In the service sector alone, U.S. firms invested over $750 billion in IT-related hardware during the decade of the 1980s

Increased productivity	Benoit, et al., 1984; Attewell, 1991; Hitt & Brynjolfsson, 1996; Bjorn-Anderson, et al., 1986; Danziger & Kraemer, 1986; Majchrzak, et al., 1987; Bikson, 1986; Millman & Hartwick, 1987
Increased job pressure & stress	Danziger & Kraemer, 1986; Irving, et al., 1986; Majchrzak, et al., 1987; Millman & Hartwick, 1987; Perrolle, 1987
Reduced job satisfaction among clerical workers	Irving, et al., 1986; Kraut, et al, 1989
Reduced interest in work among phone workers	Feldberg & Glenn, 1987
Reinforced chains of command, power structures, & social relationships	Bjorn-Andersen, et al, 1986; Kraemer & Danziger, 1984; Kraft, 1987
Lower perceived task meaningfulness for managers	Klopping, 1989
Decreased clerical autonomy	Smith, et al, 1981
Reduced perceived discretion and autonomy	Bradley, 1977; Mann & Williams, 1960
Decreased autonomy among clerical workers in large offices	Carter, 1986
No significant impact on clerical workers	Kling, 1978; Medcof, 1989; Sheppard, 1971
Increased clerical work discretion	Turner, 1985
Increased motivation & satisfaction associated with end user computing	Barker, 1995; Kappelman & Guynes, 1995
Advanced IT diffusion associated with perceived empowerment among social workers	Frans, 1993
Increased perception of control among clerical workers	Rafaeli & Sutton, 1986
Increased interest in tasks and job among managers	Millman & Hartwick, 1987; Gattiker, et al., 1988
Increased autonomy among clerical workers in small offices	Carter, 1986

TABLE 2
Impacts of IT

(Computer Science & Telecommunications Board, 1994). According to the 1988 report of the U.S. Congressional Office of Technology Assessment (cited in Perrolle, 1988), 40% of all new investments in plant and equipment among U.S. firms are committed to computers and communication technology. The rationale most often cited by managers and executives for making such sizable commitments to advanced information technology is the desire to increase profits, margins, and returns on investments through reduced costs and increases in employee productivity (Computer Science & Telecommunications Board, 1994).

Despite managerial hopes to the contrary, hard evidence of increased organizational efficiency resulting from increased investment in information technology investment is generally lacking. In non-manufacturing sectors, which have seen the greatest increase in IT use, productivity growth has been particularly low (.25% per year during the period 1973 to 1987) (Baily & Gordon, 1988). Between the years 1995 and 1978, while the dollar value of information technology investments per white-collar worker has increased over 10,000 percent, white-collar productivity has increased less than 1 percent (Rudd, 1996). This has lead some researchers to suggest that "data show Use on Employee Attitudes enormous productivity gains in the manufacture of computers but apparently little productivity improvements in their use" (Baily & Gordon, 1988: 350-351).

It is postulated that this paradox can be explained largely by the failure of macro and microeconomic metrics to capture the value added by information technology. Because the implementation of IT does not generally result in a net reduction in overall

work force numbers and that standard productivity ratios do not account for improvements in product or service quality, variety, or reliability, positive impacts of IT may not be revealed in standard industry statistical reports. Hitt and Brynjolfsson (1996) report that, at the firm level, IT spending does translate into increased productivity for the firm and increased value for the firm's customers, but was not related to higher levels of profitability. As IT has become widely available to all participants in markets, its power to improve competitiveness and increase profits has been found to be only short-term. Ultimately, it appears that financial benefits afforded by IT may be passed through to customers as mature competitive markets make IT investments more a cost of doing business rather than a source of competitive advantage (Committee, 1994).

Professional observations and anecdotal reports by managers, consultants, and researchers have consistently found IT to be an effective tool for increasing the quantity of outputs associated with information-related work. Empirical research examining productivity impacts at the individual job or activity level tends to support these observations. Benoit, et al., (1984, cited in Kraut, 1987) calculated that one skilled operator working with a word processor could do the work of 1.8 typists using non-computerized equipment. Others have found significant increases in the quantity of general clerical output after conversion to computerized systems (Attewell, 1991; Bjorn-Anderson, et al., 1986; Danziger & Kraemer, 1986; Majchrzak, et al., 1987). Bikson (1986) found that almost 90% of work groups studied reported perceived increases in productivity. Other researchers, specifically studying the effects of IT use on middle

managers found that while 22% of respondents reported reduced output, 76% claimed increased productivity (Millman & Hartwick, 1987).

Employee Attitudes. Research results concerning the impact of IT use on employee job satisfaction, feelings of job stress, and perceptions of quality of work environment are conflicting. Most studies examining job stress have found that job pressure and stress are increased by the introduction of IT (Danziger & Kraemer, 1986; Irving, et al., 1986; Majchrzak, et al., 1987; Millman & Hartwick, 1987; Perolle, 1987). Perrolle's (1988) caution that IT has the potential to create "intellectual assembly lines" apparently has become a reality in at least some, mainly clerical, job environments. Other researchers have found evidence that IT has significant negative impacts on employee attitudes towards their jobs. In studies of clerical workers, Irving, et al., (1986), and Kraut, et al., (1989) found that IT use is associated with lower reports of job satisfaction. Feldberg and Glenn (1989) found that service representatives viewed their jobs to be less interesting after IT was introduced.

Research results may, however, suggest that IT can also be used to increase information workers' interest in and satisfaction with their jobs. Millman and Hartwick (1987) found that middle managers believed that computers make their work more interesting and controllable. Gattiker, et al. (1988) report that employees find computers fun to use at work.

Empowerment. While authors, consultants, and many managers are enthusiastic about the potential of information systems and technology for empowering work forces (e.g., Currid, 1992; Lawler, 1986; Losey, 1995), virtually no research has been reported

that can confirm or deny the empowering nature ascribed to such technology. Researchers generally agree that information technology has the potential to effect significant redistribution of knowledge, decision making authority, and resources in organizations, but evidence in support of increased decentralization and egalitarianism related to deployment of IT has not been overwhelming (Malone, 1997). Findings tend to suggest the opposite, in fact. Information systems have been determined in several studies to reinforce existing chains of command, power structures, and social relationships (Bjorn-Andersen, Eason, & Robey, 1986; Kraemer and Danziger, 1984; Kraft, 1987).

Based on limited case studies or professional experiences, some authors have reported that the empowering potential of computerization has simply not been fully realized (Ickes & Riley, 1990; McClimans, 1995). In a population of social workers, Frans (1993) finds that more advanced stages of IT diffusion are associated with higher levels of employee-reported empowerment. Among managerial workers, Klopping (1989) finds attitudinal differences between groups using various levels of technology, with higher levels of technology use associated with lower levels of task meaningfulness. Using autonomy as a dependent variable, Carter (1986) finds that in large offices, clerical employees who are frequent users of IT experience decreased autonomy, while in small offices, technology use is associated with increased autonomy. Looking specifically at end user computing (EUC), Barker (1995) suggests that the introduction of EUC is an empowering strategy. He demonstrates empirically that increasing levels of EUC complexity is associated with increased motivation and satisfaction. Studies of client/server systems conducted by Kappelman and Guynes (1995) support this finding.

Looking specifically at clerical workers, Smith, et al. (1981) find that video-display-terminal use is associated with decreased levels of reported autonomy when compared to clerical workers who complete their tasks without the use of computer terminals. Other researchers have found similar results, namely that the use of IT applications inhibited worker discretion and feelings of self-control (Mann & Williams, 1960). In a study of clerical workers, Rafaeli and Sutton (1986) report that perceptions of personal control are positively related to the use of word processors rather than typewriters. Interestingly, this study determined that certain computer attributes, including system dependability, ease of use, and screen quality, are also related to user perceptions of general control. Other studies report no significant relationship between perceived autonomy and IT use (Kling, 1978; Medcof, 1989; Sheppard, 1971). Work by Turner (1984), on the other hand, has found a positive relationship between IT use and work discretion.

CHAPTER THREE

MODEL DEVELOPMENT AND PROPOSITIONS

Kraemer and Danziger, in their 1990 review of research concerning the impact of computer technology on information-based work, call for the building of an analytical framework around which research results can be organized and compared. Kraemer and Danziger suggest that the fragmentary objectives and inconsistent results in the literature may, in part, be attributable to IT researchers working without such a framework. The importance of such frameworks for anchoring research efforts and providing direction for future investigations has been recognized in many domains (see Parkhe, 1993).

Kraemer and Danziger (1990) also argue that the failure of researchers to produce consistent results may reflect their inattention to factors that intervene in the relationship between increased computer use and social outcomes. They are certainly not alone in this belief. Researchers in the area of technological innovations, as well as practitioners responsible for managing the introduction of new technologies in the workplace, have also expressed disappointment with overly simplistic impact models that do not attempt to capture the joint influence of technology, organization, and individual in shaping how new technology is accepted and used (Turner, 1984). In an effort to address both of these omissions in the research literature, Kraemer and Danziger (1990) borrow from the work of organizational theorists (Leavitt, 1983; Leavitt, Pondy, and Boje, 1989) to develop a tentative model of social impacts of computer usage. In this model, they identify people, task, and technology as variables that interact to affect the nature and level of IT-related

social impacts, such as worker-perceived control, decision-making, productivity, and job-enhancement.

IT-EMPOWERMENT MODEL

Inspired by Kraemer and Danziger's (1990) efforts, this dissertation presents a conceptual model that attempts to both bring structure to the research efforts concerning the IT-empowerment relationship and, at the same time, incorporate a more complex and explanatory depiction of how employee empowerment is affected by increased interaction with information technology in the workplace. This model posits that the direction and intensity of the relationship between information technology use and user empowerment is influenced by three classes of intervening factors. A graphical representation of the proposed model is presented in Figure 1. Based on a survey of the existing research and theoretical literature, the following factors are hypothesized as being particularly important for determining the empowering potential of information technology use:

1. The specific task-related function the technology is employed to perform by the user;
2. The nature of the user's work role in the organization; and
3. The characteristics of the implementation context, including discretion, participation, training, and rewards.

Each of the proposed factors will be discussed in more detail in the following sections.

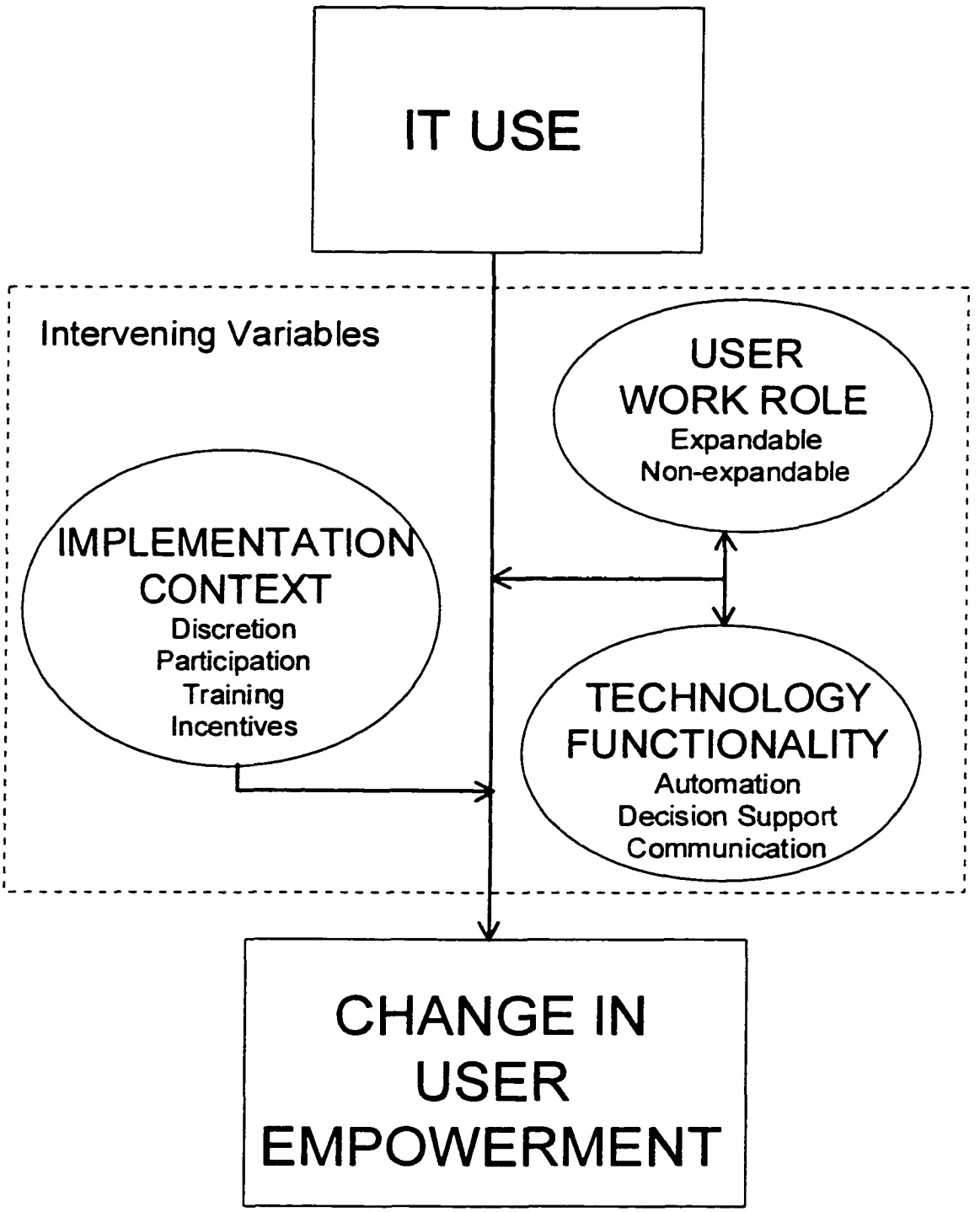

FIGURE 1
IT-Empowerment Model

Information Technology Functionality

This model suggests that the impacts of information technology use on user empowerment will vary systematically based, in part, on the specific task-related functions that the IT is employed to perform. Inconsistency and poor measurement of functionality has been identified by Kraemer and Danziger (1990) as a major shortcoming in the previous research literature concerning social impacts of IT use. Mankin, Bikson, and Gutek (1984), in their review, similarly criticize a propensity for IT research to treat information technology as a uniform set of tools with undifferentiated features and functions. This variable is designed to more clearly identify the exact nature of the information technology in use. This is particularly critical when studying the effects of information technology use, because computers are complex, multi-purpose tools that are designed, configured, and implemented to perform highly variable tasks.

By clarifying the general class of functions that the IT is employed to perform, either by manufacturer design or by user adaptation, we have a much better opportunity to predict and understand the outcomes associated with its use. In addition, categorizing IT in terms of specifically defined functionality makes it possible to link our study of computerized information technology with a broader consideration of empowerment impacts associated with other types of technological innovations.

Information technology functionality is categorized in this model based on how the technology replaces or complements human efforts. IT can be used, therefore, as a tool of one or more of the following functions: automation, decision-support, and communication. These categories represent a condensation of Davenport and Short's

(1990) classification of IT capabilities and is also consistent with Browning's (1990) characterization of computers as assistants, advisors, and communicators.

Automation represents uses of information technology to replace human labor, activities, and judgements. Generally, in order to be a suitable candidate for computer automation, tasks or judgements must be structured and amenable to conversion into electronic instructions, algorithms, and control. Information technology has been successfully applied in many work environments to automate routine data handling tasks, including text processing, data storage and retrieval, transaction record processing, and machine control. Familiar examples of IT in the role of automating technology include word and data processing, direct data entry, retail transaction handling, barcode scanning, and assembly line pacing.

Decision support represents the use of information technology as a computerized advisor, which provides decision-critical information and expertise to its user. Decision support applications typically encompass data storage, manipulation, and modeling capabilities with a highly interactive interface. The primary role of decision support IT is the delivery of information in a more accurate, timely, or meaningful form than is possible without the technology. While Sprague (1996) describes decision support systems as most appropriately serving the needs of Type II (goal-oriented) knowledge workers, they can be designed to support the work of users possessing any level of computer experience, from technically trained programmers to casual or novice users, and at any level of functional expertise, from NASA scientists to automobile mechanics. Examples of IT decision support implementations include statistical calculations and

forecasting, spreadsheet analysis, sales force automation tools, management simulations, and expert systems.

The important distinction here between automation and decision-support functions lies not in the types of efforts being replaced by the technology, but in the level of judgement required of the individuals employing the output of the technology. For example, a computer application may be developed for use by a policy analyst that calculates a number of financial ratios useful for determining the potential benefits and costs associated with particular policy decisions. Prior to development of the application, the analyst may have performed these calculations by hand or simply made decisions without these ratios, perhaps because their calculation was complex, time consuming, or prone to error. Because use of the technology results in information feedback that helps the user solve problems or make decisions, the technology's functionality is described as predominantly decision support, even though the computer is completing tasks that may have once been performed by a human actor. If, however, the application completely captures the expertise required for evaluating the potential impacts of the policy decision and the analyst is no longer responsible for making the decision, the technology is more appropriately classified as an automating tool.

Communication involves the transmission of messages between individuals or groups either across space, time, or both dimensions. A communication medium is the physical channel that facilitates the exchange of these interpersonal messages. In the organizational literature, computer-mediated communication has been identified as a vertical integrator, bringing information to employees concerning organizational

missions, goals, and performance, or conversely, moving information from the front-line up through the hierarchy. It may also function as a lateral integrator, increasing communication between coworkers, departments, and units. Common implementations of information technology as a communication medium include electronic mail, teleconferencing, on-line meetings or discussion groups, and electronic bulletin boards.

User Work Role

The concept of work role represents the set of social and work-related expectations that surround an employee's position in his or her organization. Work role encompasses the formally defined description associated with an individual's job, but also a broader array of obligations, expected behaviors, and standards for performance that are generally shared by a group of employees. The process of clearly defining the boundaries of such work roles has been identified as a critical factor in supporting positive employee attitudes and performance outcomes (Conger & Kanungo, 1988; Gist & Mitchell, 1992; Rizzo, House, & Lirtzman, 1970; Sawyer, 1992).

In considering the impact of IT on user attitudes and task perceptions, it is reasonable to suggest that different types of roles will be impacted by IT in varying directions and to varying degrees (Brousseau, 1983; Kraut, 1987; Millman & Hartwick, 1987). Attempting to capture the ways in which roles differ in an organization is a very complex undertaking, because roles vary across a dizzying number of dimensions and characteristics. It is useful, therefore, to identify a limited set of descriptive work role categories that are meaningful for our research focus. Whelan (1993) describes one such way of categorizing roles based on the relative expandability of their dominant work

tasks. The expandability of a task is a continuous measure of the concreteness of completion criteria for tasks or constraints on the output that is produced. Tasks classified as having low expandability are those that have quantitative completion criteria and standards for satisfactory performance. Output associated with such tasks is usually easy to measure and monitor. Workers whose performance is evaluated primarily based on the completion of tasks that have low expandability can be classified as occupying non-expandable work roles. Typical non-expandable roles include clerks, assembly workers, sales personnel, and other production-oriented workers.

Highly expandable work roles, on the other hand, are more typical of professional, managerial, and creative occupations. Such workers tend to be evaluated based on their completion of vaguely specified tasks that have fewer and more qualitative completion standards. In practice, most highly expandable tasks are deemed complete only when resources allocated for their completion are exhausted or when output meets generally established qualitative standards. Therefore, improvements in methods, technology, or skills in such work roles will tend to result in higher quality or broader scope of outputs more so than increased quantity of outputs.

Research tends to support the presumption that work roles differentiated by the expandability of dominant tasks are affected in unique ways by information technology use. Whelan's (1993) study reveals that workers with highly expandable work roles are able to use IT to enhance their competence, self-determination, and control over their positions in the organization hierarchy. He finds that workers in less expandable work roles are much less likely to be able to use the new technology for their aggregate benefit.

For these users, efficiencies associated with IT use tend to justify management demands for increased quantity of individual output, task rationalization, and work force reductions.

Implementation Context

A third intervening factor represents the managerially determined organizational contexts in which IT innovations are implemented and used. The notion that organizational context affects individual attitudes and behavior is fundamental in the field of organizational behavior (Brousseau, 1983). It has also been suggested by numerous IT researchers that organizational context may be a critical factor in determining how IT is perceived, accepted, and utilized by workers (e.g., Amick & Ostberg, 1987; Barki & Hartwick, 1994 & 1994b; Markus and Robey, 1988; Strassman, 1985; Thompson, et al., 1989).

This model depicts four dimensions of organizational context as particularly important moderators of the IT-empowerment relationship. Each dimension represents a continuously measured variable, which can be combined additively to create an overall evaluation of the organizational context as either supportive or non-supportive of an empowering technological implementation. The four dimensions of implementation context identified in the model are:

1. The level of discretion users have over their use of the technology (discretion);
2. The level of user participation in technology-related decision-making (participation);

3. The amount of technology-specific training provided to users (training); and

4. The level of organizational incentives offered to encourage acceptance of the technology (incentives).

Discretion. The first aspect of implementation context captures how much individual control the user is able to exert concerning how and when they interact with the technology. The idea of discretion encompasses choice over when to use the specified technology for completing tasks and when to use other tools or methods. It also addresses the extent to which users can customize the technology to suit their personal preferences or work styles, the level of navigational flexibility designed into the particular system, and whether or not users can override system features or results. The importance of discretion for building positive attitudes toward both the IT-supported job and the specific IT system has been recognized in the research literature. Kraut (1987) suggests that managers and professionals tend to be more supportive of IT implementation because of their high level of discretionary control over its use, while clerical workers are less supportive because their use of IT is less voluntary. Barker (1995) has found that increased levels of discretion over IT system use is related to increased work motivation and satisfaction.

This model suggests that discretion in IT use will impact the empowering potential of information technology use in two ways. First, by creating an opportunity for the user to exercise control over this aspect of his or her job, perceptions of job-related self-determination are enhanced. Secondly, the ability to choose whether or not to use the

technology as a tool for a specific task may enable a better match between tasks and tools and, as a result, enhance the employee's ability to successfully perform their assigned tasks.

Participation. User participation in information system development has consistently been identified as an important determinant of overall information system success and user acceptance (Cushing, 1990; Ives & Olson, 1984; Martin, 1984; Swanson, 1974). Hartwick and Barki (1994) find that user participation has a significant influence on user beliefs that the system is important and personally relevant and, indirectly, on system use. In a recent study, Hunton and Price (1997) extend Hartwick and Barki's (1994) findings by determining that increased user participation leads to enhanced user performance via its direct impact on increased perceptions of control.

Hunton and Price (1997) define user participation along a continuum of control, which is anchored at the low end with a mute condition (no involvement). Participation in the form of voice, which represents the users' opportunities to express their opinions, preferences, and interests relevant to the subject technology, reflects a higher level of participation (Lind & Tyler, 1988). The exercise of choice, at the high end of the participation scale, entails the users' right to determine specific courses of action between multiple alternatives (Earley, 1984). It is easy to argue that significant participation, in the form of voice and/or choice, in information system development or implementation will positively affect a user's belief that they have some control over the technology that will impact their job (Clement, 1994; Hartwick & Barki, 1994; Hunton & Price, 1997). In addition, participative users are more likely to exercise their influence to satisfy their

personal needs and preferences for the system (Robey & Farrow, 1982). Prior research also shows that participation in system design and decision making is related to worker attribution of importance and value to the resulting system (Hartwick & Barki, 1994). Participation, then, can have positive impacts on how users perceive their interaction with the information technology, namely seeing it as increasing the meaning of their tasks, their self-determination over their work, and competence. Finally, if the development process results in a IT system that is used by others in the organization, it is also arguable that participation can lead to increased perceptions of organizational impact.

Training. Training programs designed to increase employee skills and understanding of information technology have been identified in a number of studies as essential components of successful technology implementation programs. Appropriate and effective training is associated with improved skills and knowledge, enhanced self-efficacy, reduced technology-related anxiety (Davidson & Walley, 1986; Howard, 1986), increased reports of ease of use, enjoyment, and perceived usefulness (Igbaria, 1993; Lee, 1986; Webster & Martocchio, 1992), and reduced resistance to technology use and more positive attitudes toward such technology (Igbaria, Parasuraman, and Baroudi, 1996). The level of training made available to IT users is, therefore, predicted to have a positive impact on the relationship between IT use and perceived empowerment. This impact is predicted to result primarily from the impact of training on perceptions of increased competence (via enhanced skills, knowledge, and self-efficacy, and reduced anxiety) and task meaning (via increased enjoyment and perceived usefulness).

Organizational incentives. Incentives refer to the financial and non-financial considerations managers may extend to prospective users to encourage and reinforce learning and use of the new technology. Financial rewards, such as bonuses, raises, prizes, and contingent pay plans, are the most familiar types of organizational incentives, but non-financial incentives can also be employed to motivate user efforts. Non-financial options include formal recognition, awards, promotions, improved working conditions, and time away from work. Organizational rewards inform employees about what their managers perceive to be important activities and tasks. Employees who perceive their tasks to be important to the organization are also likely to perceive that these tasks have a high degree of meaning. In addition, the receipt of rewards by users may also affect users' perceptions of their work-related competence in two ways. First, incentive-motivated use of the technology will support enhanced proficiency in its use, and second, rewards can be interpreted generally as positive performance feedback.

HYPOTHESIZED IMPACTS OF INTERVENING VARIABLES

This theoretical model suggests that employee empowerment is, at least partially, a function of the level of IT use mediated by the interaction of the technology's implemented functionality and the user work role. The impact of information technology use on perceived empowerment is further moderated by the nature of the implementation context. In essence, the model claims that the empowering potential of information technology is determined primarily by the kind of job the user has and the way the technology is used to help perform tasks associated with that job. In addition, the intensity of the effect is further influenced by the way managers implement the

technology in the workplace. This proposed relationship between IT use and user empowerment can be represented in the following equation:

$$EMP = f[USE[(FNC \times ROLE) + CONTEXT]]$$

where:

EMP=	user empowerment
USE =	level of IT use
FNC =	functionality of IT
ROLE =	user work role
CONTEXT =	implementation context

The first two intervening variables, functionality and user work role, are proposed to interact and mediate the direction of information technology's effect on user empowerment. These two factors are combined to form a 2 x 3 matrix representing six levels of mediating effect on the primary relationship between IT and user empowerment (see Figure 2). The predicted impact of each level of effect is discussed below. Hypotheses are also presented as the foundation for future model testing.

Automation x Non-expandable

The introduction of IT as a means of automating the work of employees in non-expandable roles is frequently associated with increased formalization and rationalization of their tasks. Formalization is a process by which job tasks are structured through high levels of job codification and controlled via narrow policy or work rule enforcement. Formalization is a direct encroachment on the autonomy of individual workers to make decisions about how to best perform their various responsibilities. Rationalization is an optimizing process designed to create operational efficiencies by grouping

Technology Functionality	User Work Role	
	Expandable	***Non-Expandable***
Automation	Automation X Expandable	Automation X Non-Expandable
Decision Support	Decision Support X Expandable	Decision Support X Non-Expandable
Communication	Communication X Expandable	Communication X Non-Expandable

FIGURE 2
Interactions Between User Work Role and Technology Functionality

similar tasks into jobs that are high in task specialization, routinization, and, frequently, automation. Typically, this process involves downward rationalization, in that the rationalized jobs require fewer skills, less training, and are positioned lower in the organizational hierarchy than jobs that encompass broader responsibilities. Jobs made up of rationalized tasks are often characterized by low levels of intrinsic job rewards, such as task identity, variety, responsibility, self-determination, growth opportunities, or challenge (Pollard, 1995).

Non-expandable roles are particularly vulnerable to automation-related formalization and rationalization for two main reasons. First, automating technology, by its nature, replaces human actions and judgments with mechanical or electronic processing. As a result, it allows management to replace highly variable, and in some cases unpredictable, labor costs with more controllable capital investments. To take full advantage of the capital investment in technology, human interaction with the equipment is often reorganized to ensure use of the technology's full capacity and reassigned to specialized workers who are able to more efficiently complete tasks mediated by the technology. Workers in non-expandable roles tend to perform tasks that are most amenable to replacement by mechanical or electronic devices, therefore, they are more likely to experience job modification as a direct result of automating technology. Second, jobs characterized by predominantly non-expandable tasks are more likely to be located lower in the organizational hierarchy than expandable jobs. Because of their position in the authority structure, workers holding non-expandable roles are less likely to have formal sources of power with which to exert influence over decisions concerning the new technology. Employees in non-expandable roles are more likely to experience negative outcomes associated with automation because they do not, as a group, have control over which tasks are automated, how interaction with the machine will be structured, or how work is reorganized (Keen, 1985).

Because their tasks tend to be more routine and they are less able to mold technology introductions to serve their interests, it is predicted that users in non-

expandable work roles will experience reduced meaningfulness of tasks, reduced perceived difficulty of tasks, and diminished control over how tasks are performed.

Hypothesis 1a: Use of information technology as a means of automating tasks performed by users in non-expandable work roles is negatively associated with user empowerment.

Automation x Expandable

Contrary to its effects on roles characterized as low in expandability, increased automation of tasks for those employed in expandable roles is likely to have a more ambivalent relationship with perceived empowerment. One possible scenario is that the technology helps users to create slack resources of time and attention, which can be reallocated toward more critical, non-automated work activities. More specifically, if professional or managerial workers are able to increase the efficiency of their routine data handling tasks (for example, record keeping, scheduling, or report preparation), they can focus more attention toward improving the quality of their work product. Alternately, they may choose to use their newly acquired resources to expand the boundaries of their jobs by annexing tasks, broadening the scope or depth of existing responsibilities, or investing in political behaviors to increase their position of power within the organization.

An alternate scenario, however, is that workers in expandable roles may use information technology to complete routine tasks that had previously been performed by support personnel or other specialists working in auxiliary capacities. This is a phenomenon that can be described as upward rationalization, because tasks that are

simplified through automation are excised from the task set of jobs at one level in the organization and reassigned to jobs higher in the organizational hierarchy. Given the nature of the automated tasks and the level of effort required for their completion, upwardly rationalized tasks may be transparent to workers in expandable work roles and have little or no effect on how these users perceive their work environment. However, upwardly rationalized tasks may represent a noticeable increase in the amount of attention or effort that the individual must devote to the completion of peripheral or routine activities. In this event, users of automating IT in expandable roles may perceive the increased task load as distracting them from their key tasks, constraining their ability to complete these tasks effectively, and restricting their ability to control their own activities on the job.

Hypothesis1B: Use of information technology as a means of automating tasks performed by users in expandable work roles is not associated, either positively or negatively, with user empowerment.

Decision Support x Expandable

For users in expandable work roles, decision support technology may enhance empowerment in several ways. By providing access to more sophisticated, accurate, and timely information, decision support technology can effect efficiencies in decision making processes and effectiveness in problem solving outcomes for the user (Gattiker, et al., 1988; Millman & Hartwick, 1987). Enhanced efficiency and effectiveness should both lead directly to elevation of perceptions of work-related competence. Because performance in expandable work roles tends to be judged based on quality of outcomes

rather than rate of completion or other quantitative measures, process efficiencies can also be translated into slack personal resources for the user. Slack resources, once again, can be reallocated by the user toward improving the quality of task outcomes or enhancing their role in the organization by accepting new responsibilities, developing new capabilities, or participating in political activities.

It is predicted that the use of IT to provide improved access to modeled and formatted information by decision makers will increase perceptions of competence and organizational impact among users employed in expandable work roles.

Hypothesis 2A: Use of information technology as a means of supporting decision making by users in expandable work roles is positively associated with user empowerment.

Decision Support x Non-Expandable

Among employees whose primary responsibilities involve tasks low in expandability, the impact of decision-support tools is problematical. As in the case of decision support technology used by workers in expandable roles, the technology should support improvements in process efficiency as well as outcome effectiveness. User perception of competence should be positively affected by the realized performance improvements. Similarly, better support for decision making may be instrumental in creating an expanded decision making role for these users. Expanded decision making authority could result in enhanced perceptions of task meaning, self-determination, and impact.

Unlike users in expandable roles, however, non-expandable roles do not provide workers with the same opportunities for creating or redistributing slack resources. Because non-expandable roles are quantitatively evaluated and tend to encompass fairly routine decision-making responsibilities, increased efficiency may translate into increased formalization and rationalization. The potential negative impact of formalization and rationalization on user perceptions of task meaning, self-determination, and impact, could act to overpower the positive impact of decision support technology on perceived competence.

Based on these considerations of the use of decision-support tools by workers in low-expandable roles, it is predicted that this class of technology will have a moderately positive impact on user empowerment. Decision-support systems, when used by workers in non-expandable roles, will be perceived as increasing efficiency and effectiveness, but will be moderated by the extent to which the users are subjected to increased formalization or rationalization.

Hypothesis 2B: Use of information technology as a means of supporting decision-making by workers in non-expandable work roles is positively associated with user empowerment.

Communication x Expandable and Non-Expandable

This model predicts that the implementation of information technology as a medium for enhancing the flow and exchange of communication, horizontally or vertically, will have positive impacts on perceptions of empowerment that transcend role differences between employees. Access to information has been identified as a key

dimension of the empowerment construct (see Chapter 2 for a complete discussion of empowerment). Computer-mediated communication has been recognized in the organizational literature as an enabler of richer and more complex communication within and between organizations (Fulk & DeSanctis, 1995; Sproull & Kiesler, 1991). Features of communication-related information technology that have been targeted as responsible for enhancing the flow and distribution of information in organizations include:

1) Higher speeds of information transfer;
2) Lower costs of information storage and sharing;
3) High-bandwidth transmission that supports simultaneous exchange of multi-media information;
4) Expanded communication networks and linkages between organizations and individuals; and
5) Integration of simple information sharing with sophisticated computing capabilities (Fulk & DeSanctis, 1995).

While research concerning the impacts of computer-mediated communication in the workplace has been criticized for its technological imperative perspective (Zack & McKenney, 1995), it is clear that electronic communication media has the potential to enable enhanced information sharing between individuals and groups (Fulk & DeSanctis, 1995; Hinds & Kiesler, 1995; Kanter, 1989; Lind & Zmud, 1995).

Two types of organizational information have been identified as particularly influential on empowerment-related perceptions: information concerning organizational mission and information concerning individual performance (Lawler, 1992). Information

on organizational mission creates a sense of perspective and context for employees, enabling them to better understand how their efforts can be directed toward supporting and/or influencing the mission (Bowen & Lawler, 1992; Conger & Kanungo, 1988; Kanter, 1983; Lawler, 1992). Individual awareness about his or her role in the larger organization's mission is critical for motivating employees to act creatively and assume responsibility for organizational outcomes (Kouzes & Posner, 1987), as well as attributing meaning to their particular work tasks (Conger & Kanungo, 1988). Information concerning individual performance is also critical for directing individual efforts toward self-development and building a sense of competence in performing tasks (Spreitzer, 1995). As a result, it is postulated that increased use of information technology serving a predominantly communications function will result in increased perceptions of empowerment regardless of the type of work role occupied by the user.

Hypothesis 3: Use of information technology as a medium of communication by workers in expandable or non-expandable work roles is positively associated with user empowerment.

Implementation Context Effects

Context is modeled as a multidimensional, moderating factor in the relationship between IT use and employee empowerment. The implementation context associated with the introduction of workplace IT can be evaluated as a continuous variable falling somewhere on a continuum between supportive and non-supportive of technological empowerment. This implementation context measure represents the additive combination of ratings across four context dimensions--discretion in use, participation,

training, and organizational incentives--each of which is measured on a continuous scale between high and low. A supportive context will enhance the empowering nature of IT when the function and work role factors lead to a prediction of increased empowerment or diminish its disempowering impact when function and work role factors lead to a prediction in the opposite direction. Conversely, a non-supportive context will diminish the positive impact of an empowering technology or, alternately, reinforce its empowerment-reducing effects.

Hypothesis 4a: A supportive implementation context will positively influence the relationship between information technology use and user empowerment, in that it will increase the otherwise positive effect of IT use on user empowerment or, alternatively, reduce its negative effect.

Hypothesis 4b: A non-supportive implementation context will negatively influence the relationship between information technology use and user empowerment, in that it will increase the otherwise negative effect of IT use on user empowerment or, alternatively, reduce its positive effect.

This complete set of hypotheses is transformed into a matrix of predictive outcomes associated with information technology introduction in the workplace (see Figure 3). The matrix attempts to organize the hypotheses presented and to integrate the combined impacts of the intervening factors. Hypotheses 1A & B, 2A & B, and 3 propose directional changes in user empowerment, while Hypotheses 4A & B propose

User Work Role	Technology Functionality	Intermediate Effect	Implementation Context	Observed Empowerment Outcome
Expandable	Automation	Neutral	Supportive	Slightly Positive
			Non-Supportive	Slightly Negative
	Decision Support	Positive	Supportive	Strongly Positive
			Non-Supportive	Neutral to Slightly Positive
	Communication	Positive	Supportive	Strongly Positive
			Non-Supportive	Neutral to Slightly Positive
Non-Expandable	Automation	Negative	Supportive	Neutral to Slightly Negative
			Non-Supportive	Strongly Negative
	Decision Support	Moderately Positive	Supportive	Positive
			Non-Supportive	Neutral to Slightly Negative
	Communication	Positive	Supportive	Strongly Positive
			Non-Supportive	Neutral to Slightly Positive

FIGURE 3
Predictive Matrix

moderation of the effects predicted in the first five hypotheses. The outcome column on the right side of the matrix attempts to account for the cumulative effects of the intervening variables by characterizing the predicted empowerment impact along a continuum from "strongly negative" to "strongly positive". The same predictions are summarized graphically in Figure 4.

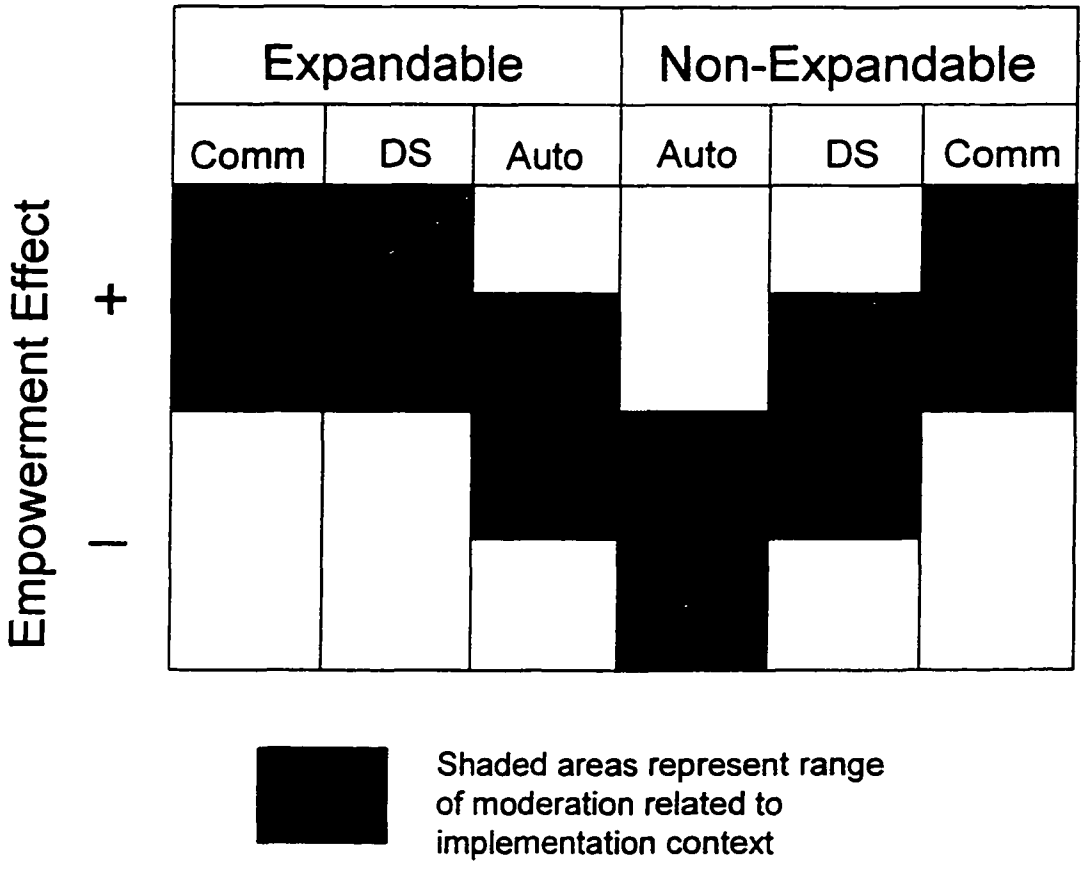

FIGURE 4
Effects Of Intervening Factors

Whether or not these model-based predictions represent a useful heuristic for anticipating actual outcomes of technology introductions will be addressed in the next three chapters. Chapter 4 is devoted to explaining and outlining a research approach to testing the model and its predictions against four historically documented technological innovation events, as well as one contemporary introduction of computerized information technology. Chapter 5 then presents the analyses of the historical events and attempts to develop an acceptable answer to the question, "Are the model's predictions supported when compared to the known outcomes of historical events?" Finally, Chapter 6 contains a discussion of the research results, their contribution to the existing research literature, and suggested directions for future efforts.

CHAPTER FOUR

METHODOLOGY

This chapter describes the approach to model testing that will be employed in this dissertation to evaluate the IT-empowerment model. Historical data related to the adoption of radical technological innovations in the newspaper printing industry will be collected and analyzed in this study, in addition to data from a contemporary study of the introduction of an innovative computer application. An historical methodology will be employed for analyzing data related to the historical innovation events as well as the contemporary IT introduction. While somewhat unusual in the management literature, in general, and the information systems literature, in particular, historical methods have substantial precedence and support in social science research and presents some particularly interesting opportunities for understanding the impact of information technology on employee empowerment.

Historical event analysis, the historical approach to data analysis developed in this study, has three main goals, each of which tends to separate this approach from more traditional historiography. The first goal is to provide access to the rich universe of historical human experiences as a source of test data for evaluating and refining hypotheses about current events and phenomena. Model testing as an objective of historical research is relatively uncommon in humanities-driven qualitative work. In this study, the IT-empowerment model will be tested via the collection of data concerning four specific historical events, each representing a radical technological innovation in the newspaper publishing and printing industry. Despite the focus on a single industry, this

is not intended, nor is it analyzed, as a longitudinal study. Each event is treated as a quasi-experiment with information collected pertaining to the treatment effects of the introduction of information technology innovations, as well as before- and after-treatment conditions.

The second goal of the historical event analysis approach is to develop a framework for organizing and facilitating historical data comparisons and interpretations. Using a structured framework to guide and explicate the analysis process should produce research results that are more understandable and replicable for future researchers. As is discussed in more detail later, clearly defined process is an important prerequisite for establishing the validity of any piece of research. In addition, the increased structure in an otherwise interpretive analysis may also make the findings more acceptable and useful for integrating with other research results produced via traditional empirical methods.

The last major goal is to develop a methodology that will be generalizable to the analysis of contemporary data sources. Historical methods, with their focus on narrative interpretation and the intricacies of social situations, can enrich the somewhat sterile analyses and results of traditional empirical research. In addition, many contemporary data resources, such as industry and practitioner publications, are largely unexploited as research data sources because they do not fit the demands of positivistic research paradigms. This type of documentation, which can be a rich repository of timely and insightful information about emerging problems on the shop or office floor, is created by people trained at telling informing and interesting stories about events rather than ensuring empirical validity. Historical methods are designed to handle just this type of

information source, employing qualitative approaches to selecting, evaluating, and synthesizing relevant bits of data into meaningful and useful explanations. Refining this process in the historical record may result in the development of methods that are equally useful for exploiting a source of information about modern problems, particularly those involving information technology that tend to have short lifecycles and are difficult to transfer to experimental settings.

The remainder of this chapter will first present a discussion of the role of historical research methods in the organizational and social sciences, including perspectives of proponents and critics. Next, the general historical research framework that will be used in this study will be outlined and explained. Finally, the application of this historical event analysis approach to the research goals of interest in this dissertation, namely the testing of hypotheses derived from the IT-empowerment model will be described. This chapter lays the methodological foundation for the historical analyses that follow in Chapter 5.

HISTORICAL RESEARCH METHODS

Over the past decade, qualitative methods have received increased attention in the business literature. Some academicians have recognized the need to broaden the ways in which researchers seek to build explanations and gain understanding about the behavior of individuals, groups, and systems (c.f., Fullerton, 1987, 1988; Ingram & Inman, 1996; Lavin & Archdeacon, 1989; Morris, 1990; Witkowski, 1989, 1990). Zald (1991/92, 1993) has argued that social sciences, in general, and organizational studies, in particular, have much to gain from the adoption of traditionally humanities-associated, qualitative

data collection and analysis methodologies. Such methodologies include interpretive historical research methods, as well as textual and rhetorical analysis, case studies, hermeneutics, literary criticism, ethnomethodology and phenomenology.

Historical methods are considered qualitative rather than quantitative because the majority of data sources upon which historical researchers depend do not lend themselves easily to numerical manipulation via traditional inferential and description statistical techniques. While quantitative data, for example financial, accounting, economic, and demographic records, have been compiled and archived throughout the years, a considerable portion of the historical record, and that most frequently exploited by historians, exists in the form of primary narrative sources (i.e., letters, diaries, newspapers, books, magazines, unpublished accounts written by individuals or produced by organizations, governmental or business records, oral histories, or various other forms of descriptive material created by participants or observers of historical events) or analyzed secondary sources (narrative descriptions of past events produced by non-participants on the basis of other primary documentation) (Thernstrom, 1982). Socio-historical researchers, including those interested in the behavioral aspects of organizations and the individuals in those organizations, must make informed, yet inherently subjective, decisions about how they are going to approach the "unpacking" of this largely narrative data and effect the necessary "radical transformation" of the material into meaningful explanations of past events (Thompson 1978: 29).

Numerous arguments have been put forward in support of employing historical research analyses in organizational research. Thernstrom (1982) and Tuchman (1994)

have identified historical research, along with other qualitative research methods, as particularly well suited for developing richly contexted data and causal explanations. Wren (1987) suggests that historical research provides an avenue for framing research questions that may later be tested via other, perhaps quantitative, methods of data collection and analysis. Lawrence also speaks to this issue when she claims that historical inquiry "...pushes thinking about alternative explanations for phenomena, helps identify more or less stable concepts, and expands research horizons by suggesting new ways of studying old questions" (1984: 311).

Kieser also argues for the expanding benefits of historical research in management studies when he states:

> Historical analyses teach us to interpret existing organizational stuctures not as determined by laws but as the result of decisions in past choice opportunities, some of which were made intentionally and others more implicitly...Historical analyses can prepare us to better identify and to make better use of choice opportunities. (1994: 611)

An historical view of events and behaviors allow us to identify dependencies between events and to appreciate the cumulative effect of sequential actions that shape future choices and behavior (Aminizade, 1992). Management researchers and practitioners who adopt a historical perspective are better able to recognize that current events, much like historical events, always have multiple causes. In other words, an understanding of historically documented events and social processes can inform researchers' interpretations of causality, as well as practicing managers' approaches to solving operational and strategic business problems.

In a similar vein, the historical record can also be embraced because of the richness it offers for studying phenomena of continuing interest. When properly supported by theory, historical research methods can be used to great effect in the study of historical phenomena that are analogous or complementary to contemporary research problems. Scrutiny of historically situated events, whose social, technological, or organizational environments may no longer be available for observation, can add significantly to our understanding of current management issues. While the assumption that all of today's management research problems have mirror images in the historical record is unwarranted, it is certainly reasonable to believe that many valid and useful analogies for modern events can be identified in our collective past. "While history may not repeat itself," as Mark Twain so poetically observed, "sometimes it rhymes" (quoted in Wren, 1987). The historical record can provide us with a wealth of rhyming, if not identical, settings for collecting data and exploring problems.

While Zald (1988, 1991/92, 1996) and Kieser (1994), among others, have argued strongly for the creation of organizational theories and research methodologies that take history seriously, it is an approach to management research that is often neglected (Lawrence, 1984). Trying to explain why intellectually vigorous researchers in the field of management ignore the value of an "historical perspective" (1984: 307), Lawrence has identified a cultural bias in Western societies against looking to the past. Goldman (1994) presents more pragmatic explanations. First, he believes that as management graduate education has become more specialized in recent decades and has been transplanted from social science departments to business schools, students have received

less training in historical and other qualitative research techniques. Historical research is decidedly non-linear and has been described by Daft as being "random and messy" (1983: 542). Without training in its use and support from faculty mentors, a foray into the uncharted territory of the historical record would seem to be ill advised for most researchers. Second, he suggests that the research journal format in which most research efforts are published, force brevity and conciseness, which favors quantitative, empirical studies over qualitative methodologies. Given that publishing productivity is the proxy by which most academic researchers are evaluated and rewarded, it is not surprising that authors have been trained to produce research products that most easily fit the requirements of the mainstream professional journals.

Silverman (1989) has suggested that the object of historically directed research is to present a convincing story that explains historical events and links those explanations to current issues of interest. The ability to create convincing stories via a strictly interpretive approach to historical analysis has been questioned by some methodologists because of the difficulty in laying the foundation for replication of research results or building support for explanations as optimal in the face of counter interpretations. Denzin & Lincoln refer to this as a "double crisis of representation and legitimization" (1994: 10), and suggest that these criticisms have forced qualitative researchers to undergo a "serious rethinking of such terms as validity, generalizability, and reliability" (1994: 11). Griffin (1993) addresses a similar concern with legitimization issues in sociohistorical research. He suggests that the interpretation of narrative historical data "is both essential to the sociological analysis of historical events and successful in providing

certain kinds of explanations, but unsatisfying as an explicit and replicable causal framework" (1993: 1097).

Qualitative researchers should embrace a form of "cautious positivism", according to Silverman, as a way of addressing some of the identified weaknesses of the interpretive approach, including the threat of "creeping anecdotalism" (1989: 59). His conception of cautious positivism, which is similar in some respects to Guba's (1990) description of post-positivism and Orlikowski & Baroudi's (1991) description of weak-constructionism, refers to an epistomological melding of the oftentimes polarized positivist and interpretive schools of social science research. In order to understand the inherent conflict in these approaches to knowledge, a brief description of their principle tenets is important.

Positivism and interpretism are frequently viewed as two competing models of scientific epistemology, or sets of assumptions about the nature of truth and facts and how scientists can proceed toward an understanding of both. Gummesson (1991) has characterized these two diverging paradigms as positivism and hermeneutics (from the Greek word *hermeneuein*, meaning "to interpret") and Hunt (1991) focuses on positivism and relativism. An examination of the epistemological and methodological approaches associated with the interpretive, hermeneutic, and relativist schools, however, reveals no differences of importance to this study, so they are treated here as synonymous terms.

A positivist viewpoint assumes that humans live in a world comprised of objective facts and concrete realities that can be measured, studied, and understood. The classic hypothetico-deductive model is the model of choice for positivist-oriented

researchers. This research paradigm calls for the deduction of testable hypotheses from general theoretical models. These hypotheses are operationalized into measurable constructs that are evaluated via data collected from statistically drawn samples from larger populations. This research method is believed to capture truth by drawing inferences about a phenomenon from this sample and extending these inferences to the stated population. The objective of positivism is to generate and test generalizable theory with the ultimate goal of discovering law-like generalizations (Denzin and Lincoln, 1994; Gummesson, 1991; Hunt, 1991).

Interpretive studies, on the other hand, seek to understand phenomena through accessing the meanings that participants assign to them, generally relying on a myriad of qualitative data collection techniques--such as interviews, participant observation, documentary research, and personal experience--and data analysis methodologies--including semiotics, content analysis, discourse, phonemic analysis, literary criticism, feminism, rhizomatics, and psychoanalysis (see Nelson, et al., 1992: 2). The interpretive researcher embraces a constructionist perspective of the world and views data collection, measurement, analysis, and ultimately the research conclusions themselves as value-laden constructions of social beings. Interpretists believe that important research questions relate to the deep structure of phenomena rather than simple statistically significant associations between measured variables. Contrary to a positivist paradigm, an interpretive paradigm places special value on the explanation of anomalous situations and on understanding the ways humans reinterpret their physical and social environment as time goes by (Gummesson, 1991).

While rejecting positivism's narrow focus on numerical measurement of constructs and rigidly formalized deductive logic and falsification techniques, the historical research approach described in the next section attempts to present a historical method that is strongly influenced by a positivistic orientation. The focus is on supporting the development of a theoretical model of information technology impacts on user empowerment by testing deductively derived hypotheses. The published results of historically-driven research in the social sciences is frequently atheoretical, encompassing a variety of descriptions, chronologies, biographical sketches, or slice-of-life narratives with very little attention to either theory generation or validation (see Smith & Lux, 1993, for a categorization of recent historically oriented marketing research). Two major theory-based objectives of historical research have been identified in the historical methodology literature, however, inductive theory generation (research questions following inspection of the data) and deductive theory testing (questions formed based on a critical review of the existing theoretical literature. While it is well accepted by historical methodologists, the deductive approach to theory testing, in particular, has been conspicuous by its absence in the humanities, social science, and business research literature (Shapiro & Doody, 1968; Smith & Lux, 1993). In this sense, then, the design of this research project and the framing of pertinent research questions is innovative.

The next step toward increasing the positivism in this work is to avoid adopting an intractable stance on the quantitative/qualitative dichotomy in research methods by employing those methods that best satisfy the research questions and data requirements. The primary setting for data collection in this study is historical. This approach was

selected predominantly because of the rich opportunities the historical record provided for studying a modern problem through past technology-related events. This approach also represented a novel way to address questions about social impacts of information technology, and as such, merited attention both in terms of its potential to contribute toward better understanding of the problem and better understanding of a seldom-used research method. An integration of positivism and interpretivism is evidenced in the use of a structured framework approach to the development of research questions and to their resolution. A primary goal of this research is that the results be amenable to replication and integration into the existing and future research on information technology, technological innovation, empowerment, and other organizational issues.

Finally, this analysis will proceed with the clear recognition that historical data, whether primary or secondary, purely descriptive or analytical, are the result of human construction and reconstruction. The rhetorical nature of such data must be understood and addressed at each step of the research process in order to avoid the "creeping anecdotalism" feared by Silverman. Issues of research quality, which are more fully discussed in the next section, must be addressed via attention to source evaluation, data comparison, internal and external consistency, and carefully constructed logical arguments for and against data interpretations.

In summary, the intent of this historical data analysis is to test the validity of hypotheses that are derived from the theoretically based, IT-empowerment model. This model posits that the use of information technology in the workplace will result in changes in the level of user empowerment and that this effect will be moderated by three

sets of intervening variables. In order to test and further refine this model, four historical technological innovations will be studied each as a discrete historical event which presents a test ground for a portion of the model. This approach is referred to in this dissertation as historical event analysis and will be conducted according to a quasi-positivist approach to interpretive historical research. The research framework which will guide the conduct of each of these historical case analyses is described in the following section.

RESEARCH FRAMEWORK

The historical method employed in each historical event analysis will follow the historical research process depicted in Fig. 5. This framework characterizes the historical research process as consisting of three reflexive stages: design, analysis, and interpretation. The first stage encompasses the formation of relevant research questions, the selection of appropriate research designs and contexts. The second stage includes the investigation of the historical record and identification, validation, and selection of relevant information. The third, and last, stage contains the synthesis of relevant information into statements of data relationships, or causal statements, and finally, the interpretation of these statements into an interpretive narrative.

The labeling of each stage is not without problems of overlapping constructs, particularly in the use of the term "interpretation". The fact that only one stage is labeled "interpretation" does not imply that researchers' judgements are not inherent or desirable components in each of the preceding stages. At each step in the process outlined, the

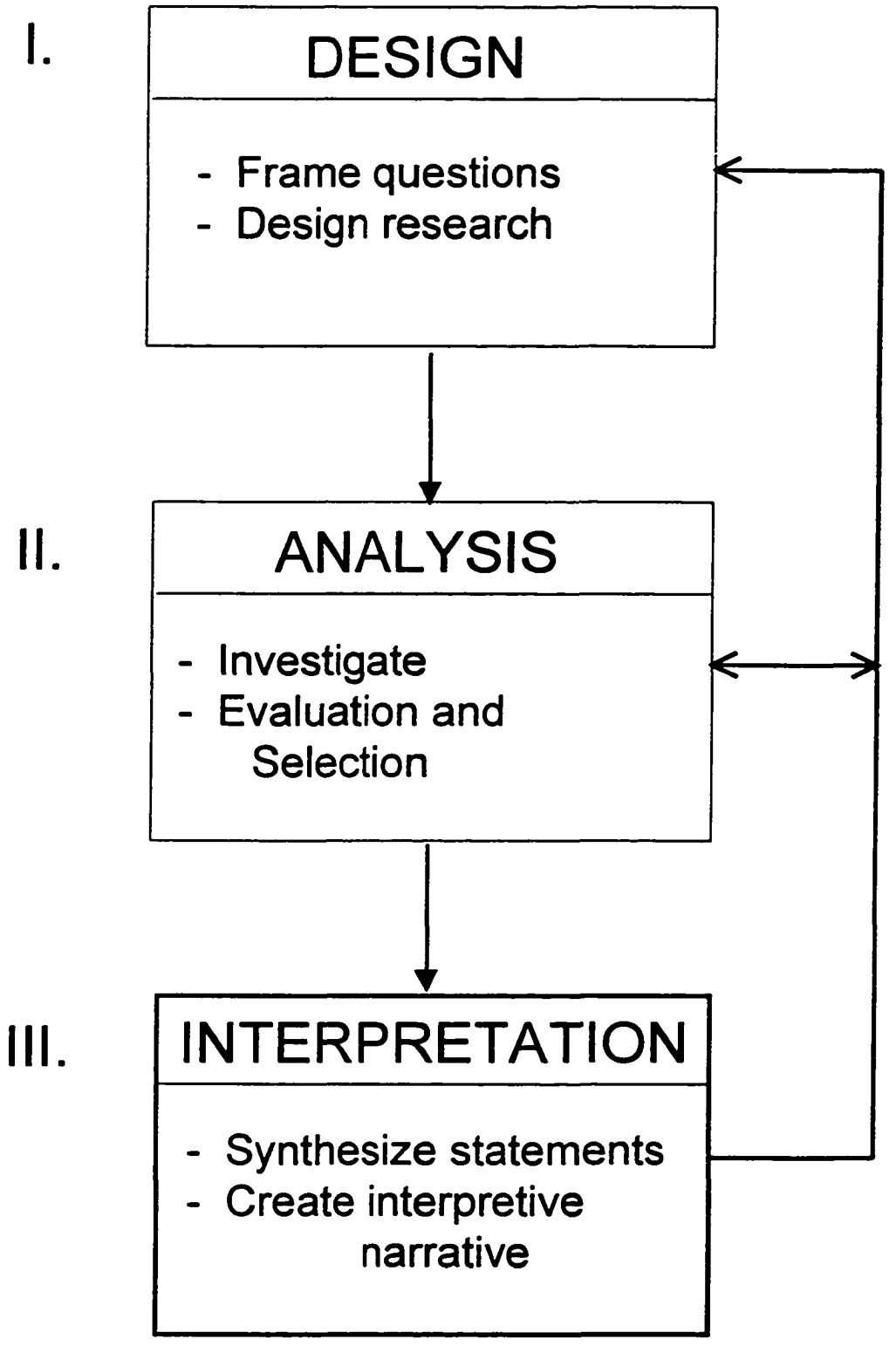

FIGURE 5
Historical Method

researcher must apply his or her expertise, knowledge, experience, and on occasion, intuition to the task of making decisions based on incomplete and oftentimes confusing data. Selection is a particularly judgmental aspect of all stages, for example, in selecting interesting research questions, or selecting which historical facts are relevant and worthy of further consideration and research and which are not.

Intrepretation is used to label the third and final stage, because it is at this point in the research process that interpretation or judgment takes on its most overt and central role. The work of synthesizing disparate pieces of data into meaningful explanations for the "hows" and "whys" of historical events can hold no pretence of being quantifiable or purely objective. It takes creative human intervention, in the form of researcher judgments, to develop interesting and meaningful explanations. As Nevett points out quite clearly, "Judgement is the end of the process of historical investigation" (1991: 17).

An important aspect of this model, and one that is a sharp departure from the positivist research tradition, is its reflexive nature. The term reflexive means that the research process is, by design, non-linear and that the researcher may freely revisit and modify previous stages whenever results suggest that questions, procedures, or analyses should be reconsidered. This reflexivity is similar, in many respects, to the hermeneutic circle that describes the creation of new understanding at each level of a research process and how that understanding informs and modifies each iteration of the research cycle (see Gummesson, 1991, for a description of the hermeneutic process). Smith and Lux highlight the divergence of this aspect of historical methods from the traditional scientific approach: "For those who take the scientific method as their research model, adjusting

research questions after beginning data collection is unthinkable; for the historian such adjustments constitute the basis for research design" (1993: 599).

Stage I: Design

Question framing. The first step in the historical research process is one that gives direction to all remaining steps and, as a result, must be considered carefully. Generally, historical studies frame research questions to guide inductive research, and, as a result, the questions tend to be complex and open-ended. Indeed, the breadth of most research questions is intentional as it is the goal of many historical researchers to highlight the complexity and variability of historical events rather than their simplicity (Cantor & Schneider, 1967; Mandelbaum, 1977; Watkins, 1959). To illustrate the approach to framing questions for historical research, Smith and Lux offer the following examples of questions that might be posed in a marketing study: "Why is working-class consumers' adoption of innovations product specific?" or "How and why did taverns influence consumer acceptance of Miller Lite?" (1993: 600-601). It is clear that these questions may be able to direct general research objectives, but they do little to assist the researcher in focusing on specific types of information that might be useful in answering the general research questions.

Since the goal of the historical research process developed here is to test specific hypotheses derived from a theoretical model, it is important that the general research questions be operationalized into queries that help guide data collection and analysis. Much in keeping with the deductive tradition, succeeding iterations of the historical research process will be initiated by the framing of questions that move from the general

to the specific. General research questions are replaced with model-defined conceptual research questions, which are further distilled into historically observable proxies. Proxies serve as bridging devices that translate conceptual research questions into queries that are more directly answerable from historical documentation. These proxies are the functional equivalent of fully operationalized, measurement variables in positivist empirical data collections. By defining proxies that are logically related to the conceptual research question, unambiguous concerning the information requested, and directly resolvable via available historical data, they serve as valuable heuristics in investigating largely narrative historical data and evaluation of research processes and results.

Research design. This second step in the historical method consists of making decisions about what types of data sources to use, which historical events or settings to investigate, as well as general and specific methodologies to be used for data collection and analysis. In large part, decisions at this level are driven by the research questions defined in the preceding step. Smith and Lux (1993) point out that choice of data sources "simply call for matching data to the interpretive end driving a research question." In addition, the practical importance of data availability cannot be overlooked. From a very pragmatic perspective, Tuchman suggests that "in historical research, as in all other kinds of research, the data to be used depend upon the question the researcher wishes to answer and the information the researcher can find to answer the question" (1994: 312).

An issue of particular concern in this study is the selection of historical events. To help understand this selection process, it is useful to compare this historical event

analysis approach with what Herriott and Firestone (1983) refer to as multi-site qualitative research or what Stake (1994) refers to as an instrumental collective case study approach. Each historical event analysis can be thought of as an instrumental case study, in that the event is investigated, not with the objective of gaining an understanding of the specific historical setting, but with the objective to test a theoretical model that attempts to explain certain generalizable aspects of the event (Stake, 1994).

Like a collective case study, the optimal selection of the event to be investigated may determine whether or not the study makes any significant contribution to theory development (Patton, 1990; Yin, 1989). Nevett has pointed out that the "lessons of history have to be learned from analogies and...the question of selection is absolutely critical" (1991: 19). According to Mitchell (1983), the selection of the study must follow from the researcher's belief that the case possesses the capacity to test or expand a hypothesis, proposition, or question of interest.

It is not necessary in this type of study, that the cases chosen be representative, in a sampling sense, of the full population of possible study settings. When only a small number of cases are accessible, either because of time, financial, or logistical reasons, and the population of hypothetical cases is very large, statistically supported generalizations from the cases to the general population will be impossible. Stake (1994) proposes that the most important criteria for case selection may be the opportunity to learn from the case, perhaps because a case of this kind has not be examined previously, it presents an interesting anomaly, or because the researcher has better access to data on a particular setting. Mitchell stresses the importance of theoretical relevance over representativeness.

He states that, "in qualitative research we choose a case because we believe it exhibits or tests some identified general theoretical principle rather than its assumed representativeness of some given population" (1983:188).

Stage II: Investigation

Investigation. The second stage of the historical method begins with the researcher's quest to accumulate a comprehensive pool of data from which to shape answers to the proxies and ultimately the research questions. The process of "learning history", while it shares many techniques with library research associated with any discipline, requires the deep exploration of research literature, reference materials, and historical documents that are unfamiliar to researchers without a formal background in historiography. Tuchman (1994) has presented an introduction to the "nuts and bolts" approach to finding historical information and assessing its usefulness. A classic, but in many respects outdated, work on the subject of historiography is authored by Barzun and Graff (1957). The availability of CD-ROM and on-line reference indexes and databases has greatly reduced the requirement for manual cross checking and searching of commonly available hardcopy references, journals, and collections of secondary resources. For those scholars focusing on primary documents, the conversion of some archives, document collections, bibliographies, and genealogical and census records into electronic formats has reduced the cumbersome requirements for travel to dispersed locations.

While the exact nature of the documentary investigation will vary greatly from study to study, most social science researchers looking to the historical record will find

themselves relying on secondary, more so than primary, resources. Lower levels of historiographical expertise, training, and familiarity with the historical resource creates a certain level of dependence of the non-historian on the professional historian's analytical work product. While historians assign a higher degree of integrity to primary data sources, the reliance of non-historian researchers on secondary sources has been justified by methodologists. Marshall pointed out, referring in this case to sociologists:

> [S]ociologists must inevitably rely extensively on secondary authorities, without going back to the original sources. They do this partly because life is too short to do anything else when using the comparative method, and they need data assembled from a wide historical field, and partly because original sources are very tricky things to use...It is the business of the historian to sift this miscellaneous collection of dubious authorities and to give to others the results of their careful professional assessment. And surely they will not rebuke the sociologist for putting faith in what historians write (1964: 51-52; quoted in Lipsett, 1982).

Evaluation and selection. Clearly, the accumulation of a large pool of historical "facts" and the reporting of all of these in a running narrative is not an adequate research result (Smith and Lux, 1993). As the body of data points grows during the investigation stage, the researcher must be assured that the data that has been revealed is authentic, reliable, and useful. Conflicting data must be resolved, and decisions must be made concerning which data items, among the thousands of bits of information encountered during investigation, are to be considered relevant to the research questions posed.

The 19th century German historian Ranke, one of the first historians to attempt to formalize investigation processes, claimed that historical data must be subjected to two forms of criticism, internal and external (Gottschalk, 1956). Internal criticism, or validation, involves the testing of authenticity of the data by "considering the source".

Are the claims of authenticity believable? Why is the author of the data source recording the event or why is the researcher conducting the historical study that is reported? There is no statistical standard that can be employed to make the determination of which data are valid and which are not. Historical researchers must rely on their diligence in checking information about the creation of the historical documents and their knowledge of the broader background and cultural milieu in which the event transpired in making judgements of internal validity (Tuchman, 1994).

The process of external criticism involves the comparison of information between various authors and historical documents. Historical data, not unlike other types of data, benefit from corroboration from multiple sources, a process referred to as triangulation. The successful analysis of historical data requires that the researcher be ever mindful of the rhetorical nature of documentary accounts of past events and the forces for bias, incompleteness, and inaccuracy that affect historical sources. Again, these threats are not restricted to historical data, but are particularly potent in the historical record with its preponderance of narrative sources. This point is so important that Tuchman (1994) summarized her discussion of the historical method with the following statement:

> Do not assume that anything about data is "natural," inevitable, or even true. To be sure, a datum has a physical presence: One may touch the page, picture, tombstone, or microfiche one has located. But that physical truth may be radically different from the interpretive truth needed to assess the application or test a theory (1994: 321)

In addition to accessing data for accuracy, it must also pass the test of relevance. According to Smith & Lux (1993), the historical record is, at least in principle, an infinitely bountiful storehouse of information concerning most historical events. (Any

historical researcher can confirm that the distribution of this bounty is highly uneven. Many historical phenomena remain enigmas, with little useful historical data upon which to build explanations or adequate descriptions.) As a result, these same authors stress the important role of selection in furthering the process of historical research. Selection represents "the process that narrows the facts from whatever is available to those appropriate to the question and procedures chosen for the research design" (Smith & Lux, 1993: 603).

The selection of relevant facts, or those pieces of information that contribute to the development of answers to proxies or research questions, is a critical step moving historical analysis from investigation toward interpretation. This process of sifting out relevant, useful bits of information from the total population of investigated data is an exercise that must be guided by the researcher's focus on the formalized research questions and familiarity with the data in hand. The appropriate definition of proxies is a useful heuristic for guiding the collection of relevant data and, as a result, leads to more efficient data collection. Even given well-constructed proxies, however, not all data collected will be important or useful. It is important that the historical researcher realize that the indiscriminant bombardment of a research question with facts is more likely to lead to confusion than to insight. As Smith and Lux point out, "the merit of a historical explanation rests on the historian's judgment about the relevance of facts. And therein lies the art to history" (1993:603).

Stage III: Interpretation

Synthesis. The hard work of the investigation stage is brought to fruition in the final stage of the historical process. The first step in this final act is labeled synthesis, during which relevant historical data are reorganized and combined to create statements of explanation that directly address the proxies or research questions. Synthesis is a necessary effort that moves the historical researcher past mere data collection and documentation. The linking together of facts into explanations, rather than the identification of historical facts, is, according to Kantrow (1986), the rightful objective of historical research. Likewise, Wren (1987) has pointed out that the synthesis of collected historical information is the heart of historical research.

The synthesis step involves the consideration of the historical data that has been evaluated and identified as relevant to the posed proxies. Consideration of the data means that the data are combined and arranged to reveal potentially meaningful relationships of historical phenomena. The recognition of patterns and connections in qualitative data can be more difficult than in quantitative data, because qualitative data tends to be richer, thicker, and more disorderly than numerically measured data (Tuchman, 1994). As the word implies, synthesis is a process of creation, requiring the addition of researcher insight and intuition to transform historical observations into convincing answers to posed questions. This synthesis is at the core of what Tuchman (1994) calls the "interpretive enterprise."

Explanatory narrative. The interpretive enterprise continues in the final leg of the historical research process to create the explanatory narrative. The explanatory narrative

is comparable to the final stage in most positivistic projects in which the statistical results are discussed in terms of how they contribute to theory or are related to previous research results. Researcher judgment and subjective interpretation, again, play a pivotal role in the final stage of historical analysis, as it does in quantitative research (see Silverman (1989) for a discussion of the inherently qualitative nature of most positivistic research).

The narrative itself is a form of story that presents and builds on the synthesized data relationships by explaining how these answers can be considered together as a meaningful explanations for past events. The story also tells how these historical explanations can contribute to better understanding of comparable modern phenomena. Finally, the narrative is constructed to tie the research results to the historian's interpretive objective, in this project to test a model describing the relationship between information technology use and employee empowerment (Smith & Lux, 1993). The interpretive narrative resolves the "So what?" question that lurks in any research endeavor.

The interpretive narrative in historical research results frequently differs from the presentation of quantitatively derived explanation in terms of the depth and complexity of the explanations pursued. As Mitchell explains: "Explanation developed from qualitative research goes beyond logical or statistical inferences about correlations, but rather comprise proposed causal connections, defended by the unassailability of the analysis" (1983). It is in the nature of historical research methods, like other qualitative approaches to social research, to pursue multi-layered and interactive explanations of events (Megill, 1989). Historical explanations are rarely simple or unidimensional, because the truth about history, and indeed about human behavior in any time period, is

not simple or easily encapsulated into formulaic explanations (Nevett, 1991; Watkins, 1959).

The illumination that historical research brings to our understanding of both past and present phenomena is fully dependent on the researcher's ability to create lucid descriptions of human behavior and compelling arguments in support of interrelationships between historical conditions, incidents, and participants. Those employing the historical method in social science research must also be able to present persuasive, defensible arguments about the implications of historical interpretations for modern research issues. Unlike scientists working in the purely positivist tradition, historical researchers cannot rely on immutable scientific terminology and statistical measurements of significance, explained variance, or goodness of fit to present and defend their determinations of meaningful relationships. As a result, the effective and creative use of language is particularly important for historians (Handlin, 1979). As Nevitt points out, "This situation produces a need for a different kind of language which, though accommodating immeasurable entities, still permits subtle and extremely precise shades of meaning" (1991: 15).

RESEARCH QUALITY

The issue of research quality, generally addressed in positivistic terms as questions about validity, reliability, and generalizability, has been discussed previously in this chapter, but is such an important consideration for interpretive research that it merits separate consideration here. The question of how to judge the quality of research then cannot be determined simply by auditing the researcher's compliance with proscribed

statistical criteria is problematical and may present a critical barrier for mainstream acceptance of interpretive research results. As the dominant paradigm in academic business research is a strongly positivistic one, the tendency all too often among research judges and consumers is to assess interpretive research from a vantage point of positivism and, based on the application of inappropriate criteria, find it lacking (Gummesson, 1991).

Due to the personalization of interpretive research designs and the inherent flexibility valued in the interpretive approach to research, it is more difficult to set firm criteria for the assessment of quality in this type of research (Gummesson, 1991). Numerous qualitative methodologists have struggled with this dilemma (see Gummesson, 1991; Odman, 1979; Shipman, 1982). Shipman (1982: xi-xiii) proposes a simple, but useful, heuristic consisting of four questions that can be posed of qualitative research to evaluate the quality of the work. Interestingly, this heuristic need not be restricted to application with interpretive research results. These four questions represent standards of research quality that are well accepted in the positivist research school, but are unfortunately not universally met. Shipman's (1982) standards of research quality include (each of Shipman's questions are quoted directly from his text, although not in the original order):

1) "Does the evidence really reflect the reality under examination?" This first question addresses the validity of research results. Are the research questions operationalized into appropriate and adequate historical proxies? Are the data accurate and free from unaccounted for error or gross

distortion? Do the findings of other researchers confirm the results of the current research, either in terms of data used or interpretations presented?

2) "If the investigation had been carried out by someone other than the author, using his methods, would the same results have been obtained?" The issue of reliability, or replicability, is highlighted in this question. Is the interpretation supported by the data presented? Are the interpretations internally consistent and logically related? Are alternate or contradictory explanations evaluated by the researcher?

3) "What relevance do the results have beyond the actual research?" This question focuses on how specific research results are generalizable to other research settings and, just as importantly, how results contribute to the resolution of problems important for managers (see Behrman & Levin, 1984, for one opinion on how this latter objective is being satisfied in academic research). Why was this particular study setting chosen? How do the research results transfer to other research settings, if at all? How can the results be applied in the workplace?

4) "Is there sufficient detail in the way the evidence was produced for the credibility of the research to be assessed?" Gummesson (1991) characterizes this question as addressing credibility of research processes. Because its methods are not rigidly prescribed, qualitative research must take special care to be very public in every stage of research design, analysis, and interpretation. Shipman (1982) identifies the public

presentation of research methods and procedures as the criteria for distinguishing scientists from other authors. Questions that arise in evaluating the credibility of research results include: Is there a detailed description of methods used and a step-by-step description of the research process? Does the researcher clearly identify his or her paradigms and assumptions about the research process and the phenomena being studied? Are data well documented and referenced?

While most historians will agree that there is, at least, some degree of truth, or objective reality about the past that is documented in the historical record, how that truth can be explored, described, or confirmed will never be accepted with consensus by historians, philosophers, or readers. (This debate, of course, is a favorite topic among philosophers of science. See Shelby Hunt (1991) for a more complete look at this and other epistomological quandaries.) In practice, the assessment of research quality is an important, qualifying step in developing a pool of plausible explanations of the human past or, for that matter, the present. As Joan Scott explains, "...there is no single standard by which we can identify "true" historical knowledge...Rather, there are contests, more and less conflictual, more and less explicit, about the substance, uses, and meanings of the knowledge that we call history...." (1989: 689). The ultimate validation of historical interpretations will rely on the contest of multiple, plausible interpretations of replicable data analyses.

THIS PROJECT

This project adopts the historical research process, outlined in Fig. 6, as the model for testing the IT-empowerment model with historical and contemporary data. This framework describes a research process guided by the iterative framing and resolution of research questions that progress from the very general toward increasing specificity and observability. The questions address, first, phenomena that represent the independent side of the IT-empowerment model and then those phenomena that reflect the dependent, or outcome, side. A map of the general event analysis approach is summarized in Figure 7.

The highest-level research question can be framed as, "How does the use of information technology in the workplace affect employee empowerment?" (see Chapter 1 for a discussion of general research questions and Table 3 for a summary of research questions and historical proxies posed in this study). The IT-empowerment model attempts to describe the relationship between level of information technology use and employee empowerment as mediated by a set of three intervening factors. The interpretive objective of this research project is to test and refine this model. Based on this general research question and objective, decisions can be made concerning such research design issues as what general research approach and data sources will be exploited.

The underlying epistemological and methodological paradigm that defines the expectations and interpretations in this research can best be described as a "cautiously positivistic" interpretive approach. It embodies a methodology that is unfettered by

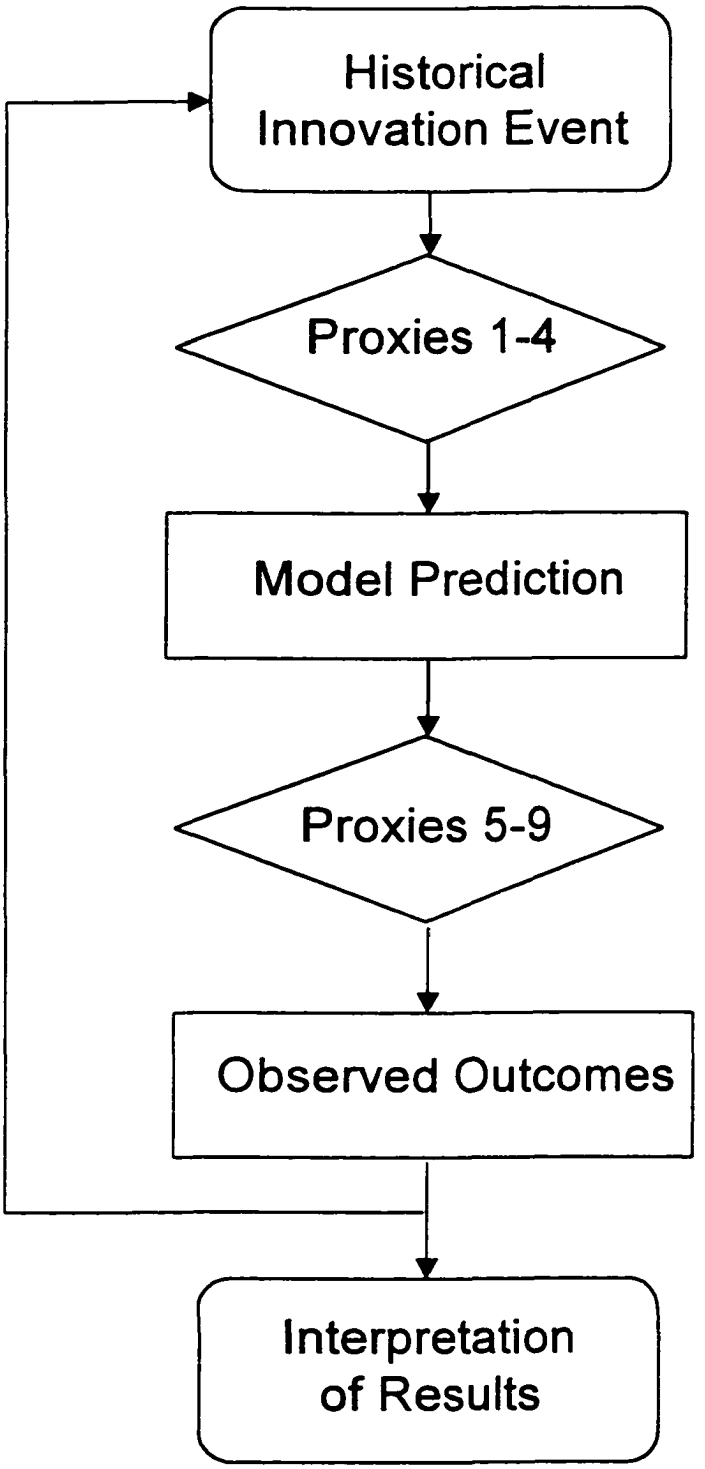

FIGURE 6
Historical Event Analysis

	QUESTIONS	PROXIES
Model Question 1	Who are the users of the technology and what is their level of technology use?	*1a: What occupational group interacts directly with the new technology?* *1b: Is the technology widely adopted in the industry (occupational saturation)?* *1c: Do workers use the technology to complete most of their work tasks (job saturation)?*
Model Question 2	What is the implemented functionality of the technology?	Does the technology mediate or perform tasks previously performed by workers (automation); does it provide information to support decision-making by users (decision support); or does it support the sharing of interpersonal communications between individuals and groups within the organization?
Model Question 3	What type of work-roles do users occupy in the organization: expandable or non-expandable?	*How were the pre-innovation performance levels of users judged: qualitatively or quantitatively?*
Model Question 4	Was the implementation context supportive of technological empowerment?	*4a(1): Is use of the technology mandatory?* *4a (2): Are users able to customize their use of the technology?* *4b(1): Did management consult with users before or after implementation?* *4b(2): Did users make decisions about the technology?* *4b(3): Were users able to block or control implementation through collective action?* *4c(1): How much training have most users received?* *4c(2): Do users express difficulties using the technology?* *4d(1): Is there an increase in wage level for users following implementation of the technology?*
Outcome Question 5	After the introduction of the technology, do users perceive their tasks or work goals to be more or less meaningful?	*Outcome Proxy 5: Is there a change in occupational status for users following adoption of the technology?*
Outcome Question 6	After introduction of the technology, does the overall level of user competence to perform tasks or accomplish work goals change?	*6a: Is there a change in occupational training requirements following adoption of the technology?* *6b: Are users better able to meet their performance goals using the technology?*
Outcome Question 7	After introduction of the technology, is there a change in the overall level of user access to information about individual, unit, or organizational performance change?	*7a: Do users receive more direct performance feedback following introduction of the technology?* *7b: Are users able to converse with coworkers more freely?* *7c: Is there more active communication between users and other departments?*
Outcome Question 8	After introduction of the technology, does the overall level of user autonomy over job tasks and processes change?	*8a: Does user control over work pace change following technology introduction?* *8b: Does the relationship between workers and supervisors change*
Outcome Question 9	After introduction of the technology, does the overall level of user influence over outcomes at the unit or organizational level change?	*9a: Is there a change in functional diversification following technology adoption?* *9b: Is there a change in occupational unionization or union effectiveness?*

TABLE 3
Research Questions and Proxies

paradigmatic rejection of either positivistic or interpretive perspectives, quantitative or qualitative methods. This researcher fully embraces the understanding of data as a socially constructed phenomena that requires interpretation to be arranged and reconstructed into meaningful explanations, and yet, does not deny that quantitative, positivistic-oriented research can contribute toward building support for such explanations. It is argued here that incorporating some character of positivism can also enhance the "usability factor" of interpretive research. Usability for interpretive research results can be enhanced by focusing on theory building as a motivating research goal and incorporating methodological considerations that ensure research validity, reliability, relevance, and credibility (Shipman, 1982).

Following Stake's (1994) recommendations, events selected for this study are defined by a core phenomena that makes them analogous or comparable in some important way to the modern situations in which our model is postulated to be valid, namely workplaces in which technological innovations have been introduced. Technological innovations comprise the broad spectrum of new ideas, manifested in the design of hardware, software, and organizational procedures, that are perceived as new by individual, group, or system to which it has been introduced (Clark & Staunton, 1989; Rogers, 1983). In his discussion of case selection approaches, Stake (1994) recommends choosing one or a number of exemplars, or limiting criteria, based on which the hypothetical number of case choices can be refined. In this study, the full population of technological innovations in the workplace throughout history represents an overly large and unmanageable field of research possibilities. In addition, many technological

innovations have had very minor or indirect effects on the workers who have come to work with them, and as a result, are much less likely to demonstrate effects of a large enough magnitude to be revealed in an historical or contemporary examination. It will be most useful to limit the hypothetical event population to those technological innovations that have had a significant impact on the economy, industry, or workforce to which they have been introduced. These types of innovations have been defined as "radical", as opposed to "incremental", in the technological innovations research literature (Dewar & Dutton, 1986).

The historical events investigated in this dissertation satisfy the criteria that they represent radical innovations in workplace information technology. The general study setting for the historical investigations is the printing/publishing industrial sectors, and the events selected for evaluation represent four episodes of radical change in typesetting and composition. The first technological innovation addresses the introduction and adoption of mechanized linecasting technology in the commercial and newspaper printing industries during the late 1800s (Investigation 1). The second addresses the introduction of teletypesetting technology during the 1940s and 1950s predominantly in the newspaper sector (Investigation 2). The third involves the introduction of computer-assisted phototypesetting technology throughout the printing and publishing industries during the late 1960s and 1970s (Investigation 3), and the fourth the transition to direct-input computerized typesetting, which took place predominantly during the 1970s and 1980s in the newspaper publishing industry (Investigation 4). The final investigation

(Investigation 5) examines the impact of the introduction of an information technology, specifically a sales force automation tool, into one company as recently as 1997-1998.

It is important to keep in mind that the historical studies are of four essentially distinct events and are not presented as parts of one longitudinal case study, despite their occurrence in similar industrial settings over time. While longitudinal studies, whether of historical or current events, are frequently desirable in social science research, the focus of this dissertation is on the short- to middle-term impact of information technology introduction in the workplace. As such, the topic of interest is the specific episodes during which new technologies are introduced and adopted into the work activities of employees.

Since our objective is to test certain hypotheses derived from the IT-empowerment model, the first undertaking in each of these investigations is to determine which of the full set of model-derived hypotheses concerning the empowerment impact of information technology use are relevant to the event under investigation. To select the appropriate hypotheses, the first group of research questions and derived proxies are posed to determine:

1) Descriptions of the primary independent variable (technology use); and
2) Descriptions of the intervening model variables (user work role, technology functionality, and implementation context).

Each of the research questions is operationalized into one or more proxies, a historically observable measure that are both clearly related to the associated research question and is resolvable from historical or contemporary data sources. The proxy is the functional

equivalent to the operationalized construct measures typically defined in empirical research studies. A definition of these research questions and their proxies are presented below (for clarity, proxies related to the independent variables are indicated as "factor" proxies, and those related to the dependent variables are indicated as "outcome" proxies).

Model Question 1: Who are the users of the technology and what is their level of technology use?

This question is designed to identify the population of users in whom we would expect to see impacts of the technological innovation, and also the intensity of their use of the technology. First, we must identify the primary groups of workers that directly manipulate, control, and/or make use of the technology in the workplace. Second, we must attempt to determine the intensity of the technology use. A number of ways of measuring levels of IT usage in empirical research have been proposed, including individual level measures of hours per day, days per week, percentage of working hours, or general impressions of intensity of IT usage. At more aggregate levels, researchers have measured distribution of equipment between units, compared expenditures on IT equipment, and surveyed managers on their general perceptions of the level of technology usage by various groups or the organization as a whole.

Because four of the investigations included in this study focus on the impact of IT use on the empowerment of users across whole industries, we must pose proxies that will examine how widely diffused the technology is across the occupation (occupational saturation). These proxies will not be relevant to the investigation that considers specific users within a single company. To understand how this diffusion affects a typical user, we must consider what portion of a typical user's overall work tasks are mediated by the new technology (job saturation). Therefore, proxies for Model Question 1 are:

Model Proxy 1a: What occupational group interacts directly with the new technology?

Model Proxy 1b: Is the technology widely adopted in the industry (occupational saturation)?

Model Proxy 1c: Do workers use the technology to complete most of their work tasks?

Model Question 2: What is the implemented functionality of the technology?

As discussed in Chapter 3, the functionality of computer technology is a variable that has been overlooked with surprising frequency in the social impacts research literature. This question is directed at determining how the information technology is utilized to produce value for the unit or organization by classifying the functionality of the technology as, either, automation, decision-support, or communication. While it is recognized that there will undoubtedly be overlapping functions associated with complex technologies, especially with computer-based tools, the dominant role of the technology in the work process of the direct user is key for categorizing the technology for this model. The proxy for this question addresses the most appropriate categorization of the technology by examining what type of outcomes the technology is used to produce.

Model Proxy 2: Does the technology mediate or perform tasks previously performed by workers (automation); does it provide information to support decision-making by users (decision support); or does it support the sharing of interpersonal communications between individuals and groups within the organization?

Model Question 3: What type of work-roles do users occupy in the organization?

Question 3 seeks to understand whether or not the primary users occupy positions within the organization that are conducive to empowering implementations of technology. Expandability was presented in Chapter 3 as an important dimension of the work role, and it was proposed that workers would interpret the impact of new

technology differently depending, in part, on the expandability of their dominant tasks. The historical proxy for this question relies on the differentiation of expandable and non-expandable jobs based on the performance standards associated with their output.

Model Proxy 3: How were the pre-innovation performance levels of users judged: qualitatively or quantitatively?

Model Question 4: Is the implementation context supportive of technological empowerment?

4a: Do the users have discretion in their use of the technology?
4b: Are users involved in the implementation process?
4c: Are users provided with adequate training on the new technology?
4d: Are users rewarded for accepting the new technology?

Situational variables, especially those associated with technology implementation features, are consistently recognized as having an impact on how technology is perceived, accepted, and adapted by users (Barki & Hartwick, 1994; Cushing, 1990; Hartwick & Barki, 1994; Ives & Olson, 1984). The IT-empowerment model specifically identifies four aspects of innovation context that are proposed as being particularly salient in the relationship between IT use and use empowerment: discretion in use, training, participation, and incentives. According to the model, these four aspects combine additively to reflect the nature of the implementation context for technological innovations.

Discretion in use is operationalized as the combination of two proxies. The first proxy addresses whether or not the workers' use of the technology is predominantly voluntary or mandated by the organization. The second proxy considers the level of user control over customizing features of the technology by manipulating various settings, overriding automated decisions, or adjusting how the machine operates. In combination,

these two descriptions of technology use present a reasonably full measure of the level of discretion users are able to exercise in their use of a technology. Participation in technology implementation is captured via three proxies that address the level of voice, choice, and collective control users were able to enact.

The level of appropriate training is evaluated by posing two proxies. The first looks at the descriptions of training made available to the users and the second asks about whether or not users express difficulties in using the technology. Finally, the last component of the innovation context, rewards, is measured by examining any possible changes in wages or general income level of the occupational or industry-specific user group following the adoption of the technology. The proxies identified for the context-related questions are:

Model Proxy 4a(1): Is use of the technology mandatory?
Model Proxy 4a (2): Are users able to customize their use of the technology?

Model Proxy 4b(1): Did management consult with users before or after initial implementation?
Model Proxy 4b(2): Did users make decisions about the technology before or after initial implementation?
Model Proxy 4b(3): Are users able to block or control implementation through collective action?

Model Proxy 4c(1): How much training have most users received?
Model Proxy 4c(2): Do users express difficulties using the technology?

Model Proxy 4d(1): Is there an increase in wage level for users following implementation of the technology?

The resolution of these proxies provide the data for evaluating the model research questions and synthesizing a prediction concerning the hypothesized outcome of the innovation event under investigation. Once the appropriate hypothesis has been

identified for testing, its predicted impact on user empowerment is evaluated via a second set of questions derived from the theoretical construction of the dependent variable in the model, empowerment. These questions specifically address the five "organizational ingredients" of employee empowerment, task meaning, competence, information access, self-determination, and impact. For the first four historical investigations, these five "outcome" questions are operationalized as historical proxies. The outcome proxies are all diachronic, in that they focus on change in a particular set of phenomena spanning the introduction of the technological innovation. (The final investigation, addressing the modern adoption of a workplace information technology, addresses the outcome questions directly and is described in the next section.) The outcome questions and their associated proxies are:

> Outcome Question 5: After the introduction of the technology, do users perceive their tasks or work goals to be more or less meaningful?

Meaning has been defined in an earlier section as the individual's determination of the intrinsic value or importance of their work tasks or role. In order to capture this construct, a single proxy queries the status of the users' occupational group before and after the technological innovation. Occupational status is defined as the level of respect or social standing attributed to individuals based on their membership in an occupational class. Status related to occupation can be viewed as a function of: 1) the perceived social importance of the tasks performed by members of the occupation; 2) the degree of power or control over others exercised by the occupation members; 3) danger or risks associated with performance of occupation tasks, 4) difficulty and required training or skills required by the occupation, and 5) relative level of financial rewards earned by members of the

occupation (Blauner, 1964). Regardless of the antecedents of occupational status, it is suggested here that the attribution of social standing to a particular occupation and, by extension to its members, is closely associated with perceptions of task and goal meaningfulness by the occupation's members. Professionalism, occupational community, and occupational pride are all related constructs that may also be considered in consideration of this research question. This leads us to one proxy for the first dimension of empowerment:

Outcome Proxy 5: Is there a change in occupational status for users following adoption of the innovation?

Outcome Question 6: After introduction of the technology, does the overall level of user competence to perform tasks or accomplish work goals change?

Competence, as it relates to a question of empowerment, is strongly linked to a dual perception of skill. In one sense, skill can be interpreted as the complexity and diversity of skills required for the successful accomplishment of work-related tasks and, in another, as the level of task-related competence possessed by the individual worker. This research question, then, addresses both how proficient the user is in doing his or her job and how difficult this proficiency is to obtain. Because this question encompasses two aspects of competence, it is evaluated via two proxies:

Outcome Proxy 6a: Is there a change in occupational training requirements following adoption of the technology?
Outcome Proxy 6b: Are users better able to meet their performance goals using the technology?

Model Question 7: After introduction of the technology, is there a change in the overall level of user access to information about individual, unit, or organizational performance?

The importance of information access has been documented in the organizational literature with respect to improving feedback to individuals concerning their own work performance, facilitating communication and cohesion between coworkers, and supporting understanding about organizational events and performance. In order to embrace these multiple dimensions of organizational communication needs, three proxies target observable signs of technology-related changes in information access. They are:

Outcome Proxy 7a: Do users receive more direct performance feedback following introduction of the technology?
Outcome Proxy 7b: Are users able to converse with coworkers more freely?
Outcome Proxy 7c: Is there more active communication between users and other departments?

Model Question 8: After introduction of the technology, does the overall level of user autonomy over job tasks and processes change?

Self-determination is operationalized in this study as: 1) the amount of control users exercise concerning how they spend their time on the job and 2) the nature of the supervisory relationship that exists between the users and immediate supervisors. Control over work pace describes the amount of freedom individuals can assert about when they work and how they distribute their effort during their work periods. Supervisory relationships encompasses issues such as the directness of supervision, processes by which work rules are developed and enforced, and the general level of cooperation or tension that exists between workers and their supervisors. The proxies for this question are:

Outcome Proxy 8a: Does user control over work pace change following technology introduction?
Outcome Proxy 8b: Does the relationship between users and supervisors change?

Outcome Question 9: After introduction of the technology, does the overall level of user influence over outcomes at the unit or organizational level change?

User influence in the organization is a fairly abstract construct that is difficult to measure directly from historical documentation. Two proxies attempt to capture influence, first as reflected in the relative size of the user workforce and second as reflected in the level of user unionization and union strength in negotiating with employers. The first proxy asks about changes in functional diversification, or the ratio of user occupational members employed by the organization or in the specific industry compared to other occupational groups. The relevance of relative user group size and group impact is suggested by DuBick (1978) and others who have posited that changes in the distribution of personnel across subunits represents the importance of that subunit to the organization. The second proxy specifically targets the role of unions in exerting influence over organizational activities and outcomes. This proxy is particularly relevant in this study because our historical setting is industrial and has a particularly rich history of union activity. Our last outcome-related proxies are:

Outcome Proxy 9a: Is there a change in functional diversification following technology adoption?
Outcome Proxy 9b: Is there a change in occupational unionization or union effectiveness?

Outcome Proxies 5 through 9 will be synthesized into a narrative description of the observed empowerment outcomes associated with use of the historically documented technology. The observed outcome is then contrasted with the predicted outcome in each investigation. With each iteration of this process, investigation by investigation, we move closer to understanding and evaluating the effectiveness and usefulness of the model. Congruence between predictions and observations build our confidence in using

the model to understand the empowering influence of information technology use and to mitigate potentially undesirable outcomes. Inconsistencies between outcomes and predictions guide our attention toward correcting and improving either our analytical methods or the model.

Analysis of Contemporary Data

To demonstrate the applicability of the historical event analysis methodology to a contemporary data collection, Investigation 5 employs this methodology to analyze and interpret the impact of computerized information system use on employee empowerment in a modern organizational setting. The historical method employed in this contemporary investigation is guided by the historical method framework utilized in the previous four investigations and graphically described in Figure 5.

Setting and data collection. A study setting was identified that represents the recent implementation of a radical example of information technology, namely a set of sales force automation software tools (SFA) into the sales unit of a large telecommunications service provider. This study consists of the collection, analysis, and interpretation of both narrative and quantitative data. Narrative information was collected via multiple telephone interviews with two managers, who were primarily responsible for the introduction of the technology, and with a training manager, who had been closely involved with both the introduction program and the appropriation of the technology by the users. These interviews, guided by the factor proxies identified in Table 3, resulted in rich descriptions of the technology functionality, the users' principle work roles, and the implementation context of the technology rollout. The researcher's written summary of

the informants' verbal descriptions and interpretation of how this information resolved the relevant factor proxies was critiqued and confirmed by the manager most directly involved in the technology introduction.

To support and extend the narrative data, an electronic questionnaire was administered to a sample of the technology users. A survey-based data collection was instituted to support and refine the narrative data used to resolve the factor proxies, and also to quantify observed outcomes and to develop some empirical tests of the accuracy of the model predictions. The questionnaires, which contain both researcher-designed items and questions constructed by the IT managers, consist of a Microsoft Word document attached to e-mail messages distributed by the company's IT unit. Subjects were instructed to type their responses in the document and attach it to reply e-mail addressed to the researchers at the University of Oklahoma. This approach was designed to maintain confidentiality and ensure candor in the subjects' responses. The questionnaire contains seven researcher-designed items pertinent to this study. The first five items represent statements describing potential impacts of the new technology on outcome-related research questions (see Table 3). Each of the items addresses one of the dimensions of empowerment. The five questionnaire items are listed below followed by the variable name that the item is intended to measure.

1. The software tools on my SFA laptop make my work seem more interesting and important to me. (MEANING)
2. The software tools on my SFA laptop meet my needs and company expectations. (COMP)

3. The software tools on my SFA laptop have helped me gain better information about the performance of my company, my department, and/or myself. (INFO)
4. The software tools on my SFA laptop allow me more freedom to do my job the way I think it should be done. (SELF)
5. The software tools on my SFA laptop help me influence decisions and events in my department and in other parts of the company. (IMPACT)

Subjects responded to each item via a five-point Likert scale describing how the subject agreed or disagreed with each statement (1=strongly agree, 2=slightly agree, 3=no preference, 4=slightly disagree, 5=strongly disagree). Another variable was created, EMPO, and coded as the row mean of the five empowerment-related variables for each subject (MEAN, COMP, INFO, SELF, and IMPACT).

Two other items are of importance here. The first attempts to determine the users' perceptions of the dominant functionality of the SFA system. This was considered important because the system is comprised of multiple applications, all of which are subject to adaptation and selective exploitation by the users. This item asks users to identify the dominant functionality of the system by ranking the appropriateness of three descriptions of SFA system functionality, each of which represent one of the three classes of IT functionality included in the IT-empowerment model. The variable FUNCTION was then coded for each subject to represent the function that was identified as most important (received a ranking of "1") by the subject. System functionality was described as follows:

1. Automates tasks that I used to do by hand.
2. Provides me with timely information about products, orders, or customers that helps me make sales or service customers.
3. Lets me communicate and share information with others.

The last research-related item on the questionnaire asks the subject to estimate the number of hours per normal workweek that they spend personally using the SFA system. The variable TIME is coded as the number of hours reported by the subject.

The questionnaires were distributed to all users of the new technology in the form of Microsoft Word documents attached to e-mail messages. The subjects were instructed to type their numerical responses to the items in specific table cells and return the completed form, as an attachment to an e-mail message, directly to an e-mail address at the University of Oklahoma. Overall, approximately 1,200 surveys were distributed, and ultimately, only 24 usable surveys were returned to the University of Oklahoma for analysis. It is possible that the e-mail delivery of the surveys was not successful or that the e-mail users were not adequately familiar with the company's e-mail system to return the surveys effectively. A relatively large number of the surveys, 11, were returned without responses, presumably because many users did not understand how to use their e-mail applications to attach the completed surveys to return e-mail messages. Two surveys were returned with some missing data. This represents a usable response rate of 2%, which would be considered unacceptably for most research purposes. It is important to remember that the focus of this empirical exercise is on exploring a methodological

approach more so than hypothesis testing or making inferences to a larger population. Possible limitations of this e-mail collection method will be considered in Chapter 6.

Data analysis. Survey results were retrieved from e-mail messages by this researcher and analyzed using SPSS for Windows (Version 8.). Descriptive statistics, including means, minimums, maximums, and standard deviations, were calculated for all of the empowerment-related variables, plus TIME. Frequencies were calculated for the variable FUNCTION and a simple one-sample t-test was conducted on the cumulative empowerment variable (EMPO) to determine whether or not findings from this sample could be generalized to the larger population of SFA system (these results are presented in Tables 4-6 in Chapter 5).

In the next chapter, the results of the five events, four historical and one contemporary, are presented. A few important considerations in reading and interpreting the historically-derived results are first introduced, followed by a brief sketch of the historical foundations of modern printing and publishing technologies. The four historical event investigations follow, beginning with the introduction of mechanized linecasting and ending with direct-input computerized composing systems. The fifth investigation, concerning the introduction of a sales force automation tool, concludes the chapter. Chapter 6 presents the final discussion of the research results, highlights contributions of this study to the existing literature, and suggests directions for future work.

CHAPTER FIVE

HISTORICAL EVENT ANALYSES

In this chapter, the historical event methodology, described in detail in Chapter 4, will be employed to specifically address the IT-empowerment model. Four investigations of relevant technological innovations will be presented. The first investigation focuses empowerment-related impacts of mechanized linecasting equipment on users in the printing industry around the turn of the last century. The second examines the impacts related to the introduction of teletypesetting equipment in newspaper production departments during the middle part of the 1900s. The third and fourth investigations consider the actual integration of computer technology into printing activities. Computer-assisted phototypesetting technology, which was adopted during the 1960s and 1970s throughout the printing industry, and its potential effects on worker empowerment is investigated and, lastly, direct-input computerized composition, introduced in the newspaper industry during the 1970s, is presented. Finally, the fifth investigation addresses the recent introduction of sales force automation technology in a large telecommunications firm.

Each investigation focuses on a unique set of circumstances and phenomena that surround a specific historical or contemporary event. These phenomena represent different technologies, institutions, innovation settings, contextual situations, and even different sets of relevant stakeholders. As a result, the resources called upon to resolve our research questions in each investigation vary greatly in terms of source, comprehensiveness, and character. Regardless of these inherent differences, the

historical event methodology will be used to provide structure to both the analysis and presentation of each investigation. Each proxy will be explored and evaluated to the fullest extent possible, constrained only by the availability of data resources.

In each investigation, a brief introduction to the specific technological innovation and the circumstances surrounding its development and introduction into the workplace will be provided. Next, the historical record or other contemporary data sources are mined to answer the first four sets of model-derived proxy questions. These results are used to identify the condition of independent model variables, and an empowerment outcome is hypothesized based on the IT-empowerment model prediction. Lastly, the model is tested by resolving whether or not the predicted outcome, in fact, is observed in the aftermath of the technological innovation under investigation. To accomplish this task, the data sources relevant to post-innovation conditions are examined in light of the last five sets of historical proxy questions. If the answers to these proxies are determined to be congruent with the predicted empowerment outcomes, the IT-empowerment model will be supported.

HISTORICAL CONTEXT: PRINTING BEFORE MERGENTHALER

The dawn of the era of modern printing is heralded by the introduction of moveable type in Europe by Johann Gensfleisch zum Gutenberg of Mainz, Germany in 1454 AD (Cockburn, 1983). Moveable type, persay, was not Gutenberg's original invention. In fact, printers in China and Korea had known and used moveable type, mainly for producing artwork, since the 11th century (Conover, 1990; Cockburn, 1983). Gutenberg's true contribution was the development and popularization of an integrated

system of printing technology that ushered in the modern age of mass-production printing. Gutenberg, who was a metalsmith by training and an entrepreneur by inclination, was responsible for the development of improved metal alloys and techniques for punch-cutting molds and casting type, improved ink formulation and manufacturing, new methods for aligning the individual types and combining individual lines into full-sized printing plates, modifications to standard platen printing presses, and even better ways of processing and using paper in the presses (Wheeler & Wheeler, 1990; Conover, 1990). Gutenberg's improved printing technologies were widely and relatively quickly adopted throughout the western world. By the end of the 15th century, over one thousand printing shops have been identified operating across 17 European countries. During this period, these shops produced an estimated 10 million copies of 40,000 different documents or literary works (Fleishman, 1997).

Moveable type consists of raised characters formed at the head of small metal shafts (each piece of type is called a sort). Gutenberg's first foundry type (called foundry type because each piece of type was produced individually of iron alloy in a metal shop) was designed to be legible for readers familiar with ornate, calligraphy-style handwriting. The letters were cast to resemble handwritten script, with numerous forms for each letter to ensure flowing connections between lower case letters. As a result, Gutenberg's first set of type contained over 300 uniquely styled characters (Wheeler & Wheeler, 1990). In the years following Gutenberg's introduction, type designers created hundreds of fonts, most of which contain 150 or so different characters (Wheeler & Wheeler, 1990).

The technology represented in the setting of moveable type into raised plates suitable for use in printing presses remained remarkably unchanged for the next 300

years. The composition technique perfected by Gutenberg, and improved upon only incrementally by future generations of printers, began with the repeated selection and removal of individual sorts from a storage case. The type case was a shallow, elevated drawer designed with many small compartments, each of which held multiple sorts for a specific character, symbol, or numeral. A case would generally hold all type in a certain style, called a font, including lower and upper case characters of both regular and italic style, as well as punctuation marks, diacritical marks, and blanks for creating spacing between words or letters. (Interestingly, the term "upper case" refers to the tradition of storing capital letters in the upper portion of the case above the non-capital letter sorts). As the characters were removed from the case by hand, one sort at a time, they were arranged, upside-down and backward, in a small hand-held frame, called a composing stick. The composing stick was especially designed to hold up to 12 lines of type in even alignment. Whole articles or pages were assembled from subsets of lines and bound together in metal frames called chases. Galley proofs, or quickly inked impressions on paper, would usually be pulled to allow proofreading and correcting of the set type. After correction, the frames containing individual articles or pages would be made up, or imposed, into larger frames which were installed directly on the press as printing plates or used to create molds for the final plates (Dodd, 1843; Wheeler & Wheeler, 1990; Zimbalist, 1979).

In British colonial America, as in Britain proper, early growth in printing was constrained by inhibitory acts, laws passed initially in 1586, which restricted the operation of printing presses to London, York, and the British universities (Cockburn, 1983). The earliest printed material from the English colonies appears in 1638 produced

in Cambridge, Massachusetts, the first city given specific dispensation by the Massachusetts General Court to house printing presses (Lause, 1991). By 1693, when the acts were officially rescinded, presses were operating, and had for some years despite the legal restriction, in several cities along the eastern coast in North America (Wroth, 1931).

Despite its logistical disadvantages, colonial America experienced a more vigorous diffusion of printing operations than did much of provincial England. By 1700, Boston had a book trade surpassed in the English-speaking world only by London. During the colonial period, more than 100 master printers are known to have operated printing establishments, at one time or the other, in 25 different cities in the colonies. In 1762 alone, 40 printing businesses have been identified in operation across the colonies (Wroth, 1931). By 1810, the number of operating printshops in the U.S. had grown to 400 (Baker, 1957).

Even after the repeal of the inhibitory acts, printers in colonial America were strictly regulated, in terms of geographic sites of operation and content of output, by colonial governments. Typical print shops throughout the 17th and 18th centuries were manned by the master printer-owner who had learned his trade through a lengthy apprenticeship either in Britain or in the colonies. The master printer's principle source of assistance was his wife or older children who helped in setting type, making up printing plates, proofreading copy, and operating the presses. If additional help was required, the printer may take on a young apprentice whom he would agree to train in the printing craft in exchange for up to seven years of indentured labor. During the colonial period, hired journeyman printers were more often than not temporary or transient employees as shops were small and were unable to support full-time or permanent staffs.

Many printers moved from place to place throughout the colonies, working wherever printing work was plentiful and employment was available (Lause, 1991).

For hired printers with entrepreneurial aspirations, the opportunities to become masters of their own shops were relatively good. Of a group of 26 printers who were identified in accounts of an early strike against their employers in 1786, 16 are known to have later become owners of their own print shops (Rosemont, 1981). Demand for printed material was growing in the principle colonial cities and, perhaps more importantly, settlements were growing in previously rural areas which created a demand for print work in geographically dispersed areas (Lause, 1991).

While the business of the earliest printers relied on the printing of government documents, religious tracts, business forms, and occasional secular works of literature and commentary, the publication of newspapers became an increasingly common second line of operation for printers before and immediately after the American revolution (Berger, 1990). Initially, printing small, local newspapers gave print shop proprietors the opportunity to demonstrate their printing skills and to take advantage of their excess printing capacity (Lause, 1991). The colonies' first newspaper, *Publick Occurrences*, which was printed in Boston in 1690, lasted only one issue before it was suppressed by the colonial government (Lause, 1991). However, a more enduring publication, Boston's *News-Letter*, began printing in 1704 and continued until the American revolution (Berger, 1990). In Philadelphia, the *American Mercury* appeared in 1719, and the *Universal Instructor* and *Pennsylvania Gazette* both began printing in 1728. As today, newspapers of the 18th and 19th centuries served commercial, journalistic, and political

functions. A year after its debut, the *Pennsylvania Gazette* was purchased by Benjamin Franklin and built into a major political organ (Lause, 1991).

Independent newspapers soon followed in the rest of the colonies. By the end of the 1700s, newspaper publishing had penetrated all of the states and most of the territories (Lause, 1991). The potential newspaper-reading and purchasing public increased many times over during the first two decades of the 19th century. Between the years of the American revolution and 1820, the major U.S. cities of Philadelphia, New York Boston, and Baltimore increased in population by over five fold (Lause, 1991). Increased demand also was associated with improved public education and literacy rates. Feeding the public's hunger for news was facilitated by a developing transportation infrastructure which made gathering information and marketing printed output across wider distances more practicable (Lause, 1991).

As the 19th century opened, the basic technology required for the printing of commercial jobs, books, newspapers and other publications was reasonably stable and well matched for small-lot work in local markets. Increasing demand for printed material and first weekly and then daily newspapers, especially in urban locales, however, put pressure on printing houses to expand in order to meet expanding needs. Initially, the demand was met with expansion in the number of printing presses installed and the number of printers hired to set type, operate the machinery, and process the printed material. In contrast to earlier colonial shops that were typically one- or two- or three-press operations (Wroth, 1931), shops with five or more presses in continuous operation became more common (Lause, 1991). A print shop doing business in Boston in 1800 is described as having five printing presses, operated by 10 pressmen, with more printers

setting type and handling the post-press work. Some urban shops operating immediately after the turn of the 19th century kept nine or 10 presses continuously busy (Wroth, 1931).

As the size of print shops increased, printing occupations became more specialized and differentiated from one another. Plate engraving, bookbinding, pressmaking, type founding, and ink making quickly became specialized crafts in the later years of the 1700s, and such services were provided outside of the typical print shop (Lause, 1991). The post-Revolution years, which witnessed the growth in size and specialization of printing businesses, also saw increased separation of printing trades into composition and presswork in the larger printing establishments, as owners attempted to make the most efficient use of their human and physical capital.

The end of the 1700s also saw the increased differentiation of printers as either proprietors of printing establishments and potential employers of printing craftsmen or as journeymen printers working in the employ of others who may or may not be experienced printers themselves (Lause, 1991). This separation of printers from ownership was accelerated by the War of 1812 and the ensuing economic Panic of 1819, which dispossessed many shop owners (Lause, 1991). Innovations in printing press technology further enhanced the economies of scale available to large print producers by making it possible to dramatically increase the speed and volume of printed output and simultaneously increasing the threshold of capital investment required to compete in larger urban markets. The first steam-driven rotary press was installed and used at the *New York Daily Advertiser* in 1825 and could produce output at a rate of 2,000 sheets per hour. This represented an 1100% increase in output over the common, manually operated Stanhope press. By 1847, impression rates had increased to 8,000 per hour, and

soon afterward, the addition of multiple print cylinders on rotary presses had driven an increase in speed to 20,000 impressions per hour (Compaine, 1980). Because of their speed, the new presses could replace multiple older, slower presses and permit later printing deadlines without the expense of composing duplicate plates for two or more presses (Howe, 1943).

Wroth (1931) estimates that the establishment of even a modest, small town print shop was a formidable undertaking for most printers by the second half of the 19th century. The cost of manual printing equipment could total several hundred dollars, and combined with other necessary front-end and operating expenses, the total capital investment required for a small concern could equal an employed printer's salary for an entire year (Wroth, 1931). Establishing a competitive shop in an urban market had become beyond the aspiration for most individuals, with steam-powered presses costing upwards of $20,000 to $25,000 each (Compaine, 1980). While logistics continued to favor a focus on local markets with little inter-regional competition, economic pressures supported the continued growth and domination of larger firms, especially in urban areas. As the financial hurdle increased, more printers experienced their crafts as employees rather than owners, and owners became farther removed from the exercise of the printing work itself. By the last half of the 1800s, consolidation of ownership across local markets had begun. Newspaper chains, first introduced by Randolph Hearst, the Scripps brothers, and Frank Munsey in the late 1870s and 1880s, leveraged financial resources required for the procurement of modern printing press equipment, as well as functional and managerial expertise (Salcetti, 1995).

Printers had a long tradition of organized action and association. Printers were the first group of workers to develop economic self-defense organizations and trade unions in almost every country of the western world (Lipset, et al., 1956). As early as 1587 in Britain, printing establishment owners were forced to agree to printers' demands to regulate the number of impressions that could be made from one frame of set type (Howe, 1947). The propensity of printers in Western Europe to organize was recognized by the King of France who, in the 16th century, forbade printers "to have banquets as a group...to assemble together...to form an occupational religious association" (Cavaignac, 1932: 9-10, cited in Lipset, et al., 1956).

The earliest record of an organized printers' strike in the new world occurred in New York City in 1776, and New York City printers also formed the first formal printers' trade union in 1795 (Lipset, et al., 1956). The first half of the 19th century saw numerous efforts to organize printers at the local level, first to provide benevolent support to members and later to seek improvements in wages, working conditions, and job control for journeymen printers (Barnett, 1909). While many of these efforts at organization were short-lived, others were more lasting. The Columbia Typographical Union, for example, formed in 1815 to represent printers in the Washington, D.C., area, later became Local 101 of the International Typographical Union, and today is the oldest trade union organization in the western hemisphere (Lause, 1991).

A national union of printers and associated printing crafts, the National Typographical Union, was created in 1852. Renamed the International Typographical Union in 1869 after the organization of Canadian chapters, this body was formed to achieve a number of goals that were deemed important to employed printers during the middle of the 1800s:

1) To build up a feeling of cooperation and brotherhood among local unions and printers so that employers could not easily hire replacement workers during local strikes;

2) To provide mutual benefits and support to locals and members during strikes, job loss, illness, and infirmity;

3) To provide a means of identifying qualified member printers so they could seek employment in jurisdictions controlled by different locals (Barnett, 1909).

During the early years of its existence, the ITU exercised little power relative to the local chapters; however, as employers grew in size and organization, the national union was delegated greater power. By the 1880s, the ITU was assuming a major role in negotiating with national associations of employers, bargaining with local employers on behalf of the local memberships, supporting local strikes, enforcing consistency in work rules between employers, organizing new locals, and recruiting members (Porter, 1954; Barnett, 1909). During its first 50 years of existence, the ITU included in its jurisdiction a broad spectrum of printing trades, including--in addition to compositors--press operators, stereotypers and electro-engravers, bookbinders, mailers, type-founders, and newspaper reporters (Barnett, 1909). At the time of its merger with the Communication Workers of America in 1986, the ITU was 134 years old and the oldest national trade union in the United States (Holtzberg-Call, 1992).

Even after the introduction of high-speed, printing presses, composition, including hand typesetting, proofreading, and plate make-up, required a high level of manual skill,

experience, and training (Cockburn, 1983). Most distressing for printing proprietors and publishers, compositors required significant lead time to set straight type, and even more time was required for tabular, numerical, or display and advertising copy. On average, a journeyman compositor could set, proof, and distribute 700 ems of type (an "em" being roughly equivalent to a standard-sized type sort) an hour by hand at a normal work pace (Rumble, 1990). The new high-speed presses quickly outstripped the hand compositor's ability to produce plates to be used in the printing of high volume and time-sensitive output, particularly newspapers, periodicals, and books. Legions of compositors were required to feed the presses, which were growing larger and faster with each round of printing press improvements (Zimbalist, 1979).

Early attempts to redress the bottleneck of hand composition met with only limited success. The Young-Delcambre typesetting machine allowed key-controlled release of individual type sorts, which were then hand justified and, later, distributed back into the machine's loading chutes. It was the object of intermittent attention and experimentation at several London newspapers. The machine was first installed at the London *Family Herald* newspaper in 1841 (Cockburn, 1983). A letter to the editor of *The Compositors' Chronicle*, the first trade paper of employed printers to be published in England, alluded to the bottleneck in the composing room when it described an editor's eagerness "to get a peep at the wondrous invention by which he might cleanse his Augean stable of the toe nibblers [compositors]." The same letter goes on to report that the newspaper editor "was sadly disappointed when he found that the invention had not yet reached such a state of perfection as to render it product to discharge all his compositors *instantum*" (quoted in Howe, 1943: 88). Several stories and letters in the same journal

the following year reported that trials of automated composing machines were abandoned because "the machine entailed one-third (we might say two-thirds) more expense than hand-labour...and the result has shown the total inapplicability of machinery in the economical composition of types" (quoted in Howe, 1943: 89).

INVESTIGATION I: MECHANIZED LINECASTING

The Innovation

By 1880, several companies in the United States and Europe were experimenting with various modes of semi-automated typesetting, most of which ultimately proved unsatisfactory. Samuel Clemens reportedly invested and lost $190,000 in a typesetting machine called the Paine Compositor. According to the famous author, who had spent time as a printer earlier in his career, the machine could "do everything but drink, swear, and go out on strike" (quoted in Kelber & Schlesinger, 1967: 3). Ottmar Mergenthaler was the first developer who successfully pulled together his machining expertise, his own original ideas, and complementary contributions of other inventors to create a machine that successfully automated the labor-intensive work of hand composition. After several less-than-successful prototypes, Mergenthaler delivered his fully refined, production model linotype machine in 1890, which entered worldwide distribution in 1894 (Johnson & Moore, 1966). The model produced by the Mergenthaler Linotype Company in that year met with almost universal acceptance, particularly among large printing establishments, publishing houses, and urban newspapers where volume or speed were critical and capital was accessible (Baker, 1933; Bullen, 1924). By 1900, 4,000 linotype

machines were in use in the U.S. (Zimbalist, 1979), and by 1968, it was estimated that over 74,000 of the machines had been sold worldwide (Cockburn, 1983).

The linotype machine allowed an operator to control all typesetting and casting operations from a specialized keyboard. A keystroke identified a desired letter or character for which a reusable mold was released to slide down a vertical chute into an alignment area. Each character's mold, called a mat or matrix, was spaced with the placement of key-controlled wedges between the mats. When properly arranged and spaced to fill the desired line length, the row of mats was flooded with molten lead to create a slug equivalent to an entire line of individual foundry type sorts. The mats were separated from the slug and returned automatically to their proper loading chutes, and the slug, or "line of type", was delivered to the operator to be assembled and bound into a metal chase. Distribution of used type was eliminated. After use, the frames of linotype slugs were dismantled, and the slugs were returned to the "hell box", a heated container of molten lead that was part of the linotype apparatus (Bullen, 1924; Holtzberg-Call, 1992; Wheeler & Wheeler, 1990; Zimbalist, 1979).

It is the involvement of molten lead in the linecasting process that linked the term "hot-metal" typesetting to mechanized linecasting. The hot metal also represented the most immediate risk to the printers operating the machines. The hell-box, which melted lead ingots and recycled slugs to a temperature of 550 degrees Fahrenheit, had the potential to release "squirts" of molten lead from poorly aligned linotype molds causing burns, blindness, and incapacitation for printers. Less immediate health hazards continued to plague the composing rooms after the transition to mechanized linecasting, mostly involving respiratory contamination. Poor ventilation and sanitation, combined

with fumes from molten lead, decomposing ink, and dust from trimming metal type, made pulmonary tuberculosis an affliction common to printers. An elevated frequency of cancer was also a long-term specter for printers during the early part of the 20th century because of the common use of carcinogenic solvent, benzene, to clean foundry type and linecast slugs (Holtzberg-Call, 1992; Loft, 1944).

The linotype represented a radical innovation in terms of increasing the capacity and productivity of typesetting operations, particularly for newspaper printing operations. The linotype dramatically modified the front-end of the typesetting process by replacing the hand work associated with selecting individual type sorts from cases and arranging these sorts into lines of text or display copy. The final task associated with hand composition, cleaning and redistributing "dead" type back into case compartments, was made unnecessary by the remelting process. Keystrokes replaced larger scale physical manipulations to sharply increase the speed of composition work. Urban newspapers able to compose news stories faster than their competitors could collect and print more late-breaking news, produce multiple editions, and claim a larger share of the circulation and advertising market. "Putting the paper to bed" later and hitting the streets earlier with the newspaper created a strong competitive advantage for publishers in large urban and metropolitan areas.

How the introduction of this technology may have affected the empowerment level of the workers who adopted it as part of their jobs is addressed next. Proxies for each of the first four model-derived research questions, measuring the level of technology use and the factors that are proposed as influencing the relationship between technology use and empowerment, are evaluated first, followed by the similar consideration of the proxies measuring the five

constituent dimensions of user empowerment. The questions and their proxies are described in Chapter 4.

Model Proxies

Model Proxy 1a: What occupational group interacts directly with the new technology?
Model Proxy 1b: Is the technology widely adopted in the industry (occupational saturation)?
Model Proxy 1c: Do workers use the technology to complete most of their work tasks?

Prior to the linotype introduction, task specialization in the printing trades had already become quite common, especially in medium- to large-sized newspapers. Printers had generally developed specific expertise as compositors, stereotypers and engravers, or press operators. When linotype machines were brought into newspapers and print shops at the end of the last century, their operation fell to the compositors who had previously worked setting type by hand. This assignment of responsibility to the compositors was partially in response to the contractual obligations employers had with locals of the ITU, but also as a way of retaining the experience and skill of the journeyman compositors. It was recognized that the new technology, while requiring a somewhat different set of physical and manipulation skills, continued to rely upon a very similar body of general typographic knowledge and judgement used in hand composition work (Lipset, et al., 1956).

The linotype represented a revolutionary change in the technology of the printing industry in that it was almost universally adopted within 10 years of its original introduction (Baker, 1933). Job saturation of the technology varied, somewhat based on the size of the printing establishment. Small firms in small markets were less able to capitalize on the increased productivity associated with the linecasting technology and, were therefore less likely to invest in machinery for typesetting. In those shops that did install linecasters but that

employed only a few printers, compositors' tasks remained largely unspecialized. In these shops, printers completed a variety of printing tasks including hand typesetting, linotype operation, page make-up, proof-press operation, proofreading, and even making plates and running the final printing press in very small and isolated situations (Zimbalist, 1979). As a result of the printers' more diversified, the switch to mechanized linecasting represented a new approach to doing only one portion of their total jobs, albeit a significant one in terms of time and skill. Job saturation of the technology can be described as moderate for users in small print shops or newspapers.

In larger establishments, however, larger production volumes and the need for technical efficiency led to a higher degree of specialization within the composition function even before the introduction of the linecasting technology (Barnett, 1909). Workers in larger composing rooms tended toward flexible specialization as compositors, proofreaders, or stone hands. Adoption of mechanized linecasting equipment did increase task specialization to some extent because the machines were most efficient at setting straight copy in standardized fonts (Lown, 1977). Handwork was reserved for headlines and display copy that required either setting of particularly large fonts or shifting between several fonts in the same piece of work. This work was generally performed by a few compositors with special design skills or expertise in working with non-standard material by hand (Woods, 1963).

Because of the labor-intensity of setting type, even following mechanization, the compositors who operated the linecasting machines continued to make up the largest portion of the composing room complement (Lipset, et al., 1956). Their efforts were supported by a smaller number of proofreaders, hand compositors or headline machine operators, and stone hands. For linotype operators in medium-to-large composing rooms, the majority of their work

activities were mediated by direct interaction with the linecasting technology. In addition to keying-in instructions for assembling, spacing, and molding the character mats, operators were also responsible for maintaining, adjusting, and performing minor repairs on their machines. In summary, then, compositors in medium to large-sized establishments, including larger commercial printers, book publishers, and urban newspapers, frequently used the technology on a full-time basis. For these users, linecasting technology had a very high level of job saturation as the majority of the users' job tasks were mediated by the technology.

Model Proxy 2: Does the technology mediate or perform tasks previously performed by workers (automation); does it provide information to support decision-making by users (decision support); or does it support the sharing of interpersonal communications between individuals and groups within the organization?

Clearly, the linotype was an automating technology that mediated a significant portion of the hand compositors' manual tasks. The linotype keyboard mediated the selection of type mats, justification of the lines of arranged mats, and the delivery of the line-length slug. Further tasks were fully automated and, as a result were totally absorbed by the machine itself. The type case was made obsolete as matrices stored in the linotype machine replaced individual foundry type characters. All manual selecting, positioning, and arranging of foundry type was removed from the job. Type was not handled by the compositor until a full line of type was unmolded and delivered as a lead slug by the machine, after which point the mechanized compositor's job resembled his or her unmechanized counterpart. Lines of types were bound together into paragraphs, stories, and finally, pages, much as they were before mechanization. When corrections were required, however, once again the linotype intervened and, instead of disassembling frames to replace or rearrange individual pieces of type, whole lines of type were simply

recast and inserted in to the metal frames. A major composition task that was completely replaced by the technology included the tedious chore of reprocessing used type and redistributing it back into type cases.

Mechanical linecasters, however, did not fully automate the compositors' job, nor did it replace the compositors' contribution to the printing process (Holtzberg-Call, 1992). Aesthetically pleasing justification of text required a good eye for word and line spacing, as well as knowledge of vocabulary and hyphenation rules. While larger papers maintained more-or-less dedicated staffs of writers and copy editors, the ability to edit copy on-the-fly was still considered a valuable skill among compositors, who represented the final line of defense against grammatical errors, spelling mistakes, or other embarrassments appearing in print. The linecasting machinery did not fulfill any analytical functions to help compositors make better decisions. Knowledge of the language and a trained eye for creating legible and attractive arrangements of words, spacing, and design elements remained the most important form of decision support. Justification and layout decisions were made based on visual examination of metal matrices (rather that metal foundry type) or of proof prints. Neither did the casting machines function as communication devices, even though they can easily be classified as information technology in that they did assist in the processing of mass communication messages. They were clearly a part of the operating function, processing inputs into outputs for sale to the public. They were not designed, or implemented, to facilitate the exchange of personal, organizational, or inter-organizational communications.

In summary then, mechanized linecasters can be classified as a form of automating technology which functioned to replace or mediate particular tasks and sub-tasks associated with the unmechanized compositors' work tasks.

Model Proxy 3: How was the pre-innovation performance level of users judged: qualitatively or quantitatively?

While the quality of composed type was important for all typesetters, the vast majority of compositors were valued by their employers relative to the quantity of set-type they produced in a given work period. A certain small segment of compositors were involved in setting type for artistic works or premium-quality books and these workers may have experienced a heightened emphasis on aesthetics and quality of work than speed of output. This segment, however, was far overshadowed by the body of printers who labored in producing printed matter for mass public consumption.

Prior to the introduction of mechanized linecasting machines, most compositors were paid based on piece-rate scales, with unionized newspaper compositors generally enjoying weekly minimum salaries. Union pay scales generally incorporated adjustments for difficult or display work, as well as rates for time spent waiting for work to become available for setting. Compositors who specialized in display typesetting, page make-up, or proofreading were more likely to be paid based on hourly or weekly rates, as were printers in job and book-printing shops (Barnett, 1909). The publication cycle in newspaper printing created intense pressures for speed during the hours immediately proceeding scheduled distribution. Because urban newspapers tended to pay higher piece rates to compositors than did job or book printers, the fastest compositors gravitated toward the more speed-intensive, higher paid jobs at large newspapers (Lipset, et al.,

1956; Barnett, 1909). Book-printing and job shops did not have the same compressed production cycle and job printers, in particular, tended to set more display copy and non-standard work that was difficult to price in a piece-rate system (Barnett, 1909).

Speed composition, first by hand and later via mechanical linecasters, was considered an enviable skill and a source of pride for the individual and his or her coworkers. "Intramural"-like typesetting races were common within individual shops and between different employers within a city. Major competitions were held, often sponsored by major newspapers or professional promoters, which drew competitors from across North America (Rumble, 1990). Employers were supportive of races as a way of challenging and encouraging their staff compositors to increase their speed on the job; a motivation that was not lost on the ITU, which established rules against participation in speed competitions in a 1902 amendment to their general laws (Huss, 1973; Lipset, et al., 1956).

Model Proxy 4a(1): Is use of the technology mandatory?
Model Proxy 4a (2): Are users able to customize their use of the technology?

Linotype operators had a limited amount of discretion over their use of their machines. When newspaper owners made the decision to invest in mechanized linecasting equipment, the composing room rarely converted fully to linecasting; hand composition was retained for headlines and display work. The early linotype machines were only suitable for setting straight copy, and especially in smaller shops, the compositor may have had discretion to set type either by hand or by linotype as the copy demanded. In medium- to large-sized newspapers and shops, however, printing jobs were more specialized, and copy not suited for linecasting was generally passed on by

operators to hand compositors. There is no evidence to suggest that compositors had the power to exercise personal preferences in terms of whether or not to use linecasting equipment in the conduct of their jobs. Due to the equipment's expense and the obvious productivity enhancements it produced, use of linecasters, once installed, was mandated for all copy that could be set in this fashion.

On a micro level, linecasting operators did have some control over how they interacted with the linecasting machines. How linotype operators specifically operated their machines was largely uncontrolled by management, as their work tended to be evaluated in terms of the product they produced. Compositors continued to be trained via an apprenticeship system that relied on the exchange of often very personalized expertise from journeymen to trainee. Operators were responsible for performing maintenance and, to a large extent, repairs to the complex machines. They adjusted their keyboards, chutes, and mechanisms to respond effectively to their particular rhythms of operation. It has been reported that experienced operators developed an intense rapport and familiarity with their machines as a result (Cockburn, 1983; Holtzberg-Call, 1992). This ability to maintain their machines to support the operator's particular style of operation was considered a positive aspect of the compositors' job and efforts to separate the maintenance and repair function into non-composition positions was vigorously decried by the compositors involved.

In summary, then, after the introduction of mechanized linecasting equipment into the composing room, users had little or no discretion over whether or not they used the equipment to perform their tasks. Conversely, operators frequently did have a significant level of discretion over how they operated the machinery and had the power to support

this "customized" usage of the equipment through personal maintenance and adjustment of the machinery.

Model Proxy 4b(1): Did management consult with users before or after initial implementation?
Model Proxy 4b(2): Did users make decisions about the technology before or after initial implementation?
Model Proxy 4b(3): Are users able to block or control implementation through collective action?

There is no evidence to suggest that users enjoyed any significant level of direct participation in the decisions related to the conversion from hand to mechanized typesetting technology in printing operations across North America. The linotype machine itself, especially during the first few decades following its introduction, was produced according to factory specifications, with little opportunity for customization based on specific customer or user requirements. The "closed architecture" of the technology did not lend itself to significant user input into design or configuration issues. While informal communication between owners and printers concerning the expected benefits of investing in linotype machines, the number of machines requires, and the best way to introduce the machines into the specific composing rooms may have occurred, especially in smaller shops where the relationship between employers and employees was closer and more symbiotic, it has not been reported in the historical literature. Frequently described in printers journals, however, is the antipathy and resistance printers felt toward the potential introduction of the machinery.

While there is no evidence of user involvement at the individual level, there is evidence of significant indirect, collective participation through the local compositors' unions, and by extension, the ITU. ITU had resisted earlier attempts at automating

composition, and this opposition was validated by the lack of reliability that any of these machines ultimately demonstrated in the shops where they were installed (Holtzberg-Call, 1992). The recognized superiority of the Mergenthaler linotype, in terms of speed, reliability, and acceptable quality, compelled the union to take a proactive role in negotiating jurisdiction over machine operators, schedules for the machinery's introduction into composing rooms, and processes for operation. The ITU established general laws, which were included in all local contracts without negotiation, concerning the acceptability of new technology, who received retraining and assignment to machine operation, work rules associated with use of the new technology, and the process for assigning work on the new machines (Lipset, et al., 1956; Barnett, 1909). Through their union, then, compositors had some level of collective input into how new technology was introduced into their work environment, if not individual involvement in relevant decision-making.

Model Proxy 4c(1): How much training have most users received?
Model Proxy 4c(2): Do users express difficulties using the technology?

There is little recorded information concerning linotype training for operators in smaller printing shops. In union shops, however, labor agreements required that existing hand compositors be retrained for work on the new linecasting equipment. Training was considered essential since some skills involved in hand assembly of type was considerably different than linotype keyboard operation and maintenance of the machinery. The ITU and local unions were active in developing and providing training programs for their members. Employers who were either unable or uninterested in providing their own training programs to prepare

compositors for the transition to mechanized processes could send their compositors to union programs (Holtzberg-Call, 1992).

Model Proxy 4d: Is there an increase in wage level for users following implementation of the technology?

Yes, working wages of the average compositor increased after introduction of linecasting equipment. Many locals were quick to negotiate time-based pay rates for compositors working on the linotype machines that created higher income levels for most operators. The unions maintained that there should be special compensation for learning the new skill and producing increased output and that time-based pay would prevent employers from pressuring employees for speed, which would work to the detriment of the slower compositors. Employers were supportive of time-based pay, because they were unsure about how to price work produced on the new machines and were interested in increasing the stability of their labor costs (Holtzberg-Call, 1992). Time-based pay quickly became the norm for all union printers, and by 1908, approximately 9/10 of all ITU members were paid on a time-based scale (Barnett, 1909). The anticipated, and achieved, increased productivity associated with use of the new machinery coupled with the huge increase in demand for journalistic and commercial printed products, created a situation in which owners benefited by linking wage increases with adoption of new technology (Baker, 1933; Cockburn, 1983; Holtzberg-Call, 1992).

The ITU locals also negotiated a shorter standard workday for compositors working as linecasting machine operators. As early as 1886, the national union had begun pressuring employers for a shortened work day as a way of not only improving the working conditions for employed compositors, but also to support full employment

among union members. By 1900, most union contracts included nine-hour workdays (Barnett, 1909). In 1901, compositors in job and commercial shops represented by the ITU were one of the first industrial occupations to win the 8-hour-work-day. Their fellow union members in newspaper composing rooms won similar workdays by 1907 (Baker, 1933; Tracy, 1913).

Other compositors, who remained on piece-rate system initially, saw substantial pay increases due to the increased speed of linotype production. Initial uncertainty over what level of productivity improvement should be expected on the job, led some owners to set piece-rate scales that turned out to be very advantageous to the linotype operators as their earnings increased at a faster rate than those for workers in other printing trades (Baker, 1933; Cockburn, 1983). It was even suggested that newspaper compositors were earning higher incomes than were top graduates from prestigious universities (Cockburn, 1983). Whether printers were paid based on hourly, weekly, or piece-rate, converting to mechanized composing was made attractive and financially rewarding to hand compositors. In fact, at some newspapers, it was estimated that the average wage among printers was substantially higher than the average wage among the editorial and writing staff (Williams, 1925).

Model Proxy Summary and Prediction

Looking back on the proxy results, the users of the technology are identified as the linotype operators who for the most part had previously worked as hand compositors. The level of usage varied, predominantly, as a function of size of the printing establishment in which the operators were employed. In smaller shops, where printers had a more diversified

set of tasks, linotype operation constituted only a subset of their overall activities, albeit a substantial portion in terms of importance and time involved. In medium- to large-sized shops, however, job assignments were more specialized and compositors assigned to linotype operation tended to interact directly with the machines virtually on a full-time basis. The bulk of their tasks were mediated or accomplished via control of the linotype machine. The proxies also revealed that the linotype is most appropriately categorized as functioning as an automating technology as it subsumed and mediated tasks previously performed manually by compositors and did not provide any decision support or act as a communication medium for workers. Prior to the introduction of the linecasting technology, compositors occupied work roles that were predominantly non-expandable. Their performance was traditionally evaluated via quantitative measures of productivity and their wages were determined based on a piece rate system. The innovation context was moderately positive. While use of the technology was generally mandated by the employers, operators did have some control over how they interacted with the machines. Direct user participation in decision-making concerning the technology also appears to have been quite limited, or at least unreported, but users did have some indirect participation in implementation decisions via their formal union representatives. Users were encouraged to develop skills in linotype operation, both by their employers and their union, via the opportunity to receive training on the new technology. Operators were also encouraged to embrace the linecasters through generous wage increases and shortened hours.

The IT-empowerment model predicts that increased use of an automating technology by workers in non-expandable work roles would result in a negative change in the level of empowerment experienced by users. The model further suggests, however, that a positive innovation context, consisting of a combination of discretion over use,

participation in decision-making, training, and rewards, should mitigate the otherwise negative impacts of the increased task automation. As a result, increased use of mechanized linecasters by compositors in the commercial and newspaper printing industries is predicted to have either a neutral or slightly negative impact on user empowerment. The level of post-technology empowerment will be evaluated based on a set of proxies targeting the five dimensions of empowerment presented in earlier chapters: meaningfulness, competence, access to information, autonomy, and impact.

Outcome Proxies

Outcome Proxy 5: Is there a change in occupational status for users following adoption of the innovation?

Before introduction of the linotype, compositors enjoyed a high level of occupational status compared to other industrial and craft occupations (Cockburn, 1983). Blauner (1964) attributes their high relative level of occupational status to: 1) the highly skilled nature of the job; 2) the demand for literacy during a period when even those in high social standing did not necessarily read and write, 3) the high degree of control printers exercised in their work, and 4) the occupation's association with literary works and notable personalities. During the early years of moveable type, printers occupied a position of elevated social status. Their non-working class was reflected in their exemption form the "mechnic's" tax and their right to carry swords, a privelege that was prohibited to common laborers (Holtzberg-Call, 1992; Cockburn, 1983. Pride in the quality of the printers' work was exceptionally high and reinforced by their many formal and informal associations. According to a document, published on behalf of journeyman printers in 1793, "Companionships find it in their mutual interest to be watchful over

each other, and see that each does an equal share; which, if not done, is easily remedied among themselves...A journeyman must be attentive, or, from the representations of his companions, he losed his situation" (cited in Howe, 1943: 67). Reflecting a similar concern with workmanship, The New York Typographical Society expelled one of its members in 1817 because of poor workmanship and negligence in correcting his mistakes, "conduct highly derogatory to the New York Typographical Society and disgraceful to himself as a member" (Stewart, 1907: 25). Updike (1924) described the "earliest printers" as educated men who took their work, and themselves, very seriously. Young printers aspired to becoming masters at their trade. An article in the *Inland Printer* described such aspiration. "Every printer will remember the youthful days when his ambition was to set the biggest string on the paper, and hope was high in his breast that he might be considered a 'swift' (Duguid, 1895).

Early compositors considered themselves as occupying higher social status than craftsmen in other occupations. Nineteenth century histories of the labor movement complain of the snobbishness and caste-like behavior of printers. Labor historians have described mid-Victorian period compositors as the "aristocracy of labor" (Cockburn, 1983: 31). Lamartin, a French poet, wrote that "Printing is the most intellectual of the manual trades," and that the goal of printers is "to remain the elite of the working class" (quoted in Lipset, et al., 1956: 27). Printers took pride in their role in bringing important works of literature, scholarship, and public interest to the reading public (Anonymous, 1920). The strong association with literacy and literary pursuit is further reflected by the number of authors, social leaders, and public figures who began their careers as printers. Benjamin Franklin, Horace Greeley, Mark Twain, Walt Whitman, Edgar Allen Poe, Joel

Chandler Harris, Sherwood Anderson, and Erskine Caldwell all spent their early years training for the printing trade (Holtzberg-Call, 1992; Howe, 1943).

The elevated occupational status of compositors was a particular source of aggravation to publishers who frequently viewed it as a threat to their control over the printing process. While they may have viewed a dented self-image among printers as a desirable by-product of the introduction of automating technology, printers continued to enjoy a high level of occupational status after adoption of mechanized linecasting technology. The level of skill required remained quite high and the profitable exploitation of linotype technology required specific skills gained through retraining as well as those skills and knowledge retained by hand compositors (Barnett, 1909). While literacy became somewhat of a less exceptional accomplishment after the turn of the century, with increased access to free public education and increased societal expectations for basic literacy, printers continued to be generally more highly educated, either formally or informally, than other craft workers (Palmer & Wood, 1936). Lipset, et al., describe printers as "the intellectuals of the working class" (1956: 33). A study of British compositors, conducted in 1959 and 1960, found that compositors held the social status more similar to white collar workers than those employed in the skilled trades (Cannon, 1967). Their involvement with current events was still a basis for status, as was their association with literature and works of scholarship. Their experience with collective organization continued to earn them substantial union-based power over their work lives and shorter than normal working days (Lipset, et al., 1956).

Not to be discounted as an important contributor to the continued status associated with work in the composing room is the printers' deeply held perception of their work as

possessing great social importance and requiring high levels of skill (Lipset, et al., 1956; Morse & Weiss, 1955;). Cockburn described compositors as a kind of "priesthood of production" with a strong belief that they knew better than their managers and supervisors how to facilitate or impede the successful production of the newspaper (1983: 53-54). Lipset, et al. described the average printer in the composing room of large newspapers as believing "rightly or wrongly, that his occupation commands considerable respect from others" (1956:). Over 60% of their survey reported that the general prestige of composition, as an occupation, was excellent, and higher than other printing trades. About three-fourths of printers claimed they liked their occupations extremely well. They cited their jobs' creativity, challenge, and educational value, among other attributes, as reasons for preferring printing over other occupations.

The desire to excel in their tasks and pride in producing quality work did not appear to diminish after introduction of mechanized linecasting. Linotype operators continued to report that the desire to set copy faster and cleaner was part of the job that that they found particularly satisfying (Cockburn, 1983). Particularly fast hand compositors were referred to as "swifts" prior to the introduction of linecasters. A machine compositor could earn the honorary title of "smooth operator" by demonstrating the ability to "hang the elevator" or key in characters faster than the linotype could assemble the matrices (Holtzberg-Call, 1992). Their breadth of training and expertise was a recognized source of pride for printers (Rogers & Friedman, 1980). The printers' knowledge about the printing enterprise, whether it involved newspaper, book, or commercial production, and his or her skill in effectively contributing to the final product was a key determinant of the individual's status among their peers.

Outcome Proxy 6a: Was there a change in occupational training requirements?
Outcome Proxy 6b: Were users better able to meet their performance goals using the technology?

Printers traditionally received their training through formal apprenticeship programs which lasted from four to six years (Zimbalist, 1979). Before the introduction of mechanized linecasting, union apprenticeship rules required that journeyman printers be trained in the full complement of composing skills, including hand composition, correction, proofreading, proof-press operation, and page makeup. An 1871 printer's manual claimed that a journeyman printer should be "a good reader, as well as job compositor, and book printer, should have a knowledge of print, of presswork, of ruling tables, binding and kindred branches" (DeVinne, 1871: 415-416). This broad training made printers able to fulfill the full spectrum of tasks associated with the composition process and also reinforced the skilled nature of journeyman printers' jobs, regardless of the level of task specialization that may have been growing in larger newspapers and printing shops (Lipset, et al., 1956; Loft, 1944). To become eligible for employment by the preferred employers, unionized newspapers and commercial printers, apprentices were required to complete the full course of training and earn their qualifications as journeyman printers.

At the time of the introduction of Mergenthaler's linotype machine into composing rooms, the ITU demanded that all new composing equipment be manned by journeyman printers (referred to as the journeyman rule) and that training for machine operation would be added to existing apprenticeship programs, but only in the last 6 months of apprenticeship (Barnett, 1909; Scott, 1987). The decision to add machine operation to a training plan that already included hand composition was an effort to

maintain the comprehensiveness of journeyman skills, which was a source of pride for journeyman printers (Rogers & Friedman, 1980). Restricting machine training to the last six months of apprenticeship was also a strategy to prevent young workers from leaving apprenticeships for non-union jobs after receiving machine operator training only (Barnett, 1909). The length of apprenticeship training was not significantly reduced until the advent of phototypesetting in the middle of the 20th century (Scott, 1987). The relative stability of union vs. non-union operators during the first half of the 20th century suggests that the breadth of skills represented by apprenticeship-trained journeyman printers were important for the effective operation of the linecasting technology (Barnett, 1926).

The performance enhancing effects of the mechanized linecasters was certainly noteworthy. When used for setting standard text, the early linotype could support the production of copy at a rate from three to five times that of hand composition (Compaine, 1980; Lown, 1977). It has been estimated that an average linotype operator could set 5,000 to 10,000 ems of type per hour, equivalent to approximately five newspaper lines per minute or a full column in about a half-hour (Cockburn, 1983; Lown, 1977). While headlines and display work continued to require the special handling of hand compositors, the bulk of newspaper and commercial print work could be set at much higher speeds and without any discernable decline in quality.

Outcome Proxy 7a: Do users receive more direct performance feedback following introduction of the technology?
Outcome Proxy 7b: Are users able to converse with coworkers more freely?
Outcome Proxy 7c: Is there more active communication between users and other departments?

During the days of hand composition, compositors typically were responsible for making corrections in their own work. Proofreaders, or often the typesetters themselves, compared the printed proofs against the original copy sheets, marking errors on the proofs, and leaving it and the frame of set type in a bin for the original typesetter to retrieve and correct. This quality assurance system provided objective evaluation of the quality of each typesetter's work directly to the individual. The piece-rate pay scale, which was most common at that time, provided further feedback to compositors concerning their productivity. Printers were compensated at a set rate per unit of set type, a measure which included correcting their own work and distributing the type back into cases after the framed pages were no longer needed for the presses.

Even after the introduction of the linotype, compositors continued, at least initially, to correct their own work and reap the benefit of this immediate performance feedback (Cockburn, 1983). Time-based pay systems, however, did begin to replace the traditional piece rate plans, and as a result, careful monitoring and feedback of measured productivity to individuals became less routine. The shift to more time-based compensation is the only evidence that suggests a possible technology-linked change in performance feedback to individuals.

There is no direct evidence to show that the new technology was related to changes in the flow of information between members of the composing department. The work pace on newspapers was traditionally such that compositors sometimes worked sporadically, with the intensity of work peaking in the few hours before the press deadline. The slow times during a work shift were filled with setting non-edition copy, such as announcement or simple ads, and consulting or socializing with co-workers. This pace was largely unaffected by the new

technology and the tradition of casual conversation and sharing of information between workers in the composing room continued after the adoption of mechanized typesetting (Lipset, et al., 1956). It can be speculated that the physical attributes of the linecasting machines, such as their size, which would increase the distance between individual workers, and the "clashing and clanging" noise associated with their operation, would present new barriers to open conversation between operators (Conover, 1990: 7). Such physical restraints to communication and socialization have been noted in studies of mechanization in more modern production environments (e.g., Faunce, 1958; Rogers & Friedman, 1989).

Similarly, there is no historical documentation that clearly addresses any change in information flow between departments related to the linotype introduction. There is some suggestion in the literature that, prior to mechanization, hand compositors would, on occasion, consult directly with writers or ad designers, but there is no evidence that this infrequent interaction did not continue (Cockburn, 1983; Howe, 1943). In medium to large newspaper composing rooms, the primary liaisons between the compositors and other functions were the print foreman and the chapel chairman. The primacy of this communication channel remained relatively unchanged for many years after the introduction of mechanized linecasting.

Outcome Proxy 8a: Does user control over work pace change following technology introduction?
Outcome Proxy 8b: Does the relationship between users and supervisors change?

Before the introduction of the linotype, compositors had an exceptionally high level of control over the pace of work in the composing room. While compositors were employed in a production-oriented function, they worked largely independently and were not tied to a process-control production line. Each compositor was responsible for an entire process, including arranging individual pieces of foundry type into an article, ad, or

display, correcting their own work, and in many smaller shops, doing their own editing, proofing, and page make-up. Particularly in the newspaper composing room, the daily deadline cycles made it possible for compositors to arrange their work around frequent breaks and socializing during the day. Printers consulted with one another regularly on the best way to arrange troublesome displays or resolve other work-related dilemmas. Each compositor had the freedom to approach each piece of work according to his own preferences, so long as it resulted in an acceptable and timely product.

A particularly interesting aspect of worker control was the high level of discretion over work schedules guaranteed to individual compositors in union contracts. A comprehensive substitute system ensured that a workforce would be made available to the union employer sufficient to produce any day's required output. A strong historical objective of the ITU, first appearing in the ITU general rules of 1890, was to maintain job property rights for union printers. A regularly employed union printer had complete discretion over whether or not to report to work on any particular day. Should a printer choose to lay-off a day, a practice that was frequently encouraged by the union, a substitute printer would be called-in from a prioritized list of union substitutes (Barnett, 1909; Porter, 1954).

At the time of linotype introduction, many compositors feared that they would lose control over the pace of the work process. The investment in mechanized equipment did create, for employers, an increased pressure for exploiting the full productive capacity of the expensive machines. Compositors, and their union representatives, expressed concerns that the faster production made possible by the linecasting machines would be used as an excuse to speed up the composing room beyond a comfortable, healthy, and

financially advantageous level. Largely due to these concerns, the ITU encouraged the shift to time-based pay schedules in union contracts and pushed for enforcement of shorter workweeks for linotype operators and other printers (Barnett, 1909; Lipset, et al., 1956).

While many compositors claimed that working at the keyboard was more restricting and fatiguing than working at the type cases used in hand composition, they continued to work in a highly autonomous setting, for the most part, maintaining task identity, controlling their personal styles of work, and moving about the composing room as needed and desired to break up their day (Barnett, 1909). Newspaper printers maintained work pace control largely because of the daily journalistic production cycle. Newspaper productivity was not measured in terms of how much type could be set all day or all week, but in terms of how much type could be set in the hour or two before the printing presses must begin to roll to produce the next edition. Capital investments could be justified in this environment based on their peak throughput during relatively short periods of intense use (Rogers & Friedman, 1980). It has been reported that many newspaper compositors relished the sprint toward the deadline and purposely paced their output during their shifts so that they could work during the final hours with intensity as the deadline for sending page frames to the pressroom drew near (Cockburn, 1983; Lipset, et al., 1956). As late as 1947, newspaper compositors surveyed by Fortune magazine reported having considerable freedom in how they paced and completed their work (cited in Blauner, 1964).

While newspaper compositors can be described as sprinters, compositors in commercial print shops were expected to produce work more in the manner of a distance

runner, where consistency and pacing are important. To recoup their investments in fixed equipment, print shop owners attempted to exert more control over the daily work process to ensure that the expensive machinery was operating at optimal capacity at all times. When work was available, print shop owners instituted multiple shifts. The replacement of costly, but highly variable, human capital with less demanding, but largely fixed, physical capital did result in increased employer control over workpace, at least in some commercial print shops (Barnett, 1909).

The effects of mechanized equipment on job property rights also was somewhat variable based on type of establishment. At larger newspapers, the introduction of the linotype brought no major change to the existing system of job property rights or work schedule control (Porter, 1954). In job shops, however, due to the need for investors to obtain full productive use of the linotype equipment, additional control over scheduling was asserted by employers, in union and especially non-union shops. The substitute system came under attack because commercial printshop employers felt they must have more predictability in worker attendance and performance in order to capitalize on their investment in equipment (Barnett, 1909). There are suggestions that workers were compelled to adopt shift work, which was already commonplace in the newspaper composing rooms, as production schedules required night and "lobster" shift work to get late breaking news into morning editions (Barnett, 1909).

There was a unique relationship between compositors in most newspapers and the printing foreman. According to union contract, the foreman must be a member of the compositors' union and was the only management representative who had rights to hire or fire and from whom the compositor could accept direction or discipline (Lipset, et al., 1956). As a

union member, the foreman was subject to union sanctions, generally fines, if they violated union laws at the behest of the employer (Baker, 1951). Union rules specified exactly what constituted grounds for dismissal, could review any firing, and determine the competence of a union member. If the ITU board found that a dismissal based on incompetence was unjustified, the employee was entitled to reinstatement (Barnett, 1909).

In practice, documents suggest that the relationship between the foreman and the composing room workers was reasonably cooperative. The foreman functioned to schedule and distribute work (although workers had considerable control over the choice of specific matter that they would set), decide when extra workers would be needed to complete the day's allotment of work, and coordinate efforts with other departments. The foreman's goal is to handle fluctuating work loads without hiring extra workers or authorizing overtime. Due to union contract rules, using extras or calling for overtime work can trigger contract requirements to increase the compliment of regularly employed printers. To avoid this, the foreman was forced to rely on his employees to be both competent and agreeable to increasing their level of effort when needed. As a result, many successful foremen worked hard to develop friendly and, at times, deferential relationships with their staffs (Woods, 1963). Especially in larger plants, it was recognized that the chapel representative rather than the foreman was the most powerful figure (Lipset, et al., 1956). Compositors tended to have less friendly relations with management representatives from other departments and stories were often retold about how printers could use strict union rules to express their disdain when other managers entered the composing room (Lipset, et al., 1956; Woods, 1963).

In summary, it appears that the average printer experienced only minor, if any, reduction in work-related autonomy as a by-product of increased automation of their work. Printer control over work pace and scheduling remained quite high, especially in unionized and newspaper printing shops. Administrative ratios were quite low in composing rooms both before and after the introduction of mechanized equipment, indicating a relatively high level of individual control over work-related tasks. The relationship between printers and their supervisors, the printing foreman, also appeared to remain remarkably stable across this transition, at least in larger union shops.

Outcome Proxy 9a: Is there a change in functional diversification following technology adoption?

Outcome Proxy 9b: Is there a change in occupational unionization or union effectiveness?

There is little evidence to suggest that there was a significant shift, related to the advent of mechanized linecasting, in the number of compositors relative to other occupational groups employed by newspapers or commercial printers. Historical descriptions of printing operations as well as occupational statistics agree that few printers were actually displaced by the introduction of the linotype (Barnett, 1926). The composing rooms originally crowded with hand compositors continued to be heavily populated by printers after the introduction of linotypes into the process (Conover, 1990). The swelling consumer demand for printed products created an increasing demand for compositors throughout the industry and within individual companies, despite the productivity improvements made possible by the linotype machine (Baker, 1933; Cockburn, 1983). Concurrent improvements in printing presses allowed firms to increase throughput, while at the same time reducing staffing in the pressroom (Baker,

1933). Long after the introduction of hot-type technology, production workers continued to outnumber editorial and administrative staff by as much as two- or three-to-one (Lown, 1977). Composition continued as the most labor-intensive of the skilled functions in the printing process.

Union representation and power was at its zenith during and after the transition to linotype-dominated composition. The ITU represented approximately 300 locals and 30,000 members in 1894 and 45,435 members in 645 locals by 1905 (Barnett, 1909). The union was particularly powerful in urban and metropolitan areas, for example, in Chicago, where the ITU was estimated to have controlled 75% to 80% of the composing room production during the 1920s (Baker, 1933). The success of the union-enforced journeyman rule for linotype operation is demonstrated by the stability of the ratio of unionized to non-unionized printing jobs between the years 1901 and 1904 (Scott, 1987). This rule could not have succeeded if, in fact, the employers had not determined that there was economic benefits to retaining journeyman-trained compositors on their staffs (Scott, 1987). This is further evidence of the importance of operator skill and composition experience for the beneficial operation of mechanized linecasters.

The increase in the power position of the national and local printers unions was related to certain environmental conditions: a strong growth in demand for printed products, including newspapers, periodicals, books, and commercial output; a generally favorable political and social climate for organized labor; and the related increased demand for skilled compositors. Printers were able to take advantage of these beneficial circumstances because of their long tradition of trade unionism and collective action, coupled with their control over the knowledge and skills required to effectively perform the tasks associated with composition.

According to many observers of trade unionism, the ITU was one of the most powerful unions in North America during the first few decades of this century (Blauner, 1964; Kelber & Schlesinger, 1967; Lipset, et al., 1956; Porter, 1954). The union has, in fact, been described as having, at one time, "the most complete control over job conditions of any union in the world." (Perlman & Taft, 1935: 51). Printers' locals, in collaboration with their strong national organization, were able to maintain job property rights, by aggressively resisting all employer attempts to rationalize tasks, hire non-journeyman labor, or introduce technological changes without benefit of union approval. The ITU had a long history of organization, having formed originally in 1857 to improve collaboration and mutual support to the many fragmented, localized printers' unions (Barnett, 1909; Porter, 1954). The national union was highly democratic, with strong national solidarity and cooperative relations with other printing industry unions (Lipset, et al., 1956). Indicative of the strength of the ITU was the work rule that no person not a member of the union—including the printers' employers—could be on the floor of the composing room during working hours. Similar union rules maintained that no one but a union printer can touch live type (a frame of metal type that had not yet be slated for break-up and melt-down). Though not generally enforced, these and other rules that controlled activity in the composing room were known to have been invoked at the printers' discretion during a grievance or as a sign of disapproval of particular individuals or management policies (Lipset, et al., 1954; Woods, 1963).

The compositors' national union was both experienced and effective at orchestrating forceful shows of control over the composing room, including public airing of grievances, work slow downs, zealous work rule enforcement, and long, bitter strikes. The ITU had a reputation of being a militant labor representative in contract negotiations, opposed to

arbitration or conciliation, especially in the early decades of the 20th century (Lipset, et al., 1956). The short shelf-life of newspapers, coupled with the localized nature of distribution and competition, placed newspapers in a particularly vulnerable position for threatened work stoppage. The increased capital intensity of linotype operations may have made the employers even more vulnerable to union power expansion (Lipset, et al., 1956).

Observed Outcomes

The outcome-related proxies have been posed of the historical documents describing the working environment of the pre- and post-linotype composing room and, from the results of these proxies, we can interpret the impact of the adoption of this work-related technology on the level of empowerment experienced by the linotype users. Proxies addressed each of five dimensions of empowerment: meaningfulness, competence, information accessibility, self-determination, and impact.

Our examination reveals that meaningfulness of work, as reflected by occupational status and pride in workmanship, was not significantly affected by the introduction of mechanized equipment. Compositors continued to enjoy an exceptionally high degree of professional and social status, as judged by the opinions of non-compositors and, perhaps most importantly, as judged by their own perceptions of their occupation. Likewise, they continued to exhibit a high level of performance-related motivation and earned individual stature among their peers based on their experience, knowledge, and performance skills. The linotype technology also supported high levels of competence for its users. Linotype operation was restricted, at least in union shops, to journeyman printers or to apprentices pursuing the final stages of their training for journeyman status. Linotype training was

treated as an addition to the collection of skills required of journeyman printers. Formal apprenticeship programs were not shortened or made less comprehensive following the general adoption of mechanized equipment in the composing room. In addition, the mechanized equipment had a significant and positive impact on the productivity of compositors. When applied to appropriate tasks, linecasting technology allowed the compositor to set more type, faster, and without a significant degradation of quality.

The informing capacity of the linotype is less clearly documented, but is suggestive of a moderate decrease in information accessibility associated with linotype technology in the composing room. In many situations, it appears that the introduction of linecasting equipment, at least initially, did not alter the way in which corrections were handled. Compositors continued to be responsible for correcting their own work, thereby receiving immediate performance feedback related to typesetting errors. At the same time, however, a general shift toward time-based, rather than piece-rate, pay scales did reduce the clarity of feedback regarding the quantity of output produced. It is difficult to make definitive statements concerning the effects of technology on information flow between coworkers and functional departments, because it received little attention in the historical descriptions of the composition function. However, the changes in physical layout required by the sheer size and configuration of the linotype machines, coupled with the noise level associated with their operation, can be posited as disrupting communication between operators.

Self-determination for compositors does not appear to have been affected by the increased mechanization of their work. Compositors continued to have extraordinarily high levels of control over work pace and scheduling, the number of

supervisory employees assigned to the composing function remained quite low, and the amount of control the supervisors were able to exert over the operation of the composing room did not increase following the technology introduction. Finally, this investigation suggests that employee impact, operationalized as a collective construct, may have actually increased for users of the new technology. Their ability to affect the performance level, policies, and strategic decision-making of their employing organizations was enhanced in the years following the introduction of the linotype as evidenced in their active involvement in trade unionism and the increased militancy and effectiveness of their local and national. While compositors may not have felt any identification or affinity for their employers, through their union, they did experience collective impact on events outside of their individual job or functional department.

Based on this historical investigation, the introduction of an automating technology appeared to effect a minor reduction or, perhaps, no net change in the level of empowerment experienced by the technology users. This interpretation is consistent with the model's prediction of neutral or slight decrease in user empowerment. The agreement between the model prediction and the historically documented outcomes provides at least partial support for the model definition.

INVESTIGATION II: TELETYPESETTING

The Innovation

Teletypesetting represents a composition technology that severs the keyboard entry of character and spacing information from the mechanized casting of hot-metal

type. Through the use of this technology, keyboarding and linecasting become two distinct and logically separable jobs. Teletypesetting is the composite of two underlying developments: tape perforating machines and tape-driven linecasters. These two technological innovations could be implemented within a single job or facility, but perhaps most significantly, they could be linked via telegraph lines to isolate the two composition processes into different jobs, different cities, or even different continents.

The idea of a punched-tape driven linecasting machine was first conceived by an experienced printer, Walter W. Morey, in 1926. Morey believed that modifying a linecaster to follow the instructions encoded on a strip of paper tape would result in more efficient and error-free production of hot-metal type slugs. His prototype models of a keyboard-driven tape perforator and a retro-fitted, tape-reading linotype were demonstrated in 1928 with generally positive results (Sylvester, 1965). Over the next few years, the basic technology involved in teletypesetting was improved, including devices for encoding keyboarded input into patterns of punched holes on long strips of paper tape, readers for converting the punched patterns into the electrical impulses of a telegraphic message, reperforaters that received the electrical impulses and created duplicate punched tape, and finally linecasting machines that could read and interpret instructions contained on paper tape.

Consistent with the ITU's position on controlling the introduction of new technology into the composing function, local unions expressed early resistance to the introduction of the teletypesetting technology (Woods, 1963). The ITU recognized that the separation of tasks represented potential deskilling of composition work and that the ability to transmit typesetting instructions via wire made it possible for employers to

profitably locate work away from their ultimate distribution target. Localized production was an important ingredient for maintaining employment stability and worker control over job property rights. Despite union disapproval and employer uncertainty about the productivity improvements represented by the new technology, many establishments were eventually motivated to adopt teletypesetting for at least a portion of their composing work. Factors supporting automated linecasting and teletypesetting included a shortage of skilled compositors following the close of World War II, increased competition and other economic pressures on newspapers and large commercial printers to increase productivity, improvements in the teletypesetting equipment itself, and the growth in multi-paper publishing conglomerates that could benefit from separation of text input from other production functions (Woods, 1963; Zimbalist, 1979).

Perhaps a direct outcome of America's involvement in the international arena of World War II, was increased interest and demand for information about events happening across the country and across the world. Wire news service agencies, such as Associated Press and United Press International, sought to satisfy this hunger for non-local news by collecting stories from around the world, via their own reporters stationed at international news desks and stories submitted by local newspapers, and re-distributing the stories to member papers via telegraphed messages. Teletypesetting technology was perfectly suited to the distribution of news by these wire news agencies because, it was fast enough to provide timely reporting of remote events and, in some cases, it eliminated the need for re-keying of wired copy at the receiving newspaper. The AP began transmitting fully justified and formatted story copy for reperforation onto paper tape by member newspapers in November of 1951, and UPI followed suit within a few months (Zimbalist,

1979). A teletype machine was used in conjunction with the reperforator to produce a hardcopy, readable version of the news stories transmitted. The typed story was useful for editorial purposes: selecting stories to use, marking up editorial cuts or changes to the story that would require re-keying by local compositors, and archiving stories for later reference (Conover, 1990). By the end of 1952, approximately 400 daily newspapers were using wire services in conjunction with teletypesetting technology (Sylvester, 1965).

In a similar fashion, newspapers with national or international distribution also were able to take advantage of logistical advantages afforded by wire transfer of typesetting instructions. During the 1950s, *The New York Times* began wiring tape to its west coast and Paris press facilities for production of the editions distributed in those geographic areas. The *Wall Street Journal*, a national financial publication, was using teletypesetting technology to wire virtually all of its text from central editorial offices to regional press and distribution facilities (Woods, 1963). The printers' union's suspicions were also, at least partly, realized as some newspapers and commercial printers moved text input to centralized facilities that could feed one or a number of affiliated newspapers or printing houses (Zimbalist, 1979). The union job loss associated with this separation of input from typesetting production was exacerbated if these centralized facilities were located in isolated plants and staffed with non-union-trained workers (Woods, 1963).

Model Proxies

Model Proxy 1a: What occupational group interacts directly with the new technology?
Model Proxy 1b: Is the technology widely adopted in the industry (occupational saturation)?
Model Proxy 1c: Do workers use the technology to complete most of their work tasks?

The users of the teletypesetting technology, keyboard input devices, reperforators, and tape-driven linecasters, were the printers who had previously worked either with linotype machines or, in some cases, directly in hand composition. As with the previous innovation of mechanized linecasting, the affect of teletypesetting technology was largely isolated to the front-end of composition. Proofreading and page make-up were not significantly affected by the separation of input from the already mechanized linecasting process.

To exactly what extent individual printers interacted with the teletypesetting technology is very difficult to determine because: 1) it was not as universally or consistently adopted by printing establishments as was the earlier shift to mechanized linecasting from hand composition; and 2) under certain implementations, it was not a radical departure from the status quo production process. The literature describing printers' work during the 1950s and 1960 is not always clear on just how directly printers in different environments worked with TTS machines, and it is probable that many printers did not interact with the technology at all. By the late 1960s, most major newspapers had incorporated teletypesetting equipment to perform at least limited functions in the composing room (Johnson & Moore, 1966). Johnson and Moore (1966) report that there were approximately 1,200 daily newspapers in the U.S. using teletypesetters by the end of 1964, as well as many weekly newspapers and commercial printers. American Newspaper Publishers Association (ANPA) statistics, reported by Johnson and Moore in 1966, recorded 902 newspapers using teletypesetting technology to some extent, specifically using, in total, 2,244 tape perforator keyboards and 11,405 tape-driven linecasters. These statistics, coupled with the descriptions of newspaper

composing rooms during the 1950s and 1960s, suggest that the introduction of tape-driven linecasters, tape-punching devices, and reperforators was quite pervasive across the industry, however its most common usage was for retrieving wire news and financial data, repunching the encoded copy on paper tapes, and converting the punched instructions into hot-metal type via tape-driven linotype machines. The average compositor working in a medium- to large-sized newspaper or printing establishment may have used the technology very little. Some shops, including newspapers and commercial printers, integrated TTS into their composing function more fully, separating their typesetting operations into two steps within a single plant, first tape perforation and then automated linecasting. In most instances, however, the two operations continued to reside in a single composing room, and compositors worked on both tape-punchers and automated linecasters during a typical day, in addition to working with standard linotype machines. In other shops, compositors were assigned to full-time duty with one machine or the other on a rotating basis. Compositors in these shops would have used the teletypesetting technology more intensively, but still the technology would mediate only a portion of their overall work tasks. Taken as a whole, their skill sets remained fairly unchanged, although their tasks became more fragmented as they moved from machine to machine (Holtzberg-Call, 1992).

At the other end of the continuum of use intensity, compositors at newspapers, such as *Billboard* and *The Wall Street Journal*, where the majority of the papers' content was transmitted by wire for linecasting and printing at distributed locations, interacted with the new technology much more intensively. The workers employed as tape punching operators in remote printing environments tended to be skilled typists with

relatively little experience in the printing industry. They did not identify themselves as compositors and tended to be represented by separate workers unions, such as the United Telegraph Workers of America (Compaine, 1980). This group of users is outside of the scope of this study, because they were largely recruited from outside the printing industry into newly-defined jobs, and, as a result had no experience in performing their work without the use of the TTS technology.

Unlike the keyboard typists, operators of the automated linecasters in remote printing shops were most likely to be experienced, albeit non-union, compositors, largely because the linecasters required skills that were not easily transferable from other occupations. Their work was significantly changed by the introduction of the TTS technology, because the input of copy, including the judgement that was a part of making justification and hyphenation decisions, was removed from their task set completely. The input function was accomplished at a distant location by specialized keyboard operators who were totally disconnected from the downstream production of the physical newspaper. The compositor's key job tasks, in such a distributed printing environment, consisted of handling the "ready to thread" tapes that were produced by the reperforator, feeding the tapes into the tape reader, monitoring the automated linotype machine, and assembling the cast lines of typeset material. The resulting impacts on compositor's jobs in distributed production environments, although potentially quite dramatic, have not been clearly or extensively described in the literature. This is perhaps because the industrial and market conditions that made this type of production solution attractive to owners were fairly isolated. Most newspapers continued to operate at a local or metropolitan level, and distributed production simply did not present a

logistical advantage. It is also possible that descriptions of fully rationalized operations are under-represented in the historical literature, because this type of implementation were most likely to occur in non-unionized, lower-profile establishments and, as such, was not the object of extensive observation and reporting.

Because the technology was implemented inconsistently, it is important to be as clear as possible about what specific environments, user groups, and industrial settings the proxies in this investigation are addressing. For the most part, the literature that speaks directly to the introduction of TTS technological innovations into the composing room describes environments in which TTS has very limited use for retrieving wire service news only or in which TTS is used along side traditional linecasting for both wire service and general typesetting work. Specific details will be reported in the analysis of each proxy, as appropriate, but in general it appears that the level of saturation of the TTS innovation was more moderate than that associated with linotype technology. The literature describes TTS equipment as being used by only a portion of the composing room staff and, when more general use of punched-tape driven equipment is portrayed, use of the new technology is generally less intense in its mediation of the compositors' tasks.

Model Proxy 2: Does the technology mediate or perform tasks previously performed by workers (automation); does it provide information to support decision-making by users (decision support); or does it support the sharing of interpersonal communications between individuals and groups within the organization?

The TTS technology represented a new approach to mediating the compositors' input tasks. The tape-punching devices accepted faster input via a QWERTY-style keyboard and a punching mechanism that was less cumbersome than direct matrix

arrangement. The technology then captured the input instructions onto rolls of punched paper tape that could easily be stored for later use, transmitted over telephone or teletype wires for processing elsewhere, or accumulated for more efficient batch-style linecasting on-site. Downstream, new and retro-fitted linotypes, equipped with punched tape readers, no longer required direct keyboarding by operators to direct the selection and arrangement of matrixes. This operation was now controlled by encoded instructions on the punched paper tape. Just as the new style keyboard and mechanisms of the tape punching devices represented a new form of mediation for the composition input tasks, the punched paper tape and the associated tape readers represented a new form of mediation for controlling the selection and arrangement of matrices during linotype operation.

As a complete technological system, the TTS innovation did not subsume tasks associated with the already mechanized linecasting process. Skilled human operators continued to control input manipulations, make justification and hyphenation decisions, and assemble hot-metal lines of type into metal frames. In another important sense, however, the technology did have the effect of automating aspects of the composition function for individual printers because it facilitated segregation of compositors' tasks into an input operation via a keyboard tape-punching device (this process included making hyphenation and justification decisions), and a linecasting operation via a reader-enabled linotype machine (this process included feeding the tape into the reader, monitoring and maintaining the machine, and removing and assembling slugs into galleys). For individual compositors working in establishments that adopted TTS technology as a means of fully and permanently separating the composition workforce

into keyboard specialists and automated linotype, the rationalized outcome would certainly be perceived as equivalent to automation by the individuals involved. The punched paper tape subsumed the tasks displaced from both the keyboardists' and linotype operators' jobs. Compositors working in establishments that had installed the TTS technologies in-plant as a way of increasing efficiency without fully rationalizing the associated tasks, continued to be involved with both sides of the composition process, albeit in a less integrated fashion. For these workers, the technology represented a new medium for accomplishing similar task outcomes and, for the most part, exercising similar levels of judgement and skill. Their work organization, scheduling, and methods were affected, for the better or worse, by the introduction of the new technology, but their tasks were not subsumed by the machine.

As with the linotype innovation before it, the TTS technology did not provide any analytical or decision-making support for its users. The technology did not include error-correction assistance to those keyboarding input, did not support line-ending decisions, or provide any type of interface with users for providing information about their tasks. Personal accumulation of knowledge and experience continued to be the prime source of intelligence in the composition process. Neither was the TTS technology used as a media of interpersonal or organizational communications. Clearly, a fundamental aspect of the TTS system was its ability to transmit encoded stories or data between locations, however, once again, this communication was solely concerned with the production product. A closely associated technology, the teletype, which was often used in conjunction with TTS to produce a text hardcopy of the encoded transmissions, was used in other settings, perhaps even within the same enterprises, as a

medium of organizational communication. TTS, however, was used solely for the transmission of product "in process" from one supplier or production site to another, and as such, does not meet our criteria as a communication-oriented technology.

Model Proxy 3: How was the pre-innovation performance level of users judged: qualitatively or quantitatively?

The dominant criteria of performance for most compositors working before and during the period of large-scale adoption of TTS technology continued to be the ability to set copy faster than the approaching publication deadlines. Accuracy and quality of output were valued, but printers frequently expressed in published accounts during the decades immediately preceding TTS introduction that there was increased pressure to increase quantity of throughput, sometimes at the expense of quality. Most compositors, whether working by hand, non-automated linecasters, or TTS-related equipment, were paid based on time rather than piece-rates, but it was clear to compositors that their value as part of the production function was largely determined by their ability to be consistently productive, in commercial print shops, or to set exceptionally high quantities of copy in the few twilight hours before press time, in newspaper composition rooms.

Model Proxy 4a(1): Is use of the technology mandatory?
Model Proxy 4a (2): Are users able to customize their use of the technology?

In considering the amount of discretion users were able to employ in their use of TTS equipment, it is important to note that TTS represented, in the majority of printing establishments, only a modification or addition to the existing technological approach to setting hot-metal type. Where TTS was adopted, it was relegated by some newspapers solely to accepting wired input from news and financial reporting services or accepting

ready-to-thread tape for repetitive announcements or classified ads. Fulfilling this function involved only a small portion of the newspaper content and, as a result, only a small portion of the working printers. At other publications, the tape-punching devices and automated linecasters were installed in-plant to increase the efficiency of on-site typesetting operations, and printers moved between the equipment as needed to accomplish each day's work. In these shops, temporary work assignments could be based on union-controlled schedules, seniority, personal preference, or proficiency at various tasks. As a result, in shops that did incorporate automated linecasting, there is evidence that workers may have worked on different equipment at different times, and they may have had some discretion over which assignments to seek. There is no evidence, however, that suggests that they had discretion in choosing which type of machinery to employ on any given type of work. Pressures for efficiency dictated that copy be set via the technology that was best suited to its characteristics, and descriptions of composing room operation during this period suggest that the printer foreman, or one of his assistants, was responsible for distributing takes, or sections, of copy to the various types of equipment.

There is no direct indication in the literature that printers operating automated linecasters had fewer opportunities for customized interaction with their machines than before the technology's introduction. It may be hypothesized, however, that because the relatively high level of customization possible with the original linotypes was the result of intimate knowledge of the equipment, the replacement of this very familiar equipment with new devices, such as the tape-punching machines, may have constrained the printers' ability to exercise discretion in how they operated or maintained the new

machines, at least initially. It is also possible that the greater sophistication and intricacy of the tape-punching equipment may have made personal maintenance and repair of the machines more difficult for the operators and less conducive to idiosyncratic operation. The literature describes that some compositors, at least initially, felt uncomfortable with the tape-punching devices and unfamiliar with their internal workings. Most operators did, over time, become proficient at the use of the new equipment, however, and it is possible that as they became more familiar with their tools, they developed approaches to customizing the equipment and its use to suit their own tastes and skills.

In summary, compositors had little or no discretion over when or if they used the TTS equipment. In shops where the equipment was installed, its use was mandated for the particular functions for which it was suited and implemented to perform (i.e., setting wire service news and data, setting announcement copy or classified ads, or setting straight news copy). It is difficult to conclude what effect the new technology may have had on the amount of control individual compositors had over how they interacted with their equipment. The high level of discretion traditional linotype operators were able to exert over how they used their machinery, a level of control that helped enrich the context of the linotype innovation, may have been constrained, at least during conversion to the new technology.

Model Proxy 4b(1): Did management consult with users before or after initial implementation?

Model Proxy 4b(2): Did users make decisions about the technology before or after initial implementation?

Model Proxy 4b(3): Are users able to block or control implementation through collective action?

Individual user participation in designing, configuring, or planning the introduction of this new machinery is not described in the historical record. As in the earlier introduction of mechanized linecasting, however, the users were not without collective influence over how the technology was implemented. The ITU presented a strong and unified force against the introduction of TTS technology into the composing room. Union refusal to allow the use of automated linecasting was ultimately resolved in some union shops by negotiating journeyman rules that required any automated equipment, including tape-punchers, reperforators, or automated linecasters, be operated by a journeyman compositor or by a non-journeyman paid at the prevailing union journeyman wage scale (Porter, 1954). Wire-transmitted tape was viewed by the compositors as a particular threat to their job security, both because of its potential for allowing relocation of certain composing or pressroom functions away from largely urban, union jurisdictions and because it represented reuse of typesetting material, a practice which had been controlled by the ITU and other printing unions since the mid-1800s (Porter, 1954). At the same time, the overwhelming power of wired tape for distributing national and international news was difficult to resist without some form of workable compromise. As a result, most local unions eventually accepted the introduction of wire-transmitted tape, but only to set type for certain highly circumscribed sections of the paper, such as stock quotes and, later, wire news stories, announcements, and classified ads (Porter, 1954). In 1953, for example, the Chicago Typographical Union, Local No. 16 of the ITU, and *The Wall Street Journal* reached an agreement concerning TTS technology that granted the union jurisdiction over all TTS-related jobs, restricted wire-transmitted tape to stock quotations only, and guaranteed

that the technology could not be used to reduce the workforce (Anonymous, 1953: 30; cited in Porter, 1954).

Model Proxy 4c(1): How much training have most users received?
Model Proxy 4c(2): Do users express difficulties using the technology?

Employers and the printers' union provided training opportunities for work on the new machinery, although the exact nature of the training offered, whether classroom or on-the-job, is not well documented. Automated linecasters required only a few new skills, including manipulation of the punched tapes, maintenance of the reader device, and trouble shooting any problems with the new assembly. Monitoring and retrieving tapes from the reperforator involved fairly simple tasks, which were quickly learned with a little practice.

Most training efforts focused on the use of the new keyboard equipment, which was designed with QWERTY-styled key arrangement, rather than traditional linotype arrangement of keys. The new arrangement, copied from that found on typewriter keyboards, was intended to make input faster and more efficient on the tape punching devices. Manufacturers of the tape punching machines claimed that initial training could be completed in a few days and that operators could be working at peak efficiency within six months (Kelber & Schlesinger, 1967). Some compositors found the transition from the linotype-style keyboard to the faster QWERTY keyboard particularly troublesome, because of their long experience with the linotype and the differences in timing between the old and the new equipment. The quality of the training was particularly important for creating proficiency on the new keyboard. Woods (1963) described well-trained TTS operators as creating virtually error-free tape at a rate of 400

lines per hour, while poorly trained operators input copy at half that rate with lower quality tape as a result. Compositors who found themselves assigned to keyboard duty also lamented their lack of skill at the new machinery. It is implied from these descriptions that the format and quality of TTS training offered to users may have varied considerably between different employers. The technology may have been marketed by manufacturers and perceived by purchasers as requiring little in the way of formal training, and as a result, the ability of users to adopt the technology fully may have been impaired.

Model Proxy 4d: Is there an increase in wage level for users following implementation of the technology?

The question about wage levels following the introduction of TTS into the printing industry does not have a simple answer. In union shops, the introduction of the technology was carefully regulated by the printers' trade union, limiting its use to prescribed functions, prohibiting workforce reductions, and mandating the continuance of jouneyman wage scales for anyone operating the new technology. In an immediate sense, then, the introduction of the automating technology did not represent a financial loss to the users, but it was not directly associated with any recorded increases in wage scales, fuller employment, or specific rewards for using the technology.

Users in non-union shops did not have the power of their union to protect them, however, there is evidence that TTS keyboard operators in most shops did not suffer financially as a result of the introduction of the technology. TTS operators responsible for making hyphenation and justification decisions were regarded as skilled workers and were compensated accordingly. Proper justification resulted in "tight lines", which were

necessary, not only for the creation of aesthetically pleasing copy, but also for the proper operation of the automated linecasting machines (McCoy, 1965). In-house TTS operators were frequently responsible for re-keying wired copy that was either unjustified, poorly justified, or had been heavily edited by the receiving paper's editors.

There is no indication that non-unionized printers were rewarded for accepting TTS equipment into their traditional processes, however, when the introduction did occur. In fact, the general sentiment of the time was that the equipment represented a threat to job security and wage levels for employed printers, both union and non-unionized.

Model Proxy Summary and Prediction

In evaluating the implications of the proxy results, it is important to remember that the technology was subject to different types and levels of implementation throughout the printing industry. Some users of the TTS technology were naïve compositors, predominantly keyboardists in fully rationalized, distributed production environments. These users are not relevant to this study. Other users were experienced compositors who had previously worked, for the most part, as non-automated linotype operators. The level of use intensity among those compositors who did use the equipment (job saturation) can be described as moderate to high, depending largely on how much time the individual compositor devoted to working on the TTS-related tape-punching devices vs. the tape-driven linecasters. Occupational saturation, however, can only be described as low to moderate because many compositors were unaffected by the technology and had no direct use of TTS-related equipment. Many newspapers and commercial printers continued to set all type with non-automated linecasting equipment

and many larger establishments were limited to setting only a small portion of type with the TTS technology. Low occupational saturation requires that we be very careful in how we evaluate and interpret descriptions of the printing occupations during the period relevant to TTS technology adoption.

The proxy evaluations also demonstrated that TTS technology can best be categorized as an automating technology, both in the sense that it mediated the input of typesetting instructions by the keyboard-operating compositor and that it captured these instruction and automated their introduction into the linecasting function. The technology did not perform support for decision making by operators, nor did it act as a media for communication between users. The work-role of users can be described as non-expandable, as speed was the most important criteria of compositor performance prior to TTS introduction.

Proxies related to the innovation context netted a mixed bag of results, which can be described as neutral to moderately negative. User discretion over the technology was relatively low. As with the linotype introduction before it, users had little individual discretion over whether or not to use the technology, but unionized users did have some collective power to resist or control how the technology, in general, was implemented in their workplaces. There is little in the literature addressing users' ability to customize or make choices about how they used the TTS equipment, but it is suggested that it may have been a less flexible technology than the earlier linotypes. User involvement in technology-related decision making also appears to be relatively low. While the ITU had considerable influence over when and to what extent the technology could be used in union shops, individual input into design, configuration, or implementation decisions

does not appear to have been a common occurrence. Retraining of compositors for work with the new equipment received only moderate attention from employers. The training programs offered seem to have been relatively informal, relying largely on on-the-job training and self-instruction, and focused for the most part on keyboarding skills. Lastly, rewards for adopting the TTS technology were low. There is no evidence of increased wages or financial incentives associated with adoption of the technology, and in fact, income for many naïve workers and non-unionized compositors was reduced as a result of the increased rationalization in some environments.

The IT-empowerment model predicts that increased use of an automating technology by workers in non-expandable work roles will result in a decreased perception of empowerment by the technology users. Coupled with the innovation context results that were evaluated as neutral, at best, and moderately negative, at worst, the outcome of the introduction of TTS-related technology in the printing industry is predicted to be a clearly negative change in perceived empowerment by those who have direct interaction with the technology. Proxies related to the outcome variables, the five dimensions of empowerment, will allow the evaluation of whether or not these predictions are valid.

Outcome Proxies

Outcome Proxy 5: Is there a change in occupational status for users following adoption of the innovation?

Looking at the occupation, as a whole, printers continued to enjoy a high level of occupation-related identity and status throughout the period of TTS technology introduction. A study of British compositors, conducted in 1959 and 1960, found that

compositors held the social status more similar to white collar workers than those employed in the skilled trades (Cannon, 1967:53). Members of the printers' trade also enjoyed a very positive professional self-image. Cockburn described compositors as a kind of "priesthood of production" who believed that they knew better than their managers and supervisors how to facilitate or impede the successful production of the newspaper (1983: 53-54). Sixty percent of a survey of New York City printers described the prestige of their occupation as excellent, and two-thirds claimed that, given a choice of jobs, they would not choose another career (Lipsett, et al., 1956). Breadth of training and expertise were key sources of pride for printers and they ascribed status to one another based on these criteria (Rogers & Freidman, 1989).

Because TTS equipment was implemented differently by employers, in terms of type of equipment used and intensity of the individuals' interaction with the technology, it is important to consider individual status differences that may have been associated with use of the technology. Linotype operators viewed keyboard input at tape-punching machines to be lower status work than other types of composition work (Kelber & Schlesinger, 1967). Linotype operators complained that tape punching using a QWERTY-style keyboard was work for typists rather than trained compositors. Separation from the physicality of the hot-metal casting process, the noise, the heat, the machinery, created an environment more typical of clerical offices than composing rooms. The switch from the familiar linotype to the QWERTY keyboard also colored input work as clerical, because QWERTY keyboards were standard on the typewriters used by clerks, typists, and secretaries. The new keyboard meant learning new skills for compositors. This particular challenge seemed to create anxiety for some operators,

concerning whether or not they would be able to achieve the input speeds that management expected. Typists working in office settings had better honed keyboarding skills than the retrained linotype operators, and yet, their jobs did not command the respect or the salaries that printers enjoyed. Typists were also largely female and tape-punching input work was frequently disparaged as "women's work", a characterization associated with reduced income and status (Cockburn, 1983; Lipset, et al., 1956;).

In summary then, it appears that the occupation as a whole did not experience a noticeable level of reduced status following the introduction of the TTS innovation. However, it is likely that those compositors assigned to full-time duty on TTS tape-punching devices, most likely compositors working in non-union shops, experienced a significant loss in individual status and work-related pride because of the restriction of their former skill and task variety, their initial lack of competence at their new tasks, and the association with their new work with clerical work. It follows that compositors assigned to part-time or rotating duty on keyboard entry may have experienced reduction in status proportional to their time spent operating the keyboard devices. However, these part-time keyboardists probably were less negatively affected because their printing skills, which were still required to successfully complete other aspects of their work, helped them maintain their key identity as printers rather than clerks.

Outcome Proxy 6a: Is there a change in occupational training requirements following adoption of the technology?
Outcome Proxy 6b: Are users better able to meet their performance goals using the technology?

In union shops, there were no significant changes in training requirements associated with the TTS innovation. Due to enforcement of the journeyman rule,

journeyman compositors were assigned to operate all TTS-related equipment in union-controlled composing rooms. While specialization among printers had become fairly common, especially at large newspapers, all journeyman printers were, by training, capable of performing the full range of printing tasks and were paid virtually the same regardless of the specific task assigned to them (Lipsett, et al., 1956). The length of union apprenticeship programs, as well as the breadth of their content, remained relatively constant during the period of the technology's introduction. In non-union shops, of course, formal training requirements were never consistently established as individual jobs varied considerable in terms of the breadth and level of skill required. Because input tasks could be isolated from the physical casting of the metal type using TTS technology, tasks could be more easily simplified and jobs designed to facilitate quicker training and easier, cheaper staffing. In situations that could benefit from distributed production and in shops where the compositors were not protected by strong union representation, jobs were deskilled and training requirements were reduced.

The TTS equipment supported significant performance improvements for the compositors who used them. Wire-transmitted tapes from news and data services, such as AP and UPI, were initially sent in all capital letters and without appropriate line endings. Stories were reset by hand at each destination. In a short time, however, encoding practices were improved and tape was transmitted properly capitalized and fully justified and hyphenated according to agreed-upon line length standards (Rogers & Freidman, 1989). Editors would decide which stories to include, using the teletype printout of the wired stories, and send the ready-to-thread tapes directly to the automated linecasters for production of the metal type. The entire input function was, as a result,

subsumed by the reperforating equipment in the receiving newsroom, thereby saving the time spent keyboarding stories.

In-plant use of tape-punching devices in association with automated linecasters could also translate into a reduction in capital equipment needs and higher overall throughput of typesetting. Tape-punching keyboards were faster that traditional linotype keyboards and skilled tape-punchers could input instructions three to four times faster than possible with linotype keyboards (Woods, 1963). Paper tape was an excellent media for capturing typesetting instructions and storing the encoded data until it could efficiently be produced. The ability to accumulate input instructions in a physical media made it possible to overcome the bottleneck in the production process that had been linotype keyboard entry. Traditional linotypes had been limited to the speed of a single operator entering instructions via the linotype keyboard. The tape readers attached to the automated linecasters could accept punched tape instructions and produce metal type faster than one individual could produce tapes and, as a result, a single automated linecaster could handle work from several keyboards (Woods, 1963). Working in this way, automated linecasters could set seven- to eight-times as much type as could a regular linotype accepting keyboard input from a single operator (Kelber & Schlesinger, 1967).

Despite its profound potential for increasing productivity, TTS technology was not regarded as contributing to increased aesthetic quality of typesetting material or to reducing operator or machine-produced errors in copy. Printers complained that TTS was responsible for producing higher quantity of lower quality type (Porter, 1954). Wire copy, which was set predominantly by workers without full composition training,

was frequently set in poor journalistic style and was subject to both operator, transmission, and reperforation errors. Similarly, in-plant tape was, at times, produced by more marginally or recently trained operators who did not have the opportunity to see the physical product of their input and to make immediate changes or corrections to improve its initial quality. Errors resulting from poor input or mechanical punching problems were not noted until it was transformed into metal type, en masse, by tape-driven linecasters. The linecasters themselves were also susceptible to mechanically produced errors (Compaine, 1980). Separation of input from output, in combination with the greater speed with which the hot-metal type was produced by newer linecasters, may have been responsible for increased error rates and reduced typographical aesthetics in TTS produced copy.

In short, the TTS innovation had an inconsistent effect on training requirements for its users. Non-unionized users experienced a potentially huge change in training requirements determined by the degree of task rationalization and job deskilling they encountered. Users in union-controlled shops, on the other hand, did not experience any significant changes in their level of required training during the period of TTS introduction. The technology is clearly associated with enhancing user performance when performance is measured as a function of throughput. Quality of the typeset material produced via TTS equipment was targeted by printers as failing to meet traditional standards of printing quality.

Outcome Proxy 7a: Do users receive more direct performance feedback following introduction of the technology?
Outcome Proxy 7b: Are users able to converse with coworkers more freely?
Outcome Proxy 7c: Is there more active communication between users and other departments?

There is no data to directly address questions concerning the possible effects of TTS technology on the users' access to information. Increased job fragmentation isolated compositors using TTS-related equipment from the physical product of their work. This may have resulted in reduced task-related feedback, specifically regarding quality of output. At the same time, however, quantitative feedback may have improved following the introduction of TTS. Fragmented tasks are more easily attributed to individuals and output more subject to objective measurement and evaluation (Kelber & Schlesinger, 1967). It is simply not clear which, if either, of these outcomes may have been relevant for printers using TTS technology.

Physical separation of input from linecasting operations, when it occurred could certainly have resulted in strained lines of communication between operators working in different rooms, areas, or buildings. Whether or not this actually occurred, however, is not described in the literature. There is no suggestion in the literature describing worker interaction in unionized environments that interpersonal relations between printers became less constant or that exchange of information became more difficult. However, it is important to note that the union carefully controlled how the TTS technology was implemented in these shops and job rationalization was minimized. Non-unionized shops may have experienced vastly different outcomes. Similarly, there is no indication in the literature that the flow of information between departments changed following introduction of TTS.

Outcome Proxy 8a: Does user control over work pace change following technology introduction?
Outcome Proxy 8b: Does the relationship between users and supervisors change?

Descriptions of printers' working environments during the 1940s and 1950s frequently focus on the high level of control printers exercised over the scheduling and timing of their activities. Printers secured the right of self-determination through the control over essential skills, expertise, and collective organization. Blauner described printers as setting their own "work rhythms", free from the pressure of direct supervision and managerial interference (1964: 42). Printers operating traditional linotypes, tape-punching devices, and automated linecasters all enjoyed considerable freedom of movement in the composing rooms, at least in larger establishments. Operators could choose break times, as their tasks permitted, to visit with coworkers, read the bulletin board, or go for coffee (Rogers & Freidman, 1989). Newspaper compositors, in particular, continued to have the freedom to schedule their day's work to suit their preferred work pace, with many printers choosing the challenge of completing the most critical of the work in the eleventh hour before press time (Cockburn, 1983; Lipsett, et al., 1956). The union-defended job property rights and individual discretion over worker substitution stood unassailed, especially in medium- to large-sized newspaper composing rooms (Porter, 1954).

While, overall, printers were able to exert a high level of control over their immediate work environments, those assigned to keyboard work did complain that working with the tape-punching devices tended to be more confining and monotonous. Printers perceived, perhaps rightly, that there was an expectation to produce more consistent output throughout their shift. Tape could be produced in advance for ads or announcements that would run in future editions, and as a result, the keyboard operators may not have had the same finite body of work that could be scheduled during their shift

as they preferred. They also believed that their output on the tape-punching machines was more easily monitored and tabulated than was output on the linecasters (Kelber & Schlesinger, 1967). As a result, depending on the amount of time the printers devoted to work on the keyboards, some printers probably did experience some loss of control over work pace associated with the TTS innovation.

There is no evidence to suggest that the relationship between printers and their supervisors was altered as a result of the introduction of TTS technology. Productivity gains made possible by TTS were, in most cases, leveraged to address competitive demands for more editions and expanded news and editorial content. Neither headcount reductions in the composing workforce nor increased supervisory presence in the composing room were deemed to be economically advantageous for most printing establishments. In the case of union shops, in fact, workforce reductions following TTS introduction was often expressly forbidden by union contract (Porter, 1954). Descriptions of typical happenings in the composing rooms of medium- to large-sized newspapers and commercial printing firms during this period portray fairly stable relationships between firm management, generally represented by a single print foreman and possibly his assistants, and the printers, usually through their chapel representatives (Cockburn, 1983; Lipsett, et al., 1956).

Outcome Proxy 9a: Is there a change in functional diversification following technology adoption?

Outcome Proxy 9b: Is there a change in occupational unionization or union effectiveness?

No significant shift in functional diversification of newspapers and commercial print shops is documented for the period following the introduction of TTS technology.

Technological advances in the press room continued to out-distance the productivity enhancing power of composing room innovations with the result being head count reductions among press operators that were more severe that any felt in the composing room. The composing function represented the largest portion of production labor cost, because of the labor intensity of the hot-metal process even when assisted with TTS technology (Woods, 1963). And the production staff continued to constitute by far the largest segment of the workforce for both commercial printers and even newspapers. Production workers tended to outnumber editorial and administrative workers on newspapers throughout the 1960s by as much as two or three to one (Lown, 1977).

The possible impact of TTS technology on the level of printer unionization and power exercised by their union is somewhat complex. The overall level of unionization does not appear to have changed significantly following the introduction of TTS to the industry. Journeyman rules were enforced and restrictions were established to control how and when TTS technology could be implemented and used. Such union vigilance kept employment among union printers relatively high and average pay scales for union printers considerably above non-union workers (Scott, 1987).

From another perspective, TTS technology was the forerunner of much more automated equipment destined to be introduced into the composing rooms, including phototypesetting and computer-controlled digital typesetting (Kuney, 1967). While the ITU maintained its tight control over the composing room during the 1950s and early 1960s, employers anticipated the new technologies with eagerness. Large publishers collaborated and invested resources in the continued development and refinement of workplace automation technologies. Printing establishments, especially newspapers that

were particularly vulnerable to threats of work stoppage by printers, began to proactively develop organization strategies to help them aggressively fight for increased automation in the production process. Smaller newspapers consolidated and larger newspaper owners sought diversification as a way of neutralizing their financial vulnerability to strikes. Immediately after signing a contract with the printers' union in 1965, *The New York Times*, for example, began a diversification strategy that included the acquisition of magazine and book publishers, television stations, and smaller newspapers. The Newspaper Publishers Association, which represented the largest newspapers in New York City, also established a secret training school to train non-printing employees on new composing and printing technology for work in the composing rooms should the printers call a strike during the next contract negotiation (Raskins, 1974; Rogers & Freidman, 1989).

The ITU, as well as other printing unions, were not unaware of the technological advances on the horizon. They realized that their power to resist the introduction of further technological innovations relied on their ability to maintain strict union discipline and develop stronger solidarity with trade unions representing related occupational groups. Ultimately, however, as technology was developed that could better displace the printers' skill, knowledge, and expertise, the union would find it more and more difficult to maintain their control over the composing room.

Observed Outcomes

Proxies have been evaluated that address each of the five dimensions of empowerment: meaning, competence, information accessibility, self-determination, and

impact. This evaluation reveals that meaningfulness of composition tasks may have been negatively affected for users of TTS keyboard equipment, but only when that use represented most or all of the user's total job. Printing, as an occupation, maintained a reputation as high status work, when compared to other production-oriented jobs, and printers tended to take pride in their craft. Printers did, however, describe keyboard work as somewhat demeaning, more like clerical work than printing, and as a result, printers who found themselves assigned to full-time keyboarding at tape-punching devices are very likely to have experienced a diminished sense of meaningfulness. Because most members of the occupation, especially in medium- to large-sized firms, did not devote a major portion of their work effort to TTS keyboarding , the occupation as a whole did not experience a significant loss in status and it can be inferred that most printers found their meaningfulness unaffected by the TTS technology. It is important to note that those who used the technology most were those most likely to have a negative outcome in terms of meaningfulness of their work tasks.

The proxies suggest that the TTS innovation had an inconsistent, but largely negative, effect on printers' perceived competence for completing their jobs. TTS supported greater throughput in the composing room because of its faster keyboard design and ability to accumulate punched tape created by several keyboardists to feed a single automated linecaster. The TTS also required new tasks from printers, particularly for entering instructions on the QWERTY-style keyboards, which many printers did not feel competent to perform. Quality of output may have suffered in the transition to TTS. Printers felt that the output produced by TTS equipment was less error-free and aesthetically pleasing than that produced using traditional linotypes. The length or

content of formal training programs for journeyman printers did not change significantly following the introduction of TTS. Manufacturers and employers seemed to focus on new keyboarding skills as the major focus for training, and even this skill received little formal attention. Job fragmentation, especially in non-union shops, most likely was accompanied by reduced training requirements as each worker became responsible for narrower sets of printing tasks.

Data concerning the effects of TTS technology of its users access to individual and organizational information is too scant to make a satisfactory interpretation. Job fragmentation and reduced task identity may have reduced the directness of performance feedback, but, at the same time, task measurability was improved. If the separation of input from linecasting resulted in physical separation of workers from their colleagues, interpersonal communication could have been restricted. Records describing users' access to information following implementation of TTS technology is unfortunately insufficient for inclusion in this evaluation.

Like meaningfulness, self-determination was also affected by the introduction of TTS technology contingent upon the specific type of equipment used and the intensity of the users' interaction with the equipment. Printers, in general, continued to have a high level of control over their personal work environment, scheduling, and work pace. They did, however, perceive work on the keyboards as being more confining and closely monitored than work with other types of equipment. There is no evidence of any affect on the relationships between printers and supervisory personnel. Once again, it is clear on this dimension that the negative impact of the technology was experienced by the workers who used the technology the most.

Finally, this study finds that the ability of the printers to impact their organization was not affected immediately by the introduction of the TTS technology, but the technology did lay the foundation for a significant shift in the power balance between printers and their employers. During the years of widespread TTS dispersion in the printing and publishing industry, the ratio of compositors to other occupational groups across the industry and within most printing establishments remained fairly stable. The level of unionization among compositors also remained relatively constant during this period, which reflected the short-term success of the union in meeting the needs of their members while controlling access to the skilled printing craftspeople demanded by the printing and publishing industries. Through their union, printers were able to maintain both discretion over their jobs and influence over the strategic and operational decisions made by the organizations that employed them. During this period of stable power, however, employers were taking strategic steps to undercut the printers' impact by developing and deploying new technologies that could capture and replace the printers' traditional sources of power: skill, knowledge, and expertise.

In concluding this investigation, it appears that the TTS technology had a strongly negative impact on the empowerment of those printers who devoted a large portion of their efforts to working with TTS, particularly with keyboarding, and a neutral or mildly negative impact on those printers who interacted with the technology on a casual or rotating basis. The IT-empowerment model predicted a strongly negative impact of the technology on user empowerment, which is at least partially consistent with our historically observed results. This investigation has focused on a technology that was experienced by users in highly variable levels of intensity; some users

interacted with the equipment on a full-time basis while others used the equipment only intermittently. The technology also represented several distinct pieces of equipment and users did not perceive use of each type of equipment in the same fashion. The potential impact of these factors on the design of the IT-empowerment model will be addressed in the next chapter.

INVESTIGATION III: COMPUTER-ASSISTED PHOTOTYPESETTING

The Innovation

Computer-assisted phototypesetting (PTS) represented a radical technological innovation in the printing industry, ushering in the electronic age of modern publishing (Standera, 1987). Unlike the somewhat limited user impact of the TTS innovation that preceded it, PTS systems encompassed technological capabilities that automated decision making for users, introduced a totally new set of composing room skills, changed the nature of the materials involved in the production process, and significantly altered the physical working environment for users. While the technology evolved and developed over a number of years, adding features and growing in sophistication with each succeeding iteration, its defining characteristics were computer-controlled justification and hyphenation of operator-input text and automated, photographic production of printing plates. Because the creation of plates no longer involved the use of molten lead, the PTS process became nicknamed "cold-type". The almost universal diffusion and adoption of this new technology in the printing and publishing industry, along with its associated revolution in offset printing press technology, had significant impacts on

printers, particular those who had come of age during the hot-metal era (Cockburn, 1983; Holtzberg-Call, 1992).

A rather elementary process involving the use of linotype-like equipment and the photographic processing of offset printing plates was originally patented in 1895, but the process did not become practical for general printing use for another 50 years (Johnson & Moore, 1966). The offset printing process itself is related to lithography, a technique developed almost 200 years ago for printing copies of artwork (Conover, 1990). Offset printing differs from the traditional letterpress process in that it uses two-dimensional rather than raised, three-dimensional printing surfaces to transfer ink to paper. Offset printing plates are created by first arranging and photographing the images to be printed and producing a film negative. The negative is placed over a chemically treated, light-sensitive aluminum plate and exposed to high-intensity light. The image exposed on the plate will attract and hold oil-based printing ink. The inked plate is then used to create a positive impression on a rubber reproduction mat, which in turn creates the final paper printing (Conover, 1990; Wheeler & Wheeler, 1996).

The first generation of machines designed to create camera-ready images for photographic plate making were electro-mechanical devices that operated in a similar fashion to the old linecasters. In 1947, the Intertype Fotosetter was the first commercially marketed phototypesetter (Johnson & Moore, 1966). Letter matrices were selected via keyboarded instructions and aligned to create sections of text that were then photographed. The devices produced film negatives of text only slightly faster than a traditional linotype, in the hands of a skilled operator, could produce hot-metal type. The first generation phototypesetters could produce three to five characters per second and the

quality of output was acceptable, if not of high, quality. Reliability, however, was a serious issue with the early machinery and the equipment was several times more expensive than comparable hot-metal machines (Andersson, 1967; Samaddar, 1994; Seybold, 1984).

Second generation technology, referred to as photo-optical typesetters, represented a clear improvement over the preceding version. Photo-optical typesetters, which were generally tape-driven, created images by selecting and positioning rotating glass disks that were inscribed with various character negatives. A controlled flash of high intensity light exposed each selected character onto a strip of chemically impregnated paper that was delivered to the operator outside the machine. Camera-ready copy was created by "pasting up" the strips of paper into appropriate arrangements on sheets of art board. This type of device continued to be manufactured until the mid 1980s and was the most common type of PTS in use by newspapers as late as 1977 (Lown, 1977; Samaddar, 1994; Standera, 1987).

Computer assistance was introduced to the composing room in the early 1960s in the form of computer programs that could mimic the way compositors made line justification and hyphenation decisions (Johnson & Moore, 1966; McCoy, 1965). Initially, the programs required large, general purpose computers, such as the IBM 1620 or RCA 301, both of which were priced at over $100,000 in 1961. Improvements in software and hardware quickly brought more specialized and affordable computers to the market, and by 1965, prices had dropped by half and computer-assisted typesetting was finding a place with many smaller printers and weekly newspapers (Johnson & Moore, 1966). Early computers ran "smart" reperforating machines that could accept unjustified

punched-paper tape created by TTS keyboard operators and reproduce that tape with added line-ending codes. The re-punched tape could then be fed into the automated linecasters for casting of hot-metal type or into photo-optical typesetters to produce bromide strips (Johnson, & Moore, 1966; Lown, 1977). Later computers produced instructions on magnetic tape which directed the faster photographic typesetters. The Mergenthal Linasec, for instance, which was the most widely used specialized composing room computer in the mid-1960s, could justify over 6,000 lines of text per hour, a speed that human operators could simply not match (Johnson & Moore, 1966).

The third generation of devices, which became commercially available in the late 1960s, is distinguished from earlier generations of phototypesetters because it used computer technology to create images based on numerical, or digital, descriptions of characters and graphic images. The images are reproduced on high-gloss paper using laser technology. Operators typically controlled the typesetting process via a keyboard attached to a computerized video display terminal (VDT), although the operator's view of the input was typically unformatted. Because this technology was driven by computers with broad capabilities, justification, formatting, and printing instructions could be stored and recalled later for standardized material or entered along with the copy to be set. The digital typesetting unit was amazingly fast and could efficiently produce copy input via a number of VDT units (Samaddar, 1994; Seybold, 1984).

PTS began to make inroads into the previously undisputed domain of hot-metal typesetting in 1959 when a few non-union employers in New York first began a craft training program for photocomposition (Scott, 1987). By 1963, however, acceptance of PTS was still spotty among newspapers because of their previous investments in

expensive and durable hot-metal linecasters and their dependence on letterpress printing equipment, required raised-letter printing surfaces that PTS did not easily produce (Gardner, 1964; Holtzberg-Call, 1992; Willis, 1988; Woods, 1963). The benefits of PTS, including better print quality, faster composition, and less reliance on skilled printers, was more easily realizable in job printing offices and small newspapers where offset press equipment was more common and labor opposition was less entrenched (Engwall, 1978; Woods, 1963).

Quality issues were also at the heart of the relatively slow adoption of PTS in the newspaper industry. As late as 1966, production managers were still not completely satisfied with the fastest available PTS systems, partially because the range of available fonts was still limited, the machinery was complex, and failure rates were sometimes unacceptably high. One technology observer explained, "To a production manager responsible for news deadlines, two high-speed machines with high failure probability are a poor bet compared with twenty slow machines with low failure probability and easy repair" (quoted in Williams, 1967: 17).

Improvements in the technologies, coupled with obsolescence of installed equipment and falling price tags, did eventually lead to the widespread adoption of PTS throughout the printing industries. By 1980, 75% of all U.S. daily newspapers were using PTS technology in conjunction with offset printing (Fitzgerald, 1984). Large papers still, however, lagged behind their smaller colleagues. In 1987, ANPA estimated that the majority of dailies in the U.S. and Canada were using PTS technology in the production of their newspapers, but as many as 35% were still using some form of the letterpress printing for at least part of their printing (Scott, 1987).

Certainly another major force in the slow acceptance of PTS technology was the militant resistance of the printers and their union, the ITU, to increased workplace automation. On larger newspapers, particularly, the union's "elephant-like inertia" helped keep the PTS equipment out of the composing rooms until the mid- to late 1970s (Woods, 1960, pg. 184). Printers feared that the radically new skill-sets demanded by the technology, the loss of human decision-making required, and the increased speed of throughput made possible by the new machines would not only undermine their positions of power within the printing establishments, but also create workforce redundancies and reduce job security. They recognized that the technological advance forecasted 75 years earlier, the typesetting machine "with brains in it", had come to pass, but much earlier than expected (quoted in Holtzberg-Call, 1992: 157).

Model Proxies

Model Proxy 1a: What occupational group interacts directly with the new technology?
Model Proxy 1b: Is the technology widely adopted in the industry (occupational saturation)?
Model Proxy 1c: Do workers use the technology to complete most of their work tasks?

Users of the PTS equipment were, for the most part, compositors who had previously trained and worked with the hot-metal linotype equipment. In shops under union control, retraining and reassignment of journeyman compositors to all aspects of the PTS process was mandated. Labor statistics seem to indicate that, at least initially, other employers also tended to retain incumbent composition staff to work on the new equipment. Redundancies were reconciled through reassignment to other functional areas, natural attrition, and, when necessary, workforce reductions (U.S. Bureau of Labor Statistics, 1973).

The existing specialties in composing trades translated into new roles in composing rooms equipped with PTS technology. Typically, linotype operators became PTS operators, imposers and stonehands were retrained as paste-up workers, and full-time proofreaders were reassigned to largely clerical duties. Some compositors were retrained to fulfill roles that had previously fallen outside of the composing room, such as camera operators, film processors, and offset platemakers (Rogers & Freidman, 1989; Samaddar, 1994). The PTS operators were responsible for keying input into the computerized terminals, monitoring the processing of these instructions into images onto paper by the phototypesetter, and delivering the output to the paste-up function. Paste-up workers did not work directly with the PTS equipment itself, but the technology of their work also changed significantly from constructing heavy metal frames of type and spacers, using chisels, saws, and hammers, to assembling camera-ready copy layouts using shiney paper, scissors, and bottles of waxey glue (Lown, 1977). Job saturation for direct users of the PTS technology, however, was almost complete. For the PTS operators, virtually every aspect of their work was mediated by direct interaction with the new equipment. Even when the composing tasks were separated into more narrowly defined jobs, such as keyboardist and typesetter operator, there were few, if any tasks, that were accomplished without mediation by the PTS machines they operated.

Occupational saturation of the PTS technology was also quite high. Descriptions of the printing industry in the U.S. during the years immediately preceding 1980 suggest that, with very few exceptions, the vast majority of printed matter was produced using cold-type technology (Fink, 1988; Goble, 1984; Rogers & Freidman, 1989; Winsbury, 1975; Zimbalist, 1979). According to ANPA data collected in 1975, 94% of member

papers in the U.S. were using automated PTS equipment to produce all or part of their type, and by 1978, that number had risen to 97% (Compaine, 1980; Hynds, 1980). The death knell of the hot-metal process sounded in 1964 when the last hot-metal linotype was produced for commercial sale (Goble, 1984). U.S. Department of Commerce figures, which show that, by 1977, shipments of hot-type related equipment in the U.S. represented less than 5% of PTS-related shipments, confirm that the PTS technology had succeeded in effectively replacing traditional linecasting by the opening of the 1980s (U.S. Department of Commerce, 1977).

Model Proxy 2: Does the technology mediate or perform tasks previously performed by workers (automation); does it provide information to support decision-making by users (decision support); or does it support the sharing of interpersonal communications between individuals and groups within the organization?

The PTS technology encompassed a system of equipment that mediated or automated virtually all user tasks that had previously been performed manually and intellectually. The VDT keyboard mediated the input of copy and typesetting instructions by the operator. Justification and hyphenation software, in conjunction with stored copy format guidelines, automated the bulk of formatting decisions, relieving operators of responsibility for determining and judging appropriate sizing, alignment, and syllabification of text. After keyboard entry, copy was transmitted electronically to typesetters, which processed the instructions into printed paper images with little or no intervention on the part of the compositors tending the machines. PTS operators monitored the typesetters for optimal performance, making minor adjustments when necessary and keeping the equipment fed with developer, toner, and paper.

Users perceived the PTS technology as making their expertise and judgement unnecessary in the typesetting process, and manufacturers marketed the equipment as accomplishing just such a feat (Holtzberg-Call, 1992). The computer could make programmable decisions much faster, if not much better, than human craftworkers, and increased speed justified the investment in the equipment (Engwall, 1978).

Model Proxy 3: How was the pre-innovation performance level of users judged: qualitatively or quantitatively?

Prior to the widespread introduction of phototypesetting, compositors were predominantly evaluated based on quantitative measures of productivity. An acceptable standard of accuracy, for most working printers, was required, but did not differentiate the good printers from the merely competent. As in earlier periods, commercial printers valued compositors who could be consistently productive, while newspaper work required compositors with the ability to deliver speed under pressure. While it is possible that a few compositors employed outside of the mainstream industry, for example creating limited editions or luxury printed products, were regarded as artists and valued for the aesthetic quality of work, these clearly did not represent the evaluation criteria of the typical printer.

Model Proxy 4a(1): Is use of the technology mandatory?
Model Proxy 4a (2): Are users able to customize their use of the technology?

There is no documented evidence that users had any real discretion in whether or not to use the PTS equipment in the completion of their work, and it is difficult to see how any real opportunity for exercising such discretion could have been practicably applied. As previously described, PTS represented a radical departure from the hot-metal approach to setting type and, especially for large newspapers that were dependent on

letterpress equipment, it necessitated parallel changes in the pre-press and pressroom technology in use (Johnson & Moore, 1977). As a result, it was not generally financially or logistically advantageous to attempt to maintain both hot-metal linotypes and cold-type technologies in one establishment. Once employers committed to recapitalization with PTS and offset equipment, use of the technology was mandatory for production employees. Alternative tools were simply not available.

The ability of users to customize or influence how they interacted with their machines is unclear, but it is likely that customization was made more difficult, in one sense, by the sheer complexity of the machinery (Cockburn, 1983). Operators were not responsible for any but the most elementary maintenance of the phototypesetters (Engwall, 1978). Staff technicians serviced and made major adjustments on the machines. The level of individual flexibility allowed by the programming of the input terminals is not well documented. It is possible that users could customize their keyboard functions or override automatic features in the typesetting programs, but the descriptions of keyboard operation by users as mindless and devoid of operator judgement do not lend support to an assumption of customizability (Holtzberg-Call, 1992).

Model Proxy 4b(1): Did management consult with users before or after initial implementation?
Model Proxy 4b(2): Did users make decisions about the technology before or after initial implementation?
Model Proxy 4b(3): Are users able to block or control implementation through collective action?

Direct, individual involvement in planning for or evaluating the performance of PTS technology is not described in the literature. A Bureau of Labor Statistics (1973) report describes the typical introduction of PTS equipment into previously hot-metal

composing rooms, and according to this report, planning for implementation was generally controlled by a small group of high-level managers in collaboration with vendors and outside consultants. The transition from hot- to cold-type was generally quite swift, with little direct involvement by composing room employees.

As with earlier innovations into the composing room, however, there was some level of collective influence exerted by printers in union shops, at least in terms of when the technology could be introduced. The ITU met with only limited success in enforcing this control, however, as negotiations failed, strikes were broken, and non-unionized workforces replaced ITU-member printers at many newspapers. Only the strongest locals were effective at significantly delaying the introduction of PTS and high-speed offset printing technology in the composing rooms, pre-press departments, and pressrooms. The ITU "Big 6" local successfully blocked the introduction of cold-type equipment in New York City composing rooms until 1974, a delay of 10 years after the introduction of the technology in most composing across the country. Following a series of bitter strikes, during which members of the Publishers' Association of New York City, an organization representing the major New York City newspapers, retrained non-union employees to operate PTS equipment, Local 6 sacrificed control over all future workplace automation in exchange for job and wage guaranties for existing employees. The 11-year contract won job security for the printers, but at the cost of any certainty of union or occupational survival (Rogers & Freidman, 1989).

Model Proxy 4c(1): How much training have most users received?
Model Proxy 4c(2): Do users express difficulties using the technology?

It is clear from the literature that training was made available to compositors who were transitioning between traditional hot-metal linotypes and PTS-related technology. Union contracts that survived the introduction of the new equipment generally stipulated that staff printers be retrained for working with the PTS technology whenever practicable. Vendor-provided on-the-job training was made available in some establishments, and the ITU cooperated with employers by offering a full range of courses covering all aspects of modern printing methods. At the union's Colorado Springs training center, keyboarding, phototypesetter operation and maintenance, camera use, darkroom techniques, paste-up, and even computer programming classes were made available, free of charge, to union members. Each class lasted about three weeks and included hands-on experience with all of the newest PTS equipment. The union also ran correspondence schools and on-site classes to make training accessible to all of its affected members (Holtzberg-Call, 1992).

By the early 1970s, training for entry-level positions in phototypesetting also became available through many public and private institutions of vocational training. According to the Bureau of Labor Statistics (1973), there were approximately 4,000 high schools, technical institutes, and vocational schools providing training in the printing trades in 1972. In addition to providing a resource for retraining experienced compositors for work with new technology, these institutions were also feeding the demand for new print workers in the increasing number of smaller printing establishments and weekly and small-circulation daily newspapers that the offset and PTS technologies had spawned.

Model Proxy 4d: Is there an increase in wage level for users following implementation of the technology?

The impact of cold-type technology on the wage rates of its users is an issue that requires some explanation. It is clear from the literature that employers considered the skill level required for successful use of PTS technology to be significantly less than that required for hot-metal equipment. Union negotiations addressed this employer-perceived skill discrepancy, but at least during the initial stages of PTS introduction into the industry, ITU locals were able to enforce journeyman rules for PTS operation, which required, among other things, that hot-metal and cold-type operators receive equitable wages (Porter, 1954). During the period of PTS adoption, wages of union printers relative to non-union printers were on the increase. In New York City, union printers earned an approximate 10% premium over their non-union colleagues in 1958, and the premium had increased to more than 60% by 1980 (Scott, 1987).

This growing disparity, however, was largely driven by the very generous wages packages negotiated by ITU Local 6 in 1974 in exchange for the surrender of certain job property rights and control over future workplace automation. The negotiated wage packages included cost-of-living and periodic increases, job guarantees that extended beyond the 11-year life of the contract, retirement enhancements, and voluntary termination incentives (Rogers & Freidman, 1989). While, on the surface, these contract points could be interpreted as rewards associated with accepting and adopting the new technology, they are more appropriately viewed as conditions of a buy-out designed to manage the replacement of expensive existing staff with a combination of technology and inexpensive human operators. The disparity between union and non-union wages can

also be accounted for by an increase in the relative number of non-union printers and a sharp decrease in the level of non-union wage levels. By 1983, the percentage of employed printers who were not union-affiliated had increased to 69%, up from 42% 15 years earlier (Scott, 1987). During the decade between 1970 and 1980, the number of craft printers, workers occupying positions that require journeyman-level training and experience, as a percentage of the total typesetting labor market declined from 75% to only 47% (Scott, 1987). Declining skill requirements, especially among non-union printers, created a semi-skilled class of printers who were paid a far lower wage than their skilled predecessors and contemporaries (McCoy, 1965), frequently as little as half of the skilled rate (U.S. Bureau of Labor Statistics, 1973).

In summary, then, it is not appropriate to interpret increased wage rates and compensation packages for some transitioning printers as indicative of a general pattern of rewards for accepting and retraining on the new technology. It appears, instead, that the PTS technology was viewed as an opportunity to deskill the work of printers. As a result, printers with strong union representation were bought out of their traditional contract rights as a way of introducing advanced technology and gaining lower pay opportunities for new employees. Most printers found their jobs deskilled and their pay rates diminish accordingly.

Model Proxy Summary and Prediction

Looking back over the model proxy results, compositors, specifically linotype operators, are identified as the primary users of the phototypesetting technology. The technology diffused widely throughout the printing and newspaper industries, and users typically found that most, if not all, of their tasks and work activities involved direct interaction with the PTS-related devices. Both job and occupational saturation of the technology was evaluated as being very high. The technology was determined to perform an automating function, because it mediated and subsumed most of the tasks previously accomplished through manual, mechanical, or mental means. Prior to the introduction of the PTS technology, compositors occupied predominantly non-expandable jobs whose primary evaluation criterion was a combination of work speed and high throughput.

The innovation context was found to be non-supportive of an empowering technology implementation. Users had no discretion in terms of whether or not to use the PTS equipment to complete their tasks, and it is unclear if there were any opportunities for individual customization of the equipment to suit specific individual preferences. There is no evidence that users had any direct involvement in planning, implementation, or evaluation of the technology, and collective action to prevent introduction of the technology into the composing function was successful only in a few instances and only partially successful in those. Compositors, in general, did not enjoy the benefits of employer-provided rewards as an encouragement to accept and adapt to the new technology. Some of the strongest locals did, however, have the power to resist the technological innovations long after most composing rooms had begun the transition to cold-type technology. These locals were able to negotiate generous compensation

packages and job guarantees for current employees in exchange for the surrender of job property rights and barriers to new technology. On a more positive note, users did have opportunities for training on the new equipment, although largely through the efforts, again, of their international union organization.

The IT-empowerment model predicts that users of automating technology in non-expandable jobs will experience diminished perceptions of work-related empowerment. Combined with an innovation context that is not supportive of an empowering technology implementation, it is predicted that the outcome of the introduction of phototypesetting technology into the newspaper and commercial printing industries will be a strong negative change in user empowerment. The five dimensions of empowerment, meaning, competence, information access, self-determination, and impact, will be evaluated in the next section based on the examination of five sets of outcome-related proxies.

Outcome Proxies

Outcome Proxy 5: Is there a change in occupational status for users following adoption of the innovation?

The traditionally high occupational status enjoyed by printers, an elevated position that had largely withstood the assault of TTS technology during the 1950s and early 1960s, fell victim at last to the radical task changes associated with introduction of phototypesetting technology. The loss of status and craft-related pride in the occupation is the dominant theme in printers' descriptions of changes associated with the shift to cold-type. Printers characterized the transition to cold-type as an almost tragic event, signaling the end of the typesetters' craft and demoting previously skilled craftsmen to common typists and machine tenders. They described hot-type composing, despite its

associated poor physical work environment and practical difficulties, as glorious work that set compositors apart from lower status trades. Because of their special skills, knowledge, and experience, they performed tasks that others could not do and worked autonomously, even when in the employ of others, thanks to their control over important processes. Printers tended to hold their work as a way of life, as much as a livelihood. They associated with printers in their free time and introduced their children to the craft of which they were proud (Holtzberg-Call, 1992; Kelber & Schlesinger, 1967; Scott, 1987).

Cold-type production was cleaner and physically easier than hot-metal work, but it did not meet the printers' requirements for feeling pride in their work. The printers' knowledge and experience that had previously determined the quality of their output was overshadowed by the computer software that now made justification and format decisions. The printers' manual dexterity and skill that had once made the difference between making the deadline or delaying the next newspaper edition was now simplified by computer-assisted keyboard entry and automated by PTS processing equipment. Excellence was now vested in the equipment, rather than in the individual (Andersson, 1967). Craftsmen were made obsolete, and employers were overtly replacing them with narrowly trained, short-term and casual workers (Compaine, 1980; Scott, 1987). Printers working in cold-type perceived, correctly, that the technology was designed primarily to increase the speed of composition. They believed that PTS produced homogenous work and blurred the distinction between good and only mediocre printers. Skill-based status differences lost value, and pride in individual performance and achievement was diminished (Holtzberg-Call, 1992). The loss of pride in the occupation is highlighted by

a survey of working cold-type printers that found that, although printing had traditionally been a craft shared between fathers and sons, that most would not encourage their children to enter the occupation (Rogers & Freidman, 1989).

Outcome Proxy 6a: Is there a change in occupational training requirements following adoption of the technology?
Outcome Proxy 6b: Are users better able to meet their performance goals using the technology?

Phototypesetting technology was perceived by its users as deskilling, and was, in fact, implemented by most employers as one component of a production system designed to reduce training requirements for operators and support headcount reductions in the composing, pre-press, and press operations (U.S. Bureau of Labor Statistics, 1973; Cockburn, 1983; Seybold, 1984). Computer-assisted PTS removed the craft from the production of typeset matter and reduced the composing room work to typing unjustified text into the equivalent of electronic typewriters, monitoring the machine-controlled reproduction of text on paper by the phototypesetting equipment, and pasting strips of paper onto artboard. The practical training requirements for work with cold-type technology was reduced from that of a journeyman printer to that of "an ordinary typist or a minimally trained commercial art student" (Compaine, 1980, pg. 168). While the strongest union locals were able to enforce journeyman rules, with its associated five-to-six year apprenticeship training period, many union locals were broken or forced to accept the creation of new job classifications for work with PTS equipment that entailed lower levels of training in conjunction with lower pay scales (Scott, 1987). Non-union typesetting training requirements plunged from six years in 1958 to about one year by 1978 (Scott, 1987). In some shops, keyboardists were being put to work with as little as

three-to-four months of training (Samaddar, 1994). Most employers were confident that typists could effectively keyboard, edit, file, and store text with no practical knowledge of typography (McCoy, 1965; Scott, 1987).

Performance enhancing effects of the PTS technology, in terms of increasing throughput and speed of composition, were unquestionable. A careful analysis of the costs associated with scientific journal publication estimated the cost of PTS typesetting in 1967, using existing hot-metal trained compositors, as roughly equivalent to the cost of hot-metal production. The evaluators determined that the shift to cold-type was advantageous, however, because future PTS costs were expected to decline while equipment speeds were expected to increase. In addition, the cost estimates did not capture the cost advantages associated with the increased reusability, storability, and transferability of the computerized input, nor did it consider savings resulting from replacing skilled operators with semi-skilled workers (Kuney, 1967). Speed is the most common measure used to reflect the benefits of the mature PTS technology. Experts claimed that PTS operators could easily produce two-to-three times the matter produced by hot-metal operators and, in repetitive format work such as directories or classified ads, could out-produce hot-metal by up to 100 fold (Scott, 1987). More complicated work, for example setting display ads and decorative work, could be set twice as fast in cold-type (Engwall, 1978). The huge productivity improvements were largely the result of computerized hyphenation and justification, stored standard formats, and the lightening speed of the electronic typesetter, which could easily reproduce the equivalent of a full newspaper page of text in about 15 seconds, a feat which would require over an hour on a tape-fed, hot-metal linecaster (Samaddar, 1994).

In contrast to the overwhelming productivity improvement associated with PTS in the composing room, there was some suggestion that these benefits may have been counterbalanced by increased costs and time required in plate-making, photography, and costs of computerized equipment (Johnson & Moore, 1966). In addition, printers expressed concerns about declining quality of print work associated with computer software that did not create accurate or aesthetically pleasing justification and hyphenation, poorly designed fonts, problems with the offset printing process, difficulties in correcting paste-up work, and a shift in industry values away from any regard for typographical quality as a measure of performance (Cockburn, 1983; Lown, 1977; Willis, 1988).

Outcome Proxy 7a: Do users receive more direct performance feedback following introduction of the technology?
Outcome Proxy 7b: Are users able to converse with coworkers more freely?
Outcome Proxy 7c: Is there more active communication between users and other departments?

The impact of PTS on its users' access to information is not well defined, with characteristics of the technology suggesting both positive and negative effects of the technology. While the trend toward job fragmentation continued in some shops (Cockburn, 1983), performance was highly measurable, and computerization could have been used to monitor and report operator performance. It would have been possible for users to receive feedback on their own performance or that of their work group. Whether or not management chose to exploit this capability, however, to bring information to users, to control or discipline them, or to disregard it entirely is not described in the literature.

Co-worker sharing of information may also have been supported or restricted by the new technology. The PTS introduction brought with it a greatly changed work environment for compositors who had previously worked in hot, noisy, dirty rooms filled with linotype machines that were "the size, weight, and vintage of Model T Fords (Winfrey, 1978:21). Workers were generally free to move around the composing room at will, but on-going conversation was restricted by physical separation and the high noise level. PTS equipment, on the other hand consisted of fewer, smaller machines that were generally located in brighter, cooler, quieter rooms (Compaine, 1980). The more white-collar ambiance of the new composing rooms would have presented fewer physical barriers to communication between workers. On the other hand, reorganization of the composing function around the PTS technology also lead to activities being relocated in physically separate areas. For example, keyboard operators were sometimes relocated near the source of their input, such as the advertising department or the newsroom, and composing activities were frequently isolated from the paste-up area (Engwall, 1978). Communication between workers who considered themselves co-workers despite physical location may have been disadvantaged by the conversion to cold-type.

Trends toward new information flows between the composing room and other functional departments have been described as resulting from PTS introduction. Interaction between the composing and editorial function grew closer, perhaps in part because of greater proximity between the two groups. After the introduction of cold-type, some newspapers moved the composing room out of the production area and placed it adjacent to the newsroom or, at times, in the newsroom (Engwall, 1978). While increased communication between editorial and composing was observed following the

change to cold-type, it was noted that the bulk of the communication between the two groups took place in the composing room, with composing room employees rarely venturing into the editorial work area. This may suggest that the increased communication was directive rather than informational and representative of increased control by the editorial group over the composing function.

Outcome Proxy 8a: Does user control over work pace change following technology introduction?
Outcome Proxy 8b: Does the relationship between users and supervisors change?

The PTS technology not only greatly increased productivity, but also reduced printers' control over the work process itself (Giebel, 1979; Holtzberg-Call, 1992; Scott, 1987). The task-related activity flow and unavoidable interruptions in linotype operation, including keyboarding input, making adjustments for justification and spacing, feeding the hell pot, adjusting the mechanisms, and assembling and binding the cast lead type, created a rhythm that compositors learned and adapted to their own work pace preferences (Cockburn, 1983; Rogers & Freidman, 1989). PTS had its own rhythm, one that was perceived as relentless by transitioning hot-metal compositors (Holtzberg-Call, 1992). The PTS equipment, for the most part, did its work invisibly with the need for few unprogrammed interventions by the operator. The equipment no longer limited the level of possible throughput; there were no elevators that could be hung up, and not even the finest operator could achieve the speed threshold of the machines (Rogers & Freidman, 1989). As a result, operators felt greater pressure to persevere at repetitive tasks for longer periods of time. Speed and volume were clearly more focused measures of performance than before the conversion. Newspaper compositors were not spared from this new emphasis on volume, because the easy storage and transfer of phototypeset

matter made it more likely that advance work, such as announcements, ads, or displays would be assigned to augment the regular edition work (Samaddar, 1994).

Control over work schedules is another aspect of work pace control that was negatively affected by the PTS technology. As part of the contract agreements that permitted the introduction of PTS, union printers gave up their traditional rights to delegate work to substitute printers. In addition, management gained all control over specific job assignments within the plant itself, which left some compositors frustrated by their lack of control over their day-to-day work tasks. Most agreed that printers still maintained more work pace control than did operators employed in assembly line manufacturing, but the loss of autonomy in their work was described by many observers and reflected increased boredom, monotony, and dissatisfaction among PTS compositors (Rogers & Freidman, 1989; Samaddar, 1994).

The role of supervision also changed in response to the introduction of the PTS technology. Hot-metal printers, craftspeople with highly internal standards of performance, had traditionally defined "good" supervision as "less" supervision, and because their skills made them experts in the processes they controlled, supervision was typically very hands-off and administratively focused. Following the introduction of PTS equipment, training for supervisory staff became far more accessible and, at times, more thorough than for compositors. Loss of reliance on hot-metal expertise changed the nature of supervisory control changed to include more operational intervention in the tasks PTS compositors were asked to perform. Printers viewed metal type, and the skills it represented, as a useful barrier that ensured their freedom from undue interference by management and other functional units (Cockburn, 1983). Supervisors were also

responsible, after PTS introduction, for making work and scheduling assignments, responsibilities that had previously been left to individuals or their chapel representatives (Rogers & Freidman, 1989). The type of supervisor relationships enjoyed by composition workers certainly varied between different shops and industries, but one observer described the atmosphere during this period in the production function of American newspapers as low in trust and characterized by win-lose dynamics (Argyris, 1974, cited in Engwall, 1978). Taken together, the evidence suggests a control shift between compositors and their direct supervisors.

Outcome Proxy 9a: Is there a change in functional diversification following technology adoption?

Outcome Proxy 9b: Is there a change in occupational unionization or union effectiveness?

There was a definite shift in functional diversification, especially on newspaper staffs, associated with the introduction of PTS technology. PTS was a productivity enhancing technology that not only allowed employers to increase the throughput of their production operations, but also to frequently reduce headcount in the composing function. A shift to phototypesetting could justify the reduction of composing staff by two-thirds (Scott, 1987; Rogers & Freidman, 1989). Looking at the printing industry as a whole, the number of compositors and typesetters as a percentage of total employment dropped from 17% in 1950 to less than 6% in 1980 (Scott, 1987). While a large portion of the displaced compositors were absorbed into other functional areas, it is clear that the production area as a whole was diminishing in size during this period (U.S. Bureau of Labor Statistics, 1973). The number of production workers as a percentage of all

newspaper employees dropped from estimated highs of 67 to 75% before the introduction of cold-type to 38% by 1981 (Fink, 1988).

Both the rate of unionization and the power of the union to exert influence over managerial decisions declined sharply following the shift to cold-type processes. Unionization rates plummeted as the number of ITU union members as a percentage of all working printers declined from 58% in 1967 to only 31% in 1983, a drop that Scott (1987) directly attributes to the deskilling impact of composing room automation. The number of employed union printers in the U.S. and Canada fell 24% between 1960 and 1976 (Rogers & Freidman, 1989). In ITU Local 6, undisputedly the strongest of the ITU locals, active journeyman members dropped from 9,559 in 1962 to 5,322 in 1977. The number of apprenticeships, which can reflect the vigor and growth potential of a union, also declined alarmingly during this period. In Local 6, which had previously boasted as many as 700 apprentices on their lists of trainees, only 70 were reported in 1975 (Winsbury, 1975). In addition to declining absolute and relative membership rates, ITU efforts to recruit new groups of printers into the union fold were increasingly unsuccessful. Success rates for organizing elections held by printing unions fell from 72% successful outcomes in 1958 to only 43% in 1981 (Scott, 1987).

Another indicator of the printers' union's "slow slide into oblivion" (Raskins, 1994: 12) was the inability of even its strongest locals to block the ultimate introduction of cold-type technology. Following turbulent contract negotiations between the New York Publishers Association members and the ITU in 1967, 1969, and 1971, employing papers began preparing for future contract disputes by establishing the Southern Production Program Inc. (SPPI). The SPPI was a facility in Oklahoma City, Oklahoma,

designed to train non-union workers in the use of modern PTS and offset production equipment. When ITU Local 6 called a strike during their 1974 contract negotiations with the *New York Daily News*, the employers' preparation was called into action. The paper continued to publish two million copies of the paper a day during the strike despite the fact that all 900 of its union printers were on the picket line. Thirty-five non-union employees, mostly secretaries, operated quickly installed PTS equipment to effectively break the strike (Raskins, 1994; Rogers & Freidman, 1989). The *New York Times* accomplished a similar feat the same year, putting out the paper with managerial ad clerical employee manning a small PTS setup and the *Washington Post* broke its printers' strike that year with non-union PTS operators trained at the *Miami Herald* (Winsbury, 1975; Zimbalist, 1979). During the same period, *The London Times* survived an 11-month printers' strike over the introduction of PTS technology (Samaddar, 1994).

The decline in power of the printers' union was almost inevitable, despite the negotiating tactics or collective actions they may have chosen to employ. The union's power was vested, ultimately, in its ability to control employers' access to skills critical to the employing firms' business. Phototypesetting was designed and implemented with the clearly articulated intentions of both reducing the size of the composing workforce via increased productivity of the new technology and reducing the level of skill required of operators by automating as much of the typesetting process as possible. As the union membership's qualifications were made obsolete, the union became impotent in its negotiations for job property rights, compensation packages, and workplace control.

Observed Outcomes

The outcome-related proxies addressed each of the five dimensions of empowerment employed in this study: meaning, competence, information access, self-determination, and impact. The first proxy revealed that there was an intensely felt loss of job meaning among users of the PTS technology. Loss of occupation-related status and pride in work quality are frequent themes in printers' descriptions of the transition from hot-metal to cold-type. Work that had previously been considered important and "glamorous" had been reduced to routine and unrewarding for many.

The level of printer competence is a complex dimension and the proxies revealed a mixed, but predominantly negative, outcome associated with the transition to cold-type. PTS equipment clearly enhanced performance in terms of increasing the speed and potential volume of typeset output. The technology, however, also had a strong negative impact on the level of skill necessary to successfully complete typesetting. In addition, printers felt that the quality dimension of their work was diminished as a result of the transition to PTS processing. In short, the PTS equipment did satisfy its purchasers' expectations by speeding up production and may have supported users in meeting productivity goals set for them by their supervisors. But at the same time, the technology reduced the level of user skills required to satisfy these goals and expectations, deskilling the work, and reducing the users' perceived competence on the job.

Evidence describing changes to user access to information related to the new technology is difficult to interpret. Continued job fragmentation and computerization of the PTS devices could have been used to improve individual performance feedback, but there is no direct record of this actually occurring. Quieter, cleaner work environments for users of smaller, less obstructing equipment may have improved the ability to

communicate between coworkers, but it is also possible that dispersion of the composing function between different departmental areas may have created barriers to intradepartmental information sharing. Also confusing are the reports that communication and interaction between the editorial and composing function increased following the transition to cold-type production. The nature of this interaction is actually more suggestive of increased direction and control of the composing function rather than evidence of organizational information sharing. As a result, this dimension of empowerment cannot be interpreted.

Printers experienced a strong decline in self-determination following the introduction of PTS equipment into the composing room. Printers perceived that they had less control over the pace of their work, because of the increased focus on speed and volume of output, as well as the narrower task set associated with the cold-type printers' jobs. The role of supervisor changed as the level of the compositors' required skills diminished. Supervision became more direct and hands-on, and the span of the supervisors' discretion over the compositors' jobs expanded to include task assignments and work schedules.

Finally, this technological innovation had a devastating impact on the printers' ability to impact the organization outside the composing room. The ratio of compositors compared to other occupational groups fell as their work was automated and management reduced production head counts. Where they had once presented an imposing presence in terms of sheer numbers, their numbers were diminishing in response to early retirement, reassignment, furlowing, and lay-offs. Automation and computerization represented by the PTS technology succeeded in undermining the power of the printers' union to protect

their traditional rule over the composing room and, ultimately, to protect their role as craftworkers.

This investigation has clearly demonstrated that the technological innovation represented by introduction of PTS technology into newspaper and commercial printing establishments during the 1960s and 1970s effected a strong negative change in the level of user-perceived empowerment. The IT-empowerment model predicted a strong negative impact of the innovation, a prediction that has been supported by this investigation.

INVESTIGATION IV: DIRECT-ENTRY, COMPUTERIZED PHOTOTYPESETTING

The Innovation

The keynote speaker at the 1963 meeting of the American Society of Newspaper Editors made several bold predictions about the future of printing technology. He predicted that, within ten years, newspapers would be produced by electronic composition and printing equipment, that all news would be fed directly into a computer by reporters, wire news services, or from each newspapers own electronic library of stories. Traditional typesetting would be totally replaced by on-screen editing and pagination, and fully digitized pages would be transmitted to fully autonomous plate-making machines or eventually directly into the homes of readers (Hynds, 1980). While his time estimations may not have been perfect, much of his vision was realized when direct-entry phototypesetting systems (DEPTS) were adopted throughout the newspaper industry during the 1970s and 1980s. Newspaper managers' dreams of eradicating the composing function as an intermediary between the editorial and press departments

finally became reality with the increased computerization of the journalistic process (Fink, 1988).

Advances in high-speed phototypesetting equipment during the 1960s and 1970s brought increased attention to the limiting slowness of keyboard copy input. As early as 1964, one observer characterized manual keyboarding of text for phototypesetting as "...analogous to fueling a jet with an eyedropper!" (Johnson & Moore, 1966: 14). Publishers clearly understood that re-entry of copy in the composing room could be eliminated if they could capture the copy when it was originally created by reporters, editors, and ad designers. Early attempts were made on a few newspapers to have reporters type their work directly on tape-punching devices, but most writers were not accurate or fast enough typists to make this approach feasible (Johnson & Moore, 1966). During the early 1970s, scanners were implemented as a relatively short-term step in the push for direct text entry (Willis, 1988). Scanners used rudimentary optical character reading technology to decipher text typed by reporters. The text was then stored in digital form in the device's internal memory, on magnetic tape, or disks for use in driving the high-speed phototypesetter. Reporters were required to prepare their copy on special paper, using a scanable font, triple-spaced, and marked with machine-readable codes to allow tracking and proper processing. Scanners varied in reading speed anywhere from 225 to 4,000 words per minute, far faster than human typists. Error rates in the typeset product associated with character conversion were estimated between .01 and .004%. While scanning text seemed an appealing option for reducing the amount of re-typing in the composing room, reporters were not fully successful at preparing copy for scanning (Willis, 1988).

The financial incentive for bringing scanner technology into the composing room was potentially significant. For example, the Worcester (Massachusetts) *Telegram and Gazette* spent $89,000 for one OCR scanner and was able to replace 12 tape keyboard operators in the composing room who represented a combined annual salary cost of $120,000 (Compaine, 1980). The usability of the scanner technology was not above question, however. The formats and coding requirements for the scannable copy were quite strict, the conversion from manual typewriters to electric machines was difficult for some reporters, typing accuracy was notoriously poor among the writers, and corrections frequently required retyping of manuscripts many times before they could be scanned (Compaine, 1980). The number of scanners in use by ANPA member newspapers was first recorded as 186 in 1973, and the number peaked at 738 in 1977. By 1978, the number of scanners in use had already begun to decline as improved computer technology made scanning a less attractive approach for capturing copy at its source (Hynds, 1980).

Distributed keyboard input was made possible by improvements in computer hardware and software technology. Speedier data transmission rates, improved video capabilities, larger data storage, and more sophisticated network and data management software made the approach technically possible. Improved reliability of the system components and falling price tags made it the solution of choice for most newspapers that had already made the switch to cold-type production (Standera, 1987). Copy input by compositors, which had already been highly automated by computer-assisted PTS technology, was made obsolete by the networked computer systems. Human intervention in the process of text justification, aligning, and formatting had become so insignificant

that the process no longer required specialized operators. Text preparation for the automated typesetters could be performed by reporters, editors, or other originators of the copy destined for typesetting as a marginal activity, requiring little effort or attention beyond that devoted to writing and editing copy (Lown, 1977). Networked video display terminals (VDTs) and keyboards were installed at the reporters' desks, replacing their typewriters. Instead of typing their work on their typewriters, news stories, columns, and other copy were typed directly on the VDT keyboards using highly simplified formatting codes and easy-to-use on-screen editing features. The computer set appropriate formats, counted the number of words, and checked the spelling. When a story was completed to the writer's satisfaction, it was stored in internal memory for later use or immediate review by the appropriate editor. Editors also worked at VDTs, accessing stored files, editing and approving copy before dispatching it through the network to the computer-controlled phototypesetter. Formatted, typeset copy was processed by the on-line PTS unit and then delivered for paste-up and photographic plate-making, tasks that were relatively unaffected by the introduction of the new computerized front-end systems (Fink, 1988; Hynds, 1980; Willis, 1988; Winfrey, 1978).

Wire news services were early supporters of on-screen editing and DEPTS. UPI was using an early version of the technology as early as 1973, and they claimed that the technology allowed them to file 20% to 30% more news and to file important news stories faster. By 1976, they had converted all 100 of their domestic bureaus to DEPTS, years before many newspapers had progressed beyond the experimentation stage with VDT-based systems (Carter & Cullen, 1983; Hynds, 1980). Many newspapers, however, were struggling with the expense of providing terminals for each staff writer. While it

was estimated that reporters spent less that 10% of their work time actually typing their stories, most of the input occurred in the few hours immediately before press deadline and shared terminals were not viewed as practical (Williams, 1967).

By the mid 1970s, many papers had installed at least some stand-alone terminals for use in copy creation and editing, frequently used side-by-side with scanners and electric typewriters (Lown, 1977). The *Chicago Sun-Times* and *Daily News* were early adopters of DEPTS technology. In 1975, they decided to install the ATEX editorial system, consisting of at least 100 reporters terminals and 50 editor's terminals wired to IBM 370 system manager, database server, and back-up computers (Anonymous, 1975). Improvements in the systems and lower equipment prices lead to a surge in the installation of DEPTS systems over the next decade. *The New York Times* converted to full-scale direct-entry system on July 3, 1978, three years after the initial introduction of DEPTS in the classified ad section. At *The Times*, 129 linotype machines were replaced by five computer-directed phototypesetting machines (Browne, 1978; Winfrey, 1978). In 1979, *The New York News*, the largest distribution newspaper in the U.S. at that time, was preparing to install a distributed front-end system that consisted of 239 VDT input terminals for use by reporters and editors, linked to 12 mini-computers running editorial software and two mini-computers that controlled the phototypesetting units (Compaine, 1980). The number of VDT units in operation in ANPA member newspapers jumped from zero in 1969 to 15,841 in 1978 and 40,651 by 1981 (Compaine, 1980; Fink, 1988).

While a major force behind the adoption of DEPTS technology was the goal of eliminating re-keying of news and editorial copy, it was also widely implemented to further automate the input and processing of classified ads (Fink, 1988; Wallis, 1975). In

fact, conversion of the classified ad section to direct entry and computerized typesetting was often the first step in the phased implementation of DEPTS (see Winfrey's (1978) description of the DEPTS inroduction at the *New York Times*). Classified ad clerks, who were frequently reassigned composing room employees, working with DEPTS on-line keyboards, could input ad copy directly into the computer, as well as customer billing information. The system not only automatically sorted and formatted the ads, but could also processed billing, and monitored the copy file for expired entries (Compaine, 1980). Terminals were also placed in the newspaper sales departments where operators could create display advertisements directly from their workstations, consulting easily with marketers, designers, and even customers. In most cases, on-line input terminals were also in place in the composing area where dedicated operators could process the odd bits of material that did not fall within the purview of other typesetting input points. Stories from off-staff reporters, letters to the editor, unexpected corrections, and advance work could all be processed by dedicated compositors in the composing department (Compaine, 1980; Rogers & Freidman, 1989; Winfrey, 1978).

Model Proxies

Model Proxy 1a: What occupational group interacts directly with the new technology?
Model Proxy 1b: Is the technology widely adopted in the industry (occupational saturation)?
Model Proxy 1c: Do workers use the technology to complete most of their work tasks?

Because of its distributed nature, the technology represented by DEPTS, VDT-based copy input and editing terminals and networked micro-computers running editorial software, was used by a broader range of occupational groups than were earlier innovations. The most visible group of users were the reporters, editors, and other

journalists working upstream of the production department. Writing activities, which had previously been accomplished by typing out copy on manual or electric typewriters, were accomplished by entering the text directly into the computer via the VDT keyboard located at each reporter's desk. Editors, who had previously marked-up copy by hand, were able to perform these tasks electronically at their own VDTs, inputting changes directly to the electronically stored copy or returning the copy to its originator for more significant rewrite. Reporters typically spent only a small portion of their total work time directly writing the stories they created. The bulk of their efforts generally revolved around collecting information, researching stories, and interviewing sources. One estimate of the percentage of actual time reporters spent at their keyboards was 10%, but a more generous estimate of 20% to 30% still leaves use of the DEPTS as a marginal activity for reporters (Williams, 1967). Editors, especially those entitled line or copy editors, were responsible for reviewing and correcting all of the copy produced by writers in their departments. As a result, they devoted a greater proportion of their time to working directly with the electronic copy via the VDTs.

A small percentage of existing compositors continued to be responsible for copy input using the new technology. Some of these workers remained in the composing room to handle copy that was not input in another department, such as stories from non-staff reporters, notices, advance work, and perhaps classified ads and display work (Carter & Cullen, 1983). In some shops, compositors became more specialized in terms of copy content and were reassigned to functional units outside of the production area. Compositors, often working under new job titles such as ad clerk or keyboard operator, could be found in the newsrooms, editorial departments, classified ad sections, or in sales

departments (Fink, 1988). In effect, the composing room had been transformed from a separate department into a subordinate technical arm of other departments responsible for the creation of newspaper content (Winsbury, 1975). Those compositors who remained on staff worked directly with the new input terminals practically on a full-time basis. Paste-up workers were largely unaffected by this technological innovation and generally remained associated with the composing room and the production function.

Occupational saturation of this technology was substantial for all three types of users. The DEPTS technology represented an overwhelmingly attractive opportunity for newspaper managers to reduce the costs associated with a dedicated composing function, save time in the transformation process between story creation and printing, and shift organizational control up the production stream to the editorial function. The diffusion of this technology into newspapers of all sizes was both rapid and widespread, and by the mid 1980s it was accepted as the status quo technology for modern newspaper production (Fink, 1988).

Model Proxy 2: Does the technology mediate or perform tasks previously performed by workers (automation); does it provide information to support decision-making by users (decision support); or does it support the sharing of interpersonal communications between individuals and groups within the organization?

For newspaper compositors, the VDT-based input represented increased automation of their traditional copy input tasks. The new systems operated with software that was more sophisticated than earlier hyphenation-and-justification programs. The software was more accurate in making formatting, layout, and printing decisions and could also integrate functions such as billing and credit approval, in the case of classified ads, that had previously been performed by other departments (Compaine, 1980). The

system was not employed to support decision-making by the compositors, nor did it serve to facilitate the transfer of organizational or interpersonal communications between users.

In the editorial department, DEPTS was implemented to provide both decision support and automation functions. On-screen editing features of the technology supported writers and editors in their creative efforts by converting their keyboarded input into characters on the VDT screen, which could be deleted, added to, or rearranged with simple keystroke commands. The ability to observe and manipulate the text visually made it easier for journalists to make intellective and creative decisions about word choice, composition, story content, and overall organization and quality of the story being written or edited. Editors, who were responsible for tailoring news items to fit newspaper space requirements, also were able to exploit system features, such as on-screen preview of typeset copy, to reduce trial-and-error in their decision making (Standera, 1987). Electronic story filing also made it possible for reporters to easily access and revisit previously drafted work and for editors to collect and review the stories completed, or in progress, by their reporters.

The direct-entry system also automated typesetting tasks that had previously been performed by specialists in the composing room. DEPTS removed the lion's share of text-entry tasks from the composing room and relocated it, in a simplified form, upstream to the reporters' and editors' desks. The innovation was responsible for adding production-related responsibilities to the journalist's job, but the technology had so automated the process that the added function was virtually transparent to the new users. As a result, it is suggested that the automating role of the new technology would not be as clearly perceived by users in the newsroom as its role in supporting their creative and

intellective work. Here we have an example of a single technological implementation that functioned as automating technology to one set of users and, at the same time, decision support technology to another.

Model Proxy 3: How was the pre-innovation performance level of users judged: qualitatively or quantitatively?

Compositors, prior to the introduction of DEPTS, were evaluated by their employers predominantly on the basis of quantitative measures of output, namely the volume of work completed and the speed with which it was produced. Editorial workers, on the other hand, were subjected to more qualitative standards of performance. The ability to work under time pressures was an important skill for everyone working in an industry with a daily, or even weekly, production cycle, but the criterion which differentiated exceptional reporters from the mediocre was the quality, rather than the number or length, of the news stories produced. Reporters who could anticipate newsworthy events, locate sources, collect relevant information, interpret facts logically, and present it in a clear and engaging story were the most sought-after and rewarded editorial employees, despite the common complaint by reporters that their editors were overly concerned with speed. Number of words written was never an indicator of superior performance. Similarly, editors were generally required to review and edit copy efficiently, but the key measures of their success was the quality of the individual stories they approved and edited for publication, the coverage of important topics that was represented in the printed stories, and how well they managed the work flow of their particular editorial departments.

Model Proxy 4a(1): Is use of the technology mandatory?
Model Proxy 4a (2): Are users able to customize their use of the technology?

There is no evidence to suggest that any of the users had any significant discretion over whether or not they used the direct-entry technology once it had been implemented by newspaper management. It is reasonable to assume that during transitional periods or when newspaper management had not committed to full-implementation of DEPTS, reporters and editors may have been presented with the choice of inputting and editing their copy directly via the terminals or handing off typewritten text to the composing room specialists. Following full installation, however, when composing room workforces had been reduced to skeleton crews of keyboard entry operators and VDTs replaced the typewriter at every reporter and editor's desk, the option to delegate text entry was not likely to have been available to many. Special circumstances may have made a low level of discretion available, for example, for reporters calling in *ad hoc* stories, string reporters without access to terminals, or for the few writers who were adverse to using the new technology and were accommodated because of their exceptional popularity, stature, or tenure with the paper (Rogers & Freidman, 1989). Dedicated compositors, whether working physically in the composing room, classified ads, or editorial, apparently had even less ability to choose between alternate means of completing their tasks. Increased automation of processes and the electronic transmission of the work product during the production stream made it virtually impossible to deviate from a standardized technology.

The ability of users to customize the way they interacted with their individual VDTs, the ease of overriding automatic features, and the amount of flexibility programmed into the editorial software programs is not clearly described in the literature.

Most of the systems installed during this period were purchased from a few designers/manufacturers who provided cost-efficient, industry-standard solutions for the majority of newspaper in the U.S. making the shift to direct-entry composing (Lown, 1977). It is likely that purchasers sacrificed a certain level of flexibility in their systems because of their lack of expertise in developing their own software.

Model Proxy 4b(1): Did management consult with users before or after initial implementation?
Model Proxy 4b(2): Did users make decisions about the technology before or after initial implementation?
Model Proxy 4b(3): Are users able to block or control implementation through collective action?

In contrast to descriptions of earlier innovations, there are reports that suggest that some newspapers did involve representatives from various functional departments in decision-making concerning the design and evaluation of prospective DEPTS systems. *The Baltimore Sun and Call-Chronicle*, for example, were described as collecting input from the news, classified, display, and production departments before choosing an on-line system (Compaine, 1980). Other observers noted that production chiefs were too frequently the defining voice in choosing front-end technology, and others noted that input from the advertising departments was generally neglected while the editorial staff enjoyed high levels of participation. It is clear from descriptions appearing in trade journals and periodicals that participation in technology-related decision making is considered an important ingredient for ensuring the procurement of systems that meet users needs. It is also evident that much of the involvement described was frequently via supervisory or managerial representatives of the functional departments rather than direct user or non-management involvement (Wolferman, 1994).

Union involvement in technology decisions related to introduction of DEPTS was minimal, at least in the U.S. By the mid-1970s, the ITU was focusing its efforts on preserving the job security of its members who were still employed in newspaper publishing. During the late 1960s and early 1970s, many newspapers had successfully broken the ITU's right to represent the printers in their composing rooms. In some shops, the ITU maintained jurisdiction over the equipment and the few remaining jobs in the composing room, but even the strongest locals had ceded the control it had once exercised over workplace technology (Holtzberg-Call, 1992; Zimbalist, 1979). While some other affected occupational groups had a low level of unionization, for example American Newspaper Guild represented reporters in a few newspapers, there is no evidence to suggest that they were active in resisting or participating in decisions concerning direct-entry technology (Compaine, 1980). British journalists, represented by the National Union of Journalists, did resist DEPTS introduction in the early 1980s, but the political pressures to improve productivity in the British publishing sector motivated a rapid quashing of the resistance (Samaddar, 1994).

Model Proxy 4c(1): How much training have most users received?
Model Proxy 4c(2): Do users express difficulties using the technology?

In general, formal training identified as facilitating the changeover from composing room typesetting to on-line, distributed VDT-based composing were rather insubstantial. Most reporters and editors learned to use the new equipment through in-house training, brief vendor-provided training sessions, informal experimentation, or some combination of the same (Lown, 1977). The American Press Institute offered a two-week class to its member on the operation of newsroom technology, including

scanners and VDTs (Lown, 1977). While the intensity and formality of training offered by different employers varied considerably, there is little evidence in the literature to indicate that users felt their training needs had not been met. Newsroom users of the VDTs often expressed some anxiety at the initial transition, but also described the transition as reasonably easy with little training required (Compaine, 1980; Lown, 1977). The Associated Press reported that staff began to feel comfortable at the VDT with only "a day or two" of practice (quoted in Compaine, 1980). There are no descriptions of training provided to PTS compositors who continued to function as full-time compositors after the introduction of DEPTS, which may be interpreted as indicating that the added skills required of the new system were not substantially different from the skills required by the previous technology.

Model Proxy 4d: Is there an increase in wage level for users following implementation of the technology?

Among compositors, the presence or absence of financial incentives associated with the introduction of the new technology is a complex question. Local 6 of the ITU did succeed in its contract negotiations of 1973 with the New York Publishers Association in gaining substantial wage increases for currently employed members, in addition to exceptional lifetime job guarantees and attractive retirement and voluntary severance compensation packages. The price, however, for these considerations was the complete relinquishment of control over workplace technology, job property rights, and a tiered compensation agreement that paid reduced salaries to any workers hired in the future (Raskins, 1974; Zimbalist, 1979). Phototypesetting equipment was installed in New York Big 6 composing rooms for the first time in 1974 and by 1977 direct-entry

VDT equipment were being introduced (Lown, 1977). Printers affected by these agreements saw their complement shrink by over two-thirds over the next 11 years, and those that remained suffered by insufficient workload, boredom, and alienation. By 1979, more than 85% of the content of the *New York Times* was being set via direct-entry VDT, leaving the remaining composing room staff with little to do (Rogers & Freidman, 1989).

The situation in New York City was certainly the exception to the rule concerning compensation levels for compositors following VDT introduction. In many cases, the ITU continued to represent what was left of the composing room after the changeover, including paste-up workers and dedicated compositors. Union compositors continued to out-earn non-union printers, typically earning annual salaries in the $10,000 to $12,000 range. In some union contracts, new classifications were defined to capture skill requirements of keyboard operators, which required less training than journeyman printers and were priced at less-than-journeyman rates (Compaine, 1980; Scott, 1987). In other cases, however, unions were decertified and workers in the composing room replaced by a smaller number of non-union workers at about half the ITU pay scale. The capturing of copy at its creative source made it possible to drastically reduce the size of the composing staff, and, coupled with the de-skilling of the input process, it was possible to replace the few remaining composing room craftspeople with less expensive semi- or unskilled workers (Compaine, 1980; Zimbalist, 1979).

The income levels for reporters and editors did not appear to have been directly or immediately affected by the introduction itself of the direct-entry technology. It was reported in 1992, however, that the real income of the average journalist had declined

during the preceding three decades because of wage stagnation (Oring & Danko, 1995). There are also no descriptions in the literature that identified examples of other, more individual, forms of financial incentives being used to encourage affected writers and editors to learn and accept the use of VDTs as a new journalistic tool.

Model Proxy Summary and Prediction

In evaluating the results of the first four proxy investigations, it is evident that two distinct occupational groups were primary users of the DEPTS innovation: existing PTS compositors and journalists. The technology was widely diffused in the newspaper publishing industry and, as a result, occupational saturation of the technology for both groups was high. The introduction of the technology, which permitted the on-screen input and editing of copy directly into the computerized typesetting equipment by the copy originators, led to a sharp reduction in the number of dedicated compositors employed by newspapers. The few compositors who survived the headcount reduction, however, used the equipment extensively to complete the tasks that were allotted to them. Job saturation for these users was quite high. Journalists were also direct users of the technology, but to a somewhat lesser degree of intensity. Writers and editors were responsible for performing a number of tasks that did not involve hands-on use of the direct-input systems, such as researching stories, organizing information, approving and planning news coverage, assigning stories to reporters, and coordinating the activities within and between departments. As a result, job saturation for journalist users of the systems was more moderate.

The two types of users also differed in terms of the types of tasks they were responsible for completing and the way the technology was used to support their work.

The work performance of compositors was evaluated predominantly based on quantitative criteria, and hence they are identified as occupying non-expandable jobs. The direct-entry typesetting technology, as employed in these non-expandable jobs, further automated tasks previously performed by the users via other typesetting technologies, or in the case of the classified ad entry systems, by other workers. Conversely, the performance criteria for journalists were predominantly qualitative, and, as a result, they are best categorized as occupying expandable roles. Further, the technology was used predominantly by journalists as a way of providing timely information, in an on-screen form not previously available to them, with which they could better make decisions regarding their work. Therefore, DEPTS was implemented as a decision-support technology for journalists.

The implementation context for the direct-entry typesetting introduction appears to have varied for the two user groups, but perhaps only marginally so. Compositors who remained on staff in the composing room or in other department had little or no discretion in when or how they used the technology. While it was reported that the head of the production area frequently was instrumental in making decisions concerning the design and choice of distributed front-end systems, there is no evidence that the compositors themselves participated directly, either in terms of voice or choice, in such decision making. The ITU, their formal union representative, had previously ceded all control over workplace automation and was more interested in obtaining job guarantees for the compositors remaining on the job. Formal training for the few remaining compositors was not viewed as essential by newspaper management. The new system did not require significantly new skills, and training that was required, for example on the classified ad

systems, was addressed informally with on-the-job instruction. The last aspect of implementation context, rewards and incentives, was clearly not a positive influence. In fact, the average income level of printers working with the technology fell as a result of the creation of lower-paid job classifications in union shops and the replacement of skilled printers with semi-skilled keyboard operators in non-union shops. For these technology users, then, the implementation context was non-supportive of an empowering innovation outcome.

Editors and reporters who used the direct-input systems in the newsroom experienced the technology implementation in similar fashion. Discretion over system use was also determined to be relatively low, but it was reported that journalists commonly had some level of input into system-related decision-making. Journalists also received training on the new equipment, either through vendor or trade association classroom training, employer-provided on-the-job training sessions, and informal peer demonstration. Lastly, while journalists did not experience decreased income levels associated with the new technology, there is no evidence that salary increases or other rewards were offered to journalists in exchange for their cooperation in the changeover process. In total, the mixed nature of the technology implementation for journalist users suggests a neutral or slightly negative empowerment impact.

The IT-empowerment model predicts different outcomes associated with the introduction of direct-input typesetting technology for each of the two groups of principle users. For compositors, the introduction of an automating technology into non-expandable jobs should manifest a decline in user empowerment. Combined with a non-supportive innovation context, the decline should be a strong one. Journalists, however,

occupied expandable jobs and experienced the direct-entry systems as decision support technology, more so than automation, and the model predicts that use of the system should lead to an increase in user empowerment. The innovation context, which was determined to be neutral or slightly negative, should have a slight dampening effect, resulting in a slight rather than strong increase in empowerment. These predicted outcomes are compared in the next section with observations related to the five dimensions of empowerment: meaning, competence, information access, self-determination, and impact.

Outcome-Related Questions

Outcome Proxy 5: Is there a change in occupational status for users following adoption of the innovation?

Among journalists, there is evidence of both positive and negative shifts in occupational status in the years following the introduction of direct-input technology, not all of which can be clearly associated with the technology itself. In the U.S., a clear downward trend in public respect for newspaper reporters, as well as participants in other forms of mass communication media, has been reported during the past two decades. The news media, in general, has acquired a public image as overly aggressive, less than honest, disrespectful of individual rights to privacy, and generally low in ethical standards. Increased competition for the reading or viewing public has motivated news, and quasi-news, organizations to focus on stories that appeal to wider audiences and to rush information into print or broadcast with less time allowed for reflection or monitoring. Despite this decline in public respect, however, journalist are still viewed as wielding considerable power over the public's access to information about current events,

public figures, and issues of political, cultural, and economic concern (Oring & Danko, 1995).

Internally, journalists have maintained a relatively high self-image regarding their occupation, which is manifested in a high level of professionalism and occupational community (Pollard, 1994, 1995). Professionalism is a term used to describe an individual or group's attitude toward their work that reflects a highly developed identity with their occupation rather than their employer, an internalized code of acceptable performance standards and behaviors, and a drive to perform their tasks based on intrinsic rather than extrinsic motivational factors (Pollard, 1995). Occupational community is a related construct that describes the level of social cohesion and occupational identification characteristic of an occupational group. Journalists are described as having a high level of both professionalism and occupational community both before and after the introduction of the direct-input technology. Reporters and editors have traditionally had a high level of participation in professional organizations, view their work as being of high social value, and believe their skills and expertise render them the best arbiters of the quality of their own work product (Pollard, 1995). A 1992 study found that 61% of surveyed newspaper journalists reported that the chance to help people was very important to them, and the most significant predictor of their overall job satisfaction was the extent to which they believed their newspaper informed and educated their audience (Weaver & Wilhoit, 1994). A 1995 survey found that editors were very serious about maintaining and enhancing the credibility and integrity of their newspapers' output. In fact, the editors described this objective as a personal responsibility (Fitzgerald, 1995). Among journalists who do reported dissatisfaction with their occupation, most attributed

this dissatisfaction, at least partially, to their newspapers' reduced focus on serving the public (Pease, 1992). In a 1989 study of newspaper journalists, it was determined that job satisfaction was not related to compensation levels, but was significantly correlated with perceived autonomy (Olson, 1989).

The effect of direct-input technology on the occupational status of dedicated compositors is difficult to interpret. Following the widespread adoption of distributed front-end systems, the very existence of composition as a clearly identifiable occupational presence in newspaper printing was compromised. The decline that was initiated by the adoption of early phototypesetting systems, continued into the 1980s with the loss of skilled craft status, relocation of compositors from a centralized department to content-specific work in other departments, wage cuts, reassignment of compositors to other jobs, and headcount reductions via lay-offs and early retirement programs. Employees recruited by newspapers following the introduction of DEPTS tended to be quite young and less stable in their position tenure. Turn-over among compositors increased at one paper from 8% before implementation of direct-input technology to over 25% following implementation (Hynds, 1979). The tasks that remained under the jurisdiction of the occupation--keyboarding incidental copy, paste-up, and feeding scanners--were all considered low status and uninteresting by compositors who had been trained during a period when the paper could not go to bed without the efforts of the printers in the composing room (Compaine, 1980).

Outcome Proxy 6a: Is there a change in occupational training requirements following adoption of the technology?

Outcome Proxy 6b: Are users better able to meet their performance goals using the technology?

Training requirements for dedicated compositors were reduced significantly following the adoption of direct-entry systems. One researcher described the VDT text input as a job that could now "...be handled by high school graduates fresh off the school bus--and at half the pay [of craft printers]" (Compaine, 1980: 167). While PTS-related keyboarding was also partially automated by computerization, the improvement in software sophistication, typesetting equipment, fragmentation of tasks, and specialization of work content reduced the training requirements for compositors from about a year for PTS composing room work, to the equivalent of about a week of training for conversion to the new systems (Scott, 1987; Compaine, 1980). The front-end system captured enough of the skill of the compositor to justify a 98% reduction in the training requirements.

Journalists did not experience a reduction in training requirements following direct-input adoption, but neither did they find themselves subjected to significant increases in training needs. The use of VDT direct-entry systems by reporters and editors was not perceived as demanding any particularly difficult skills that a short period of in-house, vendor, or outside instruction could not teach. Journalists' critical skills focused on researching, writing, and editing news stories. Most journalists were reported to find the new systems easier to use, even than expected (Compaine, 1980).

At the organizational level, the investment in DEPTS enabled huge cost reductions based on cutbacks in production headcount, lower wage scales for remaining compositors, and improved capabilities for performing pre-press tasks in-house. The *Baltimore Sun*, for example, estimated that its $3 million investment in distributed input technology would repay itself in only three years based on a planned annual attrition rate

of 7% in its composition staff alone. Many early implementers of distributed front-end systems validated their decisions to invest in automated and distributed typesetting based on standard financial measures of increased productivity. Dow Jones, the publisher of the *Wall Street Journal*, calculated that a $1.5 million investment in composition automation between 1969 and 1973 paid for itself in pre-tax profit every nine months. The sister publications, *The Raleigh Times* and *The News and Observer*, invested $1 million in phototypesetting and distributed front-end technology in the mid 1970s, and realized annual payroll savings of $628,500 in the first year after introduction and $724,500 the next (Compaine, 1980).

In the composing room, the most noticeable impact of direct-entry was in reducing workloads, headcount, and the range of tasks performed by compositors. In the incidental typesetting that remained in the composing room, productivity improvements did occur as a result of improvements in software and typesetting hardware. Soft proofing, which involved proofreading of the copy on the VDT, replaced hardcopy proofing which was necessary with earlier tape-punching keyboards (Standera, 1987). Fourth-generation laser typesetters required little operator intervention, were able to produce more variety in size and style of fonts, and set larger, more complex bodies of copy in a single job. Machine monitoring, specialized handling of copy input, and paste-up times were all reduced. For compositors reassigned to the classified ad department, automated systems created phenomenal improvements in productivity. Operators of the automated ad systems could accept information from customers, handle billing, input text, organize and sort ads, and send the entire section to the typesetter in less time than advertising clerks could previously take orders for ads from customers. By relocating the

automated input process to the source of copy, the time dedicated to setting the type was cut from hours to only minutes (Hynds, 1980).

Performance effects associated with direct-input technology in the newsroom were also generally described as positive. Journalists reported that the terminal keyboard and on-screen editing features made their writing and editing tasks faster, neater, and more efficient (Lown, 1977). The speed of the systems made story writing more aggressive, encouraging reporters to "attack, get words on the typewriter [VDT] quicker" (quoted in Compaine, 1980). While some observers claimed that use of VDTs was responsible for over-written stories, this was largely observed to be a transitional problem. Experience with the systems led most reporters to conclude that on-screen editing made it easier for writers to massage their stories, moving around sentences and paragraphs to produce higher quality work. Improvements in journalistic quality were also observed in relation to increased timeliness of newspaper stories. The abbreviated production cycle was credited with making newspapers more responsive to emerging or late-breaking events because reporters could create, self-edit, and file stories much closer to press time. The editor of the San Diego Tribune gave credit for its 1978 Pulitzer Prize to its computerized front-end system that allowed it to include coverage of a mid-air jet collision that occurred only one hour before press time (Compaine, 1980).

Interestingly, direct-input systems seemed to create more productivity pressures for editors than for reporters. Editors did not find that on-screen, electronic editing significantly reduced the time required for reworking reporters' stories. Some found that they had a tendency to devote more time to editing each story than they had when they worked with blue pencils on typescript. It was suggested that this may have been

associated with the realization that there would be no one to blame in the composing room for errors that found their way into the final printed edition (Lown, 1977). As one author described the situation, copy errors previously referred to as "typos" should be renamed "editos" under the new system (Pease, 1992). This tendency to heavy-edit came despite some early critics warnings that on-screen editing would lead to less careful or conscientious review by editors (Furhoff, 1976, cited in Engwall 1978). Editors found that while the systems provided functionality that supported their roles in editing, approving, and routing copy, organizing newsroom activities, and making content and layout decisions, they also tended to shift more vertical and horizontal responsibility to their positions. As a result, the editorial staff tended to feel that their productivity was constrained by the new equipment, while their effectiveness was enhanced. Many papers found that reductions in the composing room were at least partially offset by some increases in editorial staff following introduction of distributed front-ends (Compaine, 1980).

Outcome Proxy 7a: Do users receive more direct performance feedback following introduction of the technology?
Outcome Proxy 7b: Are users able to converse with coworkers more freely?
Outcome Proxy 7c: Is there more active communication between users and other departments?

Once again, there is little clear evidence concerning the impact of this technology on dedicated compositors' access to information in the organization. No information was discovered that described the directness or availability of performance feedback provided to the compositors working either in the composing room or in different functional areas. There is no reason to suggest that communication within the composing room, per se, was materially affected by the new technology, but it is likely that communication and

sharing of information between compositors working in various functional areas, such as the newsroom, classified ads, or sales, was reduced due to physical separation and new reporting relationships. Numerous authors described the direct-input systems as breaking down barriers between production and front-end departments, which resulted in more direct interaction between the individuals in the departments (Engwall, 1978). It is possible that this increased interaction supported the sharing of organizational information, but it is also possible that the increased subordination of the composing function to editorial and administrative units did not leave them in an advantageous position in the communication chain. Unfortunately, there is simply not enough direct data to resolve this question.

For reporters, performance feedback was certainly supported by the technology as a result of improved process monitoring by editorial staff. The on-line systems gave editors the ability to monitor story progress, in terms of incrementally reviewing story drafts and outlines and tracking performance statistics, such as numbers of required revisions, missed deadlines, and error rates (Carter & Cullen, 1983; Engwall, 1978). The system made the process of reporting more transparent to the editor, who, in turn, was better able to assist reporters in resolving specific problems or developing improved journalistic skills. The performance statistics collected by the on-line systems also provided some measure of on-going performance, if not a particularly comprehensive measure. There is no evidence that the technology had any effect on the directness or availability of feedback for the editors themselves.

The on-line front-end did facilitate the sharing of work-related information between journalists, because story notes, contact information, and archived material

could be electronically stored in a format that was easily accessible by other reporters. From another perspective, mobile VDT units, which allowed reporters to complete more of their work in the field, probably had a negative impact on the cohesion of the newsroom staff and the sharing of information between individuals. At this stage of the technology's development, inter-organizational communication concerning such topics as unit and organizational performance, operations, or routine events, were not supported. Despite the decentralization of the composing function, the remaining functional units tended to become more horizontally differentiated as increasingly sophisticated computerized typesetting systems mediated more and more of the newspapers' workflow (Engwall, 1978). Functional areas frequently experienced reduced personal communication with one another as their work efforts became less interdependent and chances increased that they were geographically distributed.

Overall, it appears unlikely that direct-input technology had a positive overall impact on journalists' access to information. While reporters probably benefited from better process-related feedback from their editors, feedback to editors was not improved. At a another level, electronic storage of journalistic work products facilitated work flow and task completion, but increased mobility of reporters and horizontal differentiation of functional units associated with the new technology's adoption likely had a negative effect on both the sharing of departmental and organizational information.

Outcome Proxy 8a: Does user control over work pace change following technology introduction?
Outcome Proxy 8b: Does the relationship between users and supervisors change?

Literature addressing the level of work pace control exercised by compositors in the composing room and in other functional units is scant. As previously described, the

composing room experienced severe declines in staffing and work volume, but there is no direct evidence that their level of control over work pace or relationships with supervisors were impacted. It may be reasonable to infer that the decrease in training and experience of composing room employees associated with the adoption of direct-input typesetting systems would necessitate closer supervision of employees. Similarly, work in functional units, such as the classified ad department, presented compositors with work environments in which the rhythm and pace of work was more determined by customer demands, automated queuing, routine work delivery schedules, and efficiency standards. Control over the pacing of work in these environments may have drifted farther away from the dedicated compositors.

Reporters have traditionally enjoyed an exceptionally high level of autonomy and control over the pace of their work. How, when, and where reporters perform the majority of their job was determined by the demands of the story and the reporter's style or personal preference. Although practices differed between news organizations and between sub-units in those organizations, presence in the newsroom was often not even a daily requirement. Reporters generally were in residence only between assignments and while they were typing up and submitting their completed stories. As long as final deadlines were met, reporters worked at their own discretion, quite free from supervisory dictates.

To a large extent, a high level of personal work pace control continued to be the norm in newsrooms well after the introduction of direct-input technology. Reporters performed the bulk of their tasks away from the workplace and were frequently able to schedule their working hours as they saw fit. Mobile terminals also allowed some

reporters to collect news, write and edit their copy, and file their stories remotely. It is clear, however, that the introduction of the on-line system created new constraints for reporters in how they controlled the process and pace of their work. Edit-trace features, which enabled editors to follow copy from its creation to typesetting, were used to monitor the number of editing changes required for each story, turn-around times for corrections, and whether or not reporters met editor-determined deadlines (Carter & Cullen, 1983). Because the computerized system made organizing large numbers of electronic documents possible, many editors implemented staged deadlines for submission of story outlines, drafts, or sections (Engwall, 1978). Also, few reporters personally owned the technology necessary to produce electronic copy that their editors could edit. While non-staff writers and a few reporters were able to rely on the composing room to enter their copy into the editorial system, the majority of reporters were compelled to write and edit their stories while in the newsroom. Several observers of newsroom practices during the past few decades have identified the loss of process control as a key source of dissatisfaction and alienation among newspaper reporters (Pollard, 1994, 1995).

Editors experienced a significant increase in control over the pace of their work following the adoption of on-line front-end systems, largely as a result of the increased control they were able to assert over the work pace of their reporters. Editors had traditionally occupied positions of authority over reporters and maintained strong control over what stories were included in the newspaper's final product, yet the demands of the job, the state of the related technology, and the nature of the reporters' occupation left editors with very little control over the actual process of producing news stories. Editors,

in practice, were dependent on the voluntary cooperation of reporters in submitting timely work, and, as a result were frequently unable to control the pace of their own work in putting together a page, a section, or an entire paper. Following the adoption of the on-line front-end systems, editors gained new tools for monitoring, reviewing, and controlling both the pacing and the quality of reporters' work. Editors established variable deadlines for stories based on characteristics of the story itself, but also based on editorial workload, expected rewrite time, and press availability. Staged deadlines were often set to require incremental submission of large, complex, or joint-authored stories (Engwall, 1978).

Responsibility for the final newspaper product was shifted more firmly to the editorial staff with the adoption of DEPTS technology. Descriptions of the introduction of the computerized front-end typically credit the technology with shifting the balance of power in newspaper organizations away from production and toward the editorial function. The move to soft-proofing and on-line submission of copy to electronic typesetters gave editors complete control over, not only scheduling and pace of the entire front-end process, but also placed final control over newspaper content and design firmly in the editors' hands. Carter (1984) found that newsroom computerization was positively related to increased decision-making authority at the editorial level.

The relationship between journalists and their managers following the adoption of direct-input technology appears to have undergone some degree of strain (Pease, 1991, 1992; Peck, 1991). Reporters in North America accepted direct-input front-end systems with little fanfare, but journalists in Great Britain vigorously resisted introduction of the same technology, because it was perceived as an attempt to assert stronger managerial

control over the newsroom (Samaddar, 1994). In the U.S., surveys of journalists who were leaving the profession revealed that management policies, focus on profit, and poor management were key reasons for their leaving the profession (Weaver & Wilhoit, 1994). Observers of newsroom issues over the past two decades have reported that animosity and tension have increased both between reporters and their editors, in particular, and the newsroom staff and management, in general. Editors have used the new technology to increase their ability to monitor and hold reporters accountable for process performance, which has lead to a serious rift between the two groups of journalists. Newspaper management has used the capabilities of the computerized systems to enforce top-down decisions about standardized news formats, story balance, and, perhaps most importantly, the size of the "news hole", that portion of the total paper devoted to news items (Fitzgerald, 1995).

Outcome Proxy 9a: Is there a change in functional diversification following technology adoption?

Outcome Proxy 9b: Is there a change in occupational unionization or union effectiveness?

Direct-input computerized typesetting brought with it drastic shifts in distribution of personnel from the back shop to various editorial functions. Full-time compositors, who were not transferred to other production jobs, pensioned, or laid-off, were frequently reassigned to auxiliary roles in other functional units. A few remained in the composing room to complete incidental typesetting tasks, but they represented a shadow of their former compliment.

The decline in composing room workers was offset to a certain extent by increased staffing in the newsroom. The employment of full-time journalists in the

newspaper industry grew 61% between 1971 and 1982, an increase of 42,572 jobs (Weaver & Wilhoit, 1994). Many papers found that editors experienced a significant increase in workload following the introduction of direct-input, and copy editors and specialized technical editors were frequently added to the editorial staff (Carter & Cullen, 1983). In a study of the effects of computerization on the number of editors employed in the newsroom, DuBick (1978) found that in both medium and large-size newspapers, there was a large increase in the number of copy editor positions associated with increased computerization. Interestingly, at the same time that the journalistic workforce was experiencing a growth in absolute and relative size, the number of administrative employees in the newspaper industry was also growing. In fact, by 1975, labor costs associated with newspaper administration and sales exceeded that associated with the editorial function for the first time (Compaine, 1980).

Despite declining memberships, the ITU mustered its resources to try to block the introduction of direct-entry technology and its use by anyone other than journeyman compositors. The union's efforts met with failure upon failure, as had earlier efforts made by the United Telegraph Workers in preventing direct-entry by news wire service reporters (Compaine, 1980). Compromises reached in 1973 with the *Detroit News* and *Oakland Tribune* earned management limited freedom to implement scanning and direct-input systems. The ITU members employed by the Richmond, Virginia, daily struck over the threatened introduction of direct-input technology, and out of 180 original composing room workers, only 10 ever returned to the composing room after the company installed its new equipment (Hynds, 1979).

Describing the modernization of newspaper production processes in 1978, Raskins wrote, "In the newspaper business,...the once mighty printer's union is being brought to its knees by computer technology" (1978: 41). The power of the ITU to support its members' interests had been so completely undermined by its losing struggles against workplace automation that it was unable to continue as an independent body. By 1979, fewer than 25% of U.S. daily newspapers were represented by the ITU (Compaine, 1980). In 1984, the ITU formally merged its 40,000 remaining members with the membership of the Communications Workers of America. By 1986, union representation among composing room workers had declined further to the equivalent of less than 20% of U.S. daily papers (Garneau, 1987).

The primary union organization representing non-production newspaper employees, the American Newspaper Guild, was organized originally in 1933. In 1976 the National Labor Relations Boards upheld the union's right to represent non-managerial journalists, by determining that journalism was not a profession. That decision notwithstanding, journalists have a tradition of professionalism that tends to overshadow strong associations with trade unionism. The Guild has been generally ambivalent toward the issue of technological innovations in the newsroom. Following the introduction of the technology, The Guild continued to focus its principle efforts at ensuring job security and wage levels for its members and addressing certain technology-related concerns, such as repetitive motion injuries, VDT radiation, and speed and accuracy standards in the use of VDTs (Compaine, 1980). Overall, The Guild has never been a particularly powerful union due to its relatively small membership and sparse distribution, and its status has not noticeably changed since introduction of the direct-input technology.

Observed Outcomes

The outcome-related proxies addressed each of the five dimensions of empowerment defined in the IT-empowerment model: meaning, competence, information access, self-determination, and impact. Because the direct-input computerized typesetting technology was used by two separate and distinct types of employees and because the IT-empowerment model predicted different outcomes for these users, it was important that each group be evaluated separately in terms of these outcome-related proxies. In one sense, it is difficult to interpret the change in occupational status experienced by newspaper compositors because, their function in the newspaper organization was almost totally replaced by the DEPTS technology. In the wake of the DEPTS innovation, the composition staffs at most newspapers were transformed from distinct bodies of skilled or semi-skilled workers responsible for a significant stage in the newspaper production to a skeleton group of workers providing auxiliary support for tasks under the principle control of other functional units. It is clear that the meaningfulness associated with the diminished tasks that remained within the purview of the composing room and full-time compositors was negatively impacted. The few compositors who did remain on staff were less career-oriented toward their jobs and described the work as uninteresting and lower in status compared to composing before the introduction of direct-input systems.

Competence was also negatively affected by the introduction of the automating technology. Training requirements for compositors after implementation of direct-input systems were slashed from one year to only a few weeks. Similarly, while some level of

productivity improvement in the composing room was enabled by increased software sophistication and hardware refinements, the key factor for reducing head count in the composing room was not that compositors were more productive using the new technology, rather that the work could be removed from the compositors' domain and transparently performed by journalists and others who were part of the creation process. As a result, compositors were not enabled by the technology to better perform their tasks. Rather, most lost their identity as compositors, skilled or semi-skilled, and were relegated to either redefined roles as support staff, transferred to other production jobs, or left their employers completely via retirement, voluntary separation, or lay-off.

Information access is, once again, a dimension that is hard to interpret due to the loss of a cohesive occupational identity for compositors within the newspaper organization and a lack of direct data concerning feedback and communication between compositors and others in the organization. Because the composition work that remained in the hands of full-time compositors was to a large extent distributed to other functional units, it may be reasonable to suggest that information sharing between compositors was constrained while communication between compositors and non-compositors was enhanced. This suggestion, however, has no direct support in the descriptive literature.

Compositors also appeared to have experienced reduced self-determination following the adoption of direct-input technology. The increased enforcement of staggered deadlines for various types of copy made possible by the on-line computerized front-end system, in addition to the different work environments in other functional units, made the pacing of work less flexible for compositors. While the relationship between compositors and their supervisors was not directly addressed in the literature, it is

reasonable to suggest that the loss of craft in the occupation, the reduced training requirements, average age of workers, and higher turnover would all require closer and more direct supervision of the remaining compositors.

Finally, the level of impact on departmental and organizational outcomes exercised by compositors was strongly reduced. Relative power in the organization, as reflected by the number of compositors compared to other occupational groups, shrank as the previously essential composition tasks were absorbed by on-line typesetting systems. Headcount reductions in the composing room were dramatic and were generally accompanied by increased employment in the editorial and administrative functions. The compositors' union, which had previously supported its members so effectively in battles to maintain their control over the composing function, was decimated by the unstoppable encroachment of automating technology on compositors skills and power. The ITU ceased to exist as a separate union following widespread adoption of direct-input technology in the newspaper industry, and union enrollment among newspaper compositors has declined to a level of practical unimportance.

Among journalists, the impact of direct-input front-end systems has been very obvious, in terms of daily operating issues and work activities, but also somewhat subtle, in terms of how the overt changes in everyday tasks affect the less obvious issues of workplace attitudes, relationships, and perceived role in the organization. Task meaning associated with the journalistic profession has been relatively unaffected by the new technology. While the public perception of journalism has reflected a joint loss of respect and increased perception of power, this is unlikely to be directly related to the technological innovation under investigation. It is clear however that during the period of

direct-input adoption, journalists' self-perceived status was high, and they viewed themselves as fulfilling a socially important role by providing information and education to the reading public. Journalists, who traditionally exhibited a high level of professionalism and occupational community, did not experience any significant change in their perception of the value of their work following the adoption of DEPTS technology.

The ability of journalists to meet their performance goals was enhanced by the new technology. While training for journalists using the systems was fairly minimal, usually consisting of at most a few weeks of classroom or on-the-job instruction, most found the systems easy to learn and operate. Reporters were able to write their stories faster, and generally reported that their story quality improved because of the increased ease of organizing, manipulating, and rewriting copy. With mobile VDT units, reporters could also move about with less restriction because stories could be prepared in the field and submitted directly to editors via phone lines. Editors also found that the system supported their efforts to edit copy, manage the newsroom, and control the content and format of the printed newspaper, but at the same time reported that expanding responsibilities created more time pressures in their jobs following the introduction of direct-entry. While editors did not find that the technology made their work faster, it did allow them to achieve their goals associated with quality standards. Competence, then, although not mirrored in significant increases in training requirements, was enhanced for both reporters and editors in terms of how the system supported their efforts to meet qualitative performance goals.

Information access was supported by the computerized direct-input technology, at least in terms of how it facilitated process feedback to reporters from their editors and provided electronic access to and sharing of story-related information between members of the newsroom. There is no evidence that this iteration of technology had any effect on performance feedback for editors from their managers nor on interdepartmental communication or access to more generalized organizational information. This information technology was designed to support the specialized work activities of the line organization and did not facilitate general communication flow or cut across horizontal boundaries in the organization.

Self-determination was inconsistently affected by this technology. Reporters tended to find that their control over the pace and scheduling of their work, which had traditionally been quite high, could be subjected to more process control by the computerized features of the direct-input front-ends. It is not clear in the literature how pervasively this feature was employed by editors to exert more control over their news staffs, but there is evidence that there was a certain level of increased strain in the relationship between reporters and editors during and following the adoption period for the technology. Editors, on the other hand, were able to exploit the on-line systems to increase their ability to monitor, schedule, and track reporters activities and progress on story work. As a result, they were able to better control both the work pace of their own job as well as that of their staffs. Unfortunately, editors seem to also have experienced a degradation of their relationship with their own managers as some decision making became more centralized and management policy diverged from journalistic standards.

The ability of journalists to impact the events and outcomes outside their own department was positively impacted by the new technology. By removing the composing room as a barrier in the writing-printing relationship, the editorial function was able to establish more comprehensive control over the content, the appearance, and the timeliness of each newspaper edition. This technology clearly enabled a shift in the center of power in the newspaper's line organization from the production department to the editorial department. This shift was evidenced by sharp declines in production, particularly composing, headcounts and associated increased staffing in the editorial arena. Unionization among journalists remained insignificant following the introduction of technology in the newsroom.

In summary, then, what the outcome proxies have revealed is that the introduction of direct-input computerized typesetting systems into newspaper composing rooms, editorial departments, and other functional units had differential effects on compositors and journalists. Compositors experienced consistent declines in four of the five dimensions of empowerment while journalists enjoyed at least modest increases in four. These findings are consistent with the prediction made via the IT-empowerment model and can be interpreted as providing support for the model's general validity.

INVESTIGATION V: SALES FORCE AUTOMATION SYSTEM

The Innovation

Global Telecom is a national corporation in the telecommunication service industry whose major lines of business include selling local and long-distance services, domestic and international private lines, broadband data services, internet services, and

fax and data connections to business customers. These varied communication services are sold to customers through the personal efforts of approximately 1,200 sales representatives who are based at a number of regional and local company offices across the United States. In 1997, Global decided that the performance of their sales teams was being undermined by poor access to computer-based support tools and timely information. The sales force automation system (SFA) was developed to fill this perceived need.

The applications that are loosely coupled under the SFA title include both custom developed software and commercially available programs. The SFA tool kit consists of an e-mail reader, remote terminal access to various legacy billing systems, a contact and opportunity management system, Microsoft Office 95 applications, and communication software that enables remote access to company intranet resources. The SFA toolkit is implemented on a Windows 95 laptop computer platform, which gives sales representatives, who tend to spend all but a few hours of each workday outside of the office making sales calls, full-time access to computer-based resources. Prior to the rollout of the SFA system, the Global sales force had access to computer tools only via desktop microcomputers located in their headquarters building, frequently shared with other sales coworkers. While most of the applications included in the SFA suite had been available for limited use by the sales reps through their office computers, the introduction of the contact manager application and the mobility of the laptop platform provided substantial enhancements in terms of features, usability, and accessibility.

The electronic mail reader included in the SFA system encompasses typical message reading, message composition, storage, and distribution features. Although

electronic mail was available before the SFA introduction, Global's management believes that it was not widely used for sharing information by sales representatives, largely due to limited accessibility. Global's sales force also had office-based access to Microsoft Office applications, including word-processing, spreadsheet, and presentation packages. Sales representatives were responsible for maintaining data concerning their sales efforts, customer calls, and closed sales. This information was tracked by sales reps, either manually or using spreadsheets. They were also responsible for producing the bulk of their customer correspondence, much of which was very standardized and routine, as well as a number of internal financial and progress reports. These documents were generally prepared using the Microsoft Office applications on their office microcomputers.

Another component of the SFA toolkit is enhanced access to various legacy billing subsystem, which prior to SFA implementation was also desktop accessible. The billing subsystem gives sales representatives read-only access to information concerning the processing of customer orders, as well as account status and customer service logs. While sales representatives are now able to retrieve this customer data on-line from the field, new service orders continue to be batched for entry into the system by order entry staff. Another important tool that has been made more usable for the highly mobile sales team is remote access to the company's intranet through a browser package. The Global intranet provides sales representatives timely access to highly dynamic organizational and product information, specifically regarding service availability, pricing schedules, and sales-related policies and procedures.

The final feature of the SFA system, the contact and opportunity manager application, has been made available to the sales team for the first time. This tool was

designed to make sales representatives more effective and efficient while servicing customers and handling sales-related administrative tasks. The contact and opportunity manager can be used by the sales representatives as:

1) An electronic diary, to record appointments and meetings;
2) An address book, to record and cross-reference customer information;
3) A time manager, to organize activities and remind the user of pending obligations;
4) A record keeper, to store and index information on sales calls and other projects; and
5) A document manager to automatically compile standard reports and produce template-driven customer correspondence.

The software is similar to several commercially available contact management software packages, but it has been specifically designed to meet the demands of Global's various lines of business and the special needs of the Global sales team.

Model Proxies

Model Proxy 1a: What group interacts directly with the new technology?

The SFA system has been made available to over half of the Global Telecom sales force across the United States. All but the most junior levels of sales representatives have received the SFA system and training. Managers could not confirm the level of usage of the system, although they anticipated that the usefulness of the tool would encourage a relatively high level of use. This expectation finds some support in the survey data

results (Table 4) which shows that survey respondents spent an average of 32.32 hours per week interacting with the various SFA tools.

Model Proxy 2: Does the technology mediate or perform tasks previously performed by workers (automation); does it provide information to support decision-making by users (decision support); or does it support the sharing of interpersonal communications between individuals and groups within the organization?

Given that the SFA system is a multi-application toolkit, determining its dominant functionality could be problematical. Not surprisingly, subjects reported mixed opinions on which of the three classes of functionality were most important in the SFA system. The largest percentage of respondents, 40.9%, described the dominant function of the SFA as decision support, followed closely by communication (36.4%). Only 22.7 percent of respondents ranked automation as the system's primary function (Table 5). Interestingly, managers responsible for designing and implementing the system at Global characterize it as a means of improving the productivity of their sales representatives by automating routine activities. Their expressed goal for the system introduction is to give back to each representative at least one hour per day that had previously been devoted to record keeping, correspondence handling, and scheduling. According to the system managers, this hour could be devoted toward increasing sales totals by making more initial customer contacts or better servicing existing customers.

Based on interviews with the system managers, several possible explanations for these differing interpretations of system functionality can be suggested. First, system managers predicted that the contact management software, a critical application in their interpretation, would be used as a form of automated scheduler, which would replace recordkeeping previously done via pencil and paper. It is possible, however, that this

particular tool, while still a key application, was not perceived by users as replacing manual activities, but as providing a new source of data collection, manipulation, and reporting that could be used to support their sales activities. Managers also described the automated report preparation features, linking the contact manager with word processing software, as particularly valuable to sales representatives as a way of saving time and effort. Again, it is possible that this feature of the SFA system may have been a time saver for the sales representatives. Its high level of automation may have resulted in such task transparency that it may have been overshadowed by other functions that more visibly affected how users completed their sales tasks. It is also possible that the system users adapted the SFA toolkit to meet their needs in ways that were not planned by the system managers, or simply that the managers and users interpreted the functionality descriptions in the instrument inconsistently.

Variable	Mean	Std Dev	Minimum	Maximum	Valid N
MEANING	2.08	1.21	1	5	24
COMP	1.87	1.14	1	5	23
INFO	2.33	1.31	1	5	24
SELF	1.79	.98	1	5	24
IMPACT	2.96	1.33	1	5	24
TIME	32.32	14.52	10	69	22
EMPO	2.20	.92	1	4.4	24

TABLE 4
Descriptive Statistics

Variable = FUNCTION

Value	Frequency	Valid Percent	Cum Percent
1.00	5	22.7	22.7
2.00	9	40.9	63.6
3.00	8	36.4	100.0
Total	24	100.0	

Valid Cases: 22 Missing Cases: 2

TABLE 5
Frequency Table

Unfortunately, the nature of the survey data does not allow a more clearly determined explanation of the differences in how managers and users interpret the functionality of the SFA system. It is reasonable to suggest, however, that the evaluations of functionality provided by those who use the system must be given strong credence in any study of how the technology impacts their own reports of empowerment. User reports of functionality suggest that the SFA system was predominantly a decision support tool with a strong communications component, and model predictions will be generated based on this definition of system functionality.

Model Proxy 3: How was the pre-innovation performance level of users judged: qualitatively or quantitatively?

The sales representatives occupy non-expandable work roles in their employment with Global Telecom. The effectiveness of each sales representative is evaluated based on quantitative measures of output, namely the volume of sales made. Sales representatives are rewarded through pay-for-performance compensation plans that are

calibrated based on quantitative benchmarks of sales performance. Completion criteria are concrete, with each sale being closed with contract execution, service delivery, or payment by the customer. As a result, increased efficiencies in task performance is likely to result in quantitative increases in throughput rather than an enhancement of output quality or an expansion of the sales rep's role to create a broader sphere of influence or responsibility.

Model Proxy 4a(1): Is use of the technology mandatory?
Model Proxy 4a(2): Are users able to customize their use of the technology?

Use of the SFA system is not a mandatory requirement for sales force members. Management has attempted to encourage use of the system by creating an environment of user "pull" for the SFA tools. Information that is available via the company's intranet and billing subsystem is not easily available through other means. Company communications that are distributed through electronic mail are not duplicated in hardcopy memos. Building interest and enthusiasm for using the SFA system is also a primary focus of the training offered to all new users. Rather than instructing users in a litany of keystrokes and mouse clicks, trainers highlight the potential benefits and enhanced outcomes made possible by use of the system.

The SFA is a loose collection of applications, many of which are highly end-user oriented and subject to considerable customization and control by individual users. Mailer, browser, and Office 95 interfaces are all highly adaptable to user preferences, in terms of interface appearance, feature activation, navigation, and configuration. Users of the SFA have an exceptional level of discretion over when to use the tools, how to use the tools, and ultimately, if to use the tools.

Model Proxy 4b(1): Did management consult with users before or after initial implementation?
Model Proxy 4b(2): Did users make decisions about the technology before or after initial implementation?

According to management descriptions of the SFA design and implementation process, users had, and continue to have, an exceptionally high level of participation in the development and introduction of the new technology. Initially, surveys were conducted to identify specific needs that the sales representatives felt were not being met by their existing information technology tools. Based on these surveys' results, a suite of software tools were assembled and installed on laptop computers for testing by a cross-divisional pilot group of 20 sales representatives. This pilot group provided feedback to the system designers, who iteratively modified and reconfigured the SFA tools according to user-defined specifications. Rollout of the system to the full sales force was initiated after six months of refinement with the pilot user group. On-going system modifications continue to be driven by formal user satisfaction surveys and *ad hoc* user suggestions for feature additions and improvements.

Model Proxy 4c(1): How much training have most users received?
Model Proxy 4c(2): Do users express difficulties using the technology?

All sales force members who were given access to the SFA technology received introductory training on use of the SFA system through a required, three-day workshop. The workshops are designed and presented at each regional office by in-house training specialists. The focus of these training sessions are to encourage interest and experimentation with the SFA tools by demonstrating how the system can enhance the sales representatives' access to information, productivity, and effectiveness in servicing

customers. The system managers report that sales force comfort level with most features of the system is relatively high.

Model Proxy 4d: Is there an increase in wage level for users following implementation of the technology?

According to managers of the SFA system, no specific financial or non-financial user rewards were associated with the rollout of the system. Trainers and managers encouraged sales representatives to use the system by stressing its potential impact on sales productivity and, by extension, individual compensation, but incentives were not directly linked to usage of the new system. Analysis of sales performance data during the pilot stage of system implementation did determine that members of the pilot group did experience significant increases in sales volumes during the study period, an increase that was partially attributed by management to use of the test version of the SFA system. Because the sales representatives are compensated based on the volume of sales they complete, use of the system could be indirectly instrumental in achieving enhanced financial rewards.

Model Proxy Summary and Prediction

In reviewing the model proxy results, users of the Sales Force Automation system are, not surprisingly, sales representatives who are responsible for representing Global Telecom and its products to potential and existing customers. These sales representatives occupy predominantly non-expandable roles in the organization, and the SFA system has been described by the users as fulfilling primarily decision support and secondarily communication functions. The implementation context can be described as being moderately high. Users have a significant level of both discretion in their use of the

technology and participation in decision-making regarding system design and implementation. Training, to date, has been consistently extended, even required, of all new system users, and managers perceive that users are comfortable with most features of the SFA system. Rewards have not, however, been clearly linked to acceptance of the technology.

The IT-empowerment model predicts that increased use of a decision support technology by workers in non-expandable work roles will lead to increased levels of user empowerment. Coupled with a supportive implementation context, the model suggests that the overall effect of the introduction of the SFA system on the empowerment level of the Global Telecom sales force will be slightly to strongly positive. Survey results will be considered next as a test of this model prediction.

Outcome-Related Questions

Based on the IT-empowerment model, the outcome effect of IT use is characterized as a categorical variable with five possible levels (see Figure 4): strongly positive, slightly positive, neutral, slightly negative, and strongly negative. In order to map cumulative empowerment index values, which is calculated as a continuous variable rather than a categorical one, to predicted categorical levels of effect, each category is described by a range of values on the scale between one and five. Making each of these categories of equal size results in the following numerical range for each category of empowerment effect:

Category	Index Range
Strongly positive	$1.0 \leq X < 1.8$
Slightly positive	$1.8 \leq X < 2.6$
Neutral	$2.6 < X \leq 3.4$
Slightly negative	$3.4 < X \leq 4.2$
Strongly negative	$4.2 < X \leq 5.0$

Once the category intervals are established, the calculated mean of the cumulative index variable, EMPO, can be assigned to a category of effect. An examination of Table 6 reveals that the mean of the variable EMPO is 2.20, which indicates a slightly positive impact on user empowerment. This is a result that is consistent with the model prediction. In order to determine with statistical assurance whether or not this sample mean does reflect an effect that can be characterized as slightly to strongly positive, a simple one-sample *t*-test is calculated. A .95 confidence level is selected as appropriate ($p \leq .05$), and the appropriate hypotheses are defined:

Null hypothesis: $H_0: \mu > 2.6$

Alternative hypothesis: $H_1: \mu \leq 2.6$

The *t*-test indicates that the sample mean of 2.2 can be accepted as indicating that the mean of the full population of SFA system users is less than or equal to 2.6, which is classified as positive. The *p* value associated with the *t* statistic in this test is .023, which indicates that there is clearly less than a 5% probability that this result is cause by random chance. The 95% confidence interval is also calculated. This interval implies that there is a 95% probability that the population mean will actually fall between 1.81 and 2.59, a

range that falls within the portion of the scale that represents a positive impact of SFA system use on user perceived change in empowerment.

Variable	Number of Cases	Mean	SD	SE of Mean
EMPO	24	2.2021	.923	.188

Test Value = 2.6

Mean Difference	95% CI Lower	Upper	t-value	df	1-Tail Sig
-.40	-.788	-.008	-2.11	23	.023

TABLE 6
t-Test Results

In summary, while these statistical analyses of the survey data were very simple, consisting of descriptive statistics and simple t-tests, they do demonstrate that quantitative empirical studies can be used in concert with qualitative methods to explore poorly documented phenomena, develop explanations of complex events and relationships, and to even test theoretical models. This type of data collection, consisting of interviews of a few well-informed participants and an empirical survey containing only a very small number of items, may be one way of effectively gathering highly dynamic information from the field. Guided by the structure of the historical event analysis method, information gleaned from such a data collection can be organized and interpreted to further understanding of more generalized research questions. Limitations of this

approach to contemporary event analysis are important, however, and will be addressed in the next chapter.

CHAPTER SIX

CONCLUSIONS AND DISCUSSION

Discussion of Results

These four investigations of historical introductions of information technology in the printing and publishing industries demonstrate consistent support for the proposed IT-empowerment model. The predicted impacts and the observed outcomes for each historical event are summarized in Table 7. As this table indicates, the adoption of mechanized linecasting, computer-assisted phototypesetting, and direct-entry phototypesetting technologies resulted in predictable changes in user empowerment. Specifically, the adoption of mechanized linecasting equipment by hand compositors in the newspaper and commercial printing industries during the final years of the last century is associated with a minor decrease in user empowerment; the adoption of phototypesetting by linotype operators in the same industries during the 1960s and 70s is associated with a strong decline in user empowerment; and the introduction of direct-input phototypesetting systems in the newspaper industry predominantly during the 1980s is associated with yet another strong decline in empowerment for compositors and a minor increase in empowerment for its journalist users. These findings clearly support the general structure of the model and the proposed relationships between the dependent and independent variables.

Partial agreement was achieved between the model-predicted and observed impact of teletypesetting technology use. The IT-empowerment model predicts that use of TTS systems will effect a strongly negative change in the empowerment of

compositors. The historical record, however, reveals that compositors fell into two groups in terms of how their work environments were affected by increased interaction

	Intervening Variables				
Investigation	**Work Role**	**Function**	**Implementation Context**	**Predicted Outcome**	**Observed Outcome**
I. Mechanized Linecasting	Non-Expandable	Automating	Positive	Neutral to Slightly Negative	Neutral to Slightly Negative
II. Teletypesetting	Non-Expandable	Automating	Negative	Strongly Negative	Strongly Negative / Neutral to Slightly Negative
III. Photo-typesetting	Non-Expandable	Automating	Negative	Strongly Negative	Strongly Negative
IV. Direct-Entry Photo-typesetting	Non-Expandable	Automating	Negative	Strongly Negative	Strongly Negative
	Expandable	Dec. Support	Negative	Slightly Positive	Slightly Positive

TABLE 7
Historical Event Analysis Results

with TTS equipment. Those compositors who used the technology most intensely, frequently on a full-time basis, were observed to experience highly negative changes in empowerment, while those who interacted with TTS equipment less intensely, appear to have experienced little or no change in empowerment following introduction of the technology. These findings do support the generally predicted negative direction of impact on users in non-expandable work roles, but also highlight the relationship between level of use, changes in the users' work environments, and shifts in user empowerment resulting from those changes. While variability in level of individual or group use of the

technology use was not easily measured in these historical studies, it is a variable that should be targeted in future work.

Contributions of Dissertation

This research effort has been motivated by the desire to make a significant contribution to prior work in both the academic and practical management domains. This author believes that this goal has been achieved by enriching and extending prior research results in four critical areas:

1. Clarifying the construct of empowerment;
2. Modeling the relationship between IT use and empowerment;
3. Extending the use of historical data in organizational research; and
4. Demonstrating the application of an historical research methodology to contemporary data.

A key prerequisite for achieving an understanding of the relationship between empowerment and any other phenomena is the development of a meaningful and useful model of the empowerment construct. A model of empowerment was adapted for use as the outcome variable in this study, which draws from both the cognitive and functional empowerment literature. The model clearly specifies employee cognitions about their work environment that combine to create the state of employee motivation that researchers and practicing managers have come to refer to as employee empowerment. By decomposing empowerment into its constituent dimensions, the construct becomes more operational and meaningful, for both researchers and practitioners.

A second contribution is the clarification and specification of the relationship between information technology use and user empowerment. The relationship between IT use and empowerment has been the subject of much speculation, but little empirical research, in the academic and practitioner literature. Much of the prior research on the

social impacts of computer use, including the small body of work that directly addresses the IT-empowerment relationship, suffers from a lack of control for possible moderating and mediating factors. In response to this criticism, one objective in creating the IT-empowerment model was to capture the complexities of the information technologies, of the organizational roles affected, and of the situational characteristics of any technology implementation. The model was partially tested in this dissertation using historical data collections, and predictions derived from the model found consistent support in these initial tests.

It is important to reiterate in this summarizing discussion that the objective of this study was not to argue or document the positive outcomes associated with enhanced employee empowerment, either at the level of individual or organizational performance. The brief review of the empowerment literature, presented in Chapter 2, was undertaken as a means of improving this researcher's understanding of how the construct has been interpreted and operationalized by other researchers, as well as to amass a better understanding of why managers and researchers are interested in empowerment as a topic of study and an organizational objective. The results of this review were presented, not as an argument for or against the optimality of employee empowerment as an organizational mission, but as a context from which the dissertation reader could better appreciate the importance of understanding the relationship between information technology use and user empowerment. Whether or not managerially driven empowerment initiatives are likely to effect changes in employee attitudes or behaviors, are appropriate under all business scenarios, are associated with bottom-line profitability improvements, or are even ethical endeavors are important questions worthy of careful

consideration and debate (e.g., Bowen & Lawler, 1992; Harari, 1997; Gandz & Bird, 1996; Lawler, 1986, 1988, 1992, 1994; Mintzberg, 1996). Resolution of these issues, however, is not a goal of this dissertation. This dissertation is justified in its study of the relationship between IT use and user empowerment based solely on the recognition that increased deployment of information technology and increased managerial interest and investment in enhancing employee empowerment are co-existing, if not collaborating, trends in contemporary business organizations. The commitment of resources inherent in both of these undertakings makes it important that managers appreciate their potential interactions, complementary or otherwise.

A third contribution of this dissertation addresses the development of an historical research approach and the application of that approach to explore and test the IT-empowerment model. Historical event analysis is proposed as a useful approach for exploiting the rich store of historical data that has been largely untapped in the organizational and information system literature. The introduction of four historical information technologies are identified as analogous to contemporary introductions of computerized information technologies, and these historical events were explored via historical data collection and quasi-empirical data analysis and interpretation. The historical event analysis methodology relies on the integration of positivistic and interpretivistic epistomologies, and this dissertation argues that this represents a valuable research approach for developing richer understandings of phenomena, while maintaining the structure necessary for reproducibility and critical evaluation.

A final contribution involves the application of the historical event analysis methodology to the direct consideration of a contemporary data set. While the

methodology was developed primarily to guide the analysis and interpretation of historical data, it is recognized that the approach could represent a useful addition to the toolkit of researchers working with modern data sources. By demonstrating a technique for incorporating structure into a traditionally interpretive research methodology, historical event analysis presents a means of organizing and synthesizing data from modern sources that are largely unexploited as data resources because they do not fit the positivist data profile. Trade journals, practitioner publications, industry magazines, personal interviews, and other journalistic or anecdotal reports have not been considered useful sources of research data by mainstream positivists. These may, in fact, represent a valuable source of insight into emerging business phenomena, particularly those phenomena with abbreviated lifecycles, given appropriate methodologies for collecting, analyzing, and interpreting the data they provide. It is certainly not difficult to argue that business-related information technology development, implementation, and adaptation is a quintessential example of a rapidly emerging and highly dynamic business phenomena. Adapting the historical event analysis methodology for capturing meaningful information from non-traditional contemporary data sources and developing meaningful and acceptable interpretations from this data represents an added contribution to the prior methodological literature.

Limitations of the Study

The primary limitation of this study is that it is incomplete in its testing of the IT-empowerment model. The model developed is a simplification of the relationship between IT use and user empowerment, but because of the realities of this relationship, a

useful representation is necessarily complex. As a result, a complete test of its validity is beyond the scope of this single research effort. The results of the historical event analyses demonstrate consistent support for several predictions derived from the model; however, the tests are limited both in terms of the combination of variables examined and the methodologies employed. This work attends to the adoption of automating technologies by workers in non-expandable work roles. Future efforts should strive to expand this consideration to the implementation of non-automating tools in both expandable and non-expandable roles, as well as exploring the problematical impact of automation technology on the empowerment of workers in expandable roles. In addition, the historical approach developed in this dissertation, while representing a valuable methodology for exploring the research questions, cannot by itself, provide the final test of validity for the IT-empowerment model. Multiple research methods, embracing both qualitative and quantitative techniques, are necessary to develop and substantiate well-rounded validations of the model.

Investigation V, which examined the contemporary introduction of a sales force automation tool, was presented in this dissertation as a methodological demonstration, rather than as a test of the IT-empowerment model. The usefulness of this analysis was constrained, primarily, because of data collection difficulties that resulted in an unacceptably low survey response rate of approximately 2%. The low response rate was largely the result of a number of problems associated with the use of e-mail as a questionnaire delivery and response media. It was decided during the course of this final investigation that an e-mail based survey distribution would be effective, because the recipients, sales representatives at a large telecommunications company, were all familiar

with the e-mail system, and e-mail would reduce the overhead of handling paper responses and allow faster turn-around of the instruments. A short questionnaire was developed by this researcher in consultation with her dissertation advisor and delivered to the company's representative who was coordinating the distribution of the questionnaire to all of the firm's sales representatives. The questionnaire was sent as an e-mail attachment to a cover message from one of the company's information systems managers with minimal instructions on how to use the e-mail software to return the questionnaire to the researchers. It became clear from the number of improperly returned e-mail responses that the recipients were not familiar with using attachments to e-mail messages, were not able to complete this procedure given the minimal directions included in the cover message, and were not able or willing to search out the appropriate reply procedures on their own. Future electronic survey instruments will be distributed as primary e-mail messages, forgoing the requirement that subjects open, save, and re-attaching survey documents to reply messages. In addition, assumptions concerning subject expertise and familiarity with e-mail features will be minimized, and detailed instructions will be included in the mailing describing how the subject should return the completed questionnaire to the researcher.

In addition to the suspected "skills" response deterrent, it is also likely that the length of the questionnaire discouraged a higher rate of return. While the original questionnaire was designed to be a single-page document, its length expanded to approximately four pages following the addition of a number of company-requested items that were not relevant to this study. The length of the instrument is particularly critical in an electronic-based survey document because limited screen size and scrolling

creates the illusion of greater document length. As a result, subjects may be more disinclined to dedicate the time and effort required to respond to the questionnaire. In future surveys, non-research related questions will be avoided as much as possible.

Future Research

Immediate recommendations for future research entail the continued examination of different examples of information technologies, implementations, and use in various settings and the integration of the results of these studies with the IT-empowerment model. Communication and decision support technologies would be particularly welcome for refining and validating components of the model. This researcher is currently in the design phase of a project to examine the potential empowering effect of the introduction of a web-accessible student information system at a Canadian university. This researcher is also participating in an on-going project to investigate the impact of the introduction of computerized sales force support tools on perceived changes in empowerment. Challenges of these undertakings include identifying field settings that are appropriate for exploring the specific research questions; developing survey instruments that are meaningful and usable for the subjects participating in the study; and developing survey distribution techniques to facilitate high response rates and yet ensure confidentiality and efficient processing of the survey responses.

In addition to furthering the validation of the IT-empowerment model, this researcher also suggests that future efforts be directed toward ancillary research questions that emerged, but were left unexplored, during the process of creating this dissertation. One particularly tantalizing issue involves the examination of possible secondary, or

indirect, effects associated with IT-influenced workplace empowerment. In the course of collecting and analyzing data in each of the historical events included in this dissertation, it became apparent that the introduction of information technology in organizations creates ripples of empowerment impact that reach well beyond the physical users of the technology and their immediate work environment. It is well accepted, if not well documented, that the introduction of IT can effect changes in how tasks are organized and completed by direct users, and this dissertation looks carefully at questions concerning potential impacts of IT use on empowerment of these direct IT users. Questions that remain unaddressed, however, surround the potential impact of information technology use on non-users. For example, workers may experience changes in their work environment, and resulting changes in empowerment, as a result of an IT introduction in a remote area of the organization. Can this outcome be modeled or predicted?

Increased reliance on information technology can also result in second order effects, such as shifts in workforce competencies, demographics, structural realignments, and power distributions, that can affect empowerment levels for employees throughout the organization. One paradoxical outcome of such second order effects could be a decline in the empowerment of IT users' first-level managers. If, as is predicted under certain conditions, IT use is associated with declining user empowerment and if that declining empowerment is associated with changes in incumbent work attitudes and new hire capabilities, users' managers may experience a reduction in empowerment commensurate with that experienced by the direct users. Reductions in user motivation and competence could necessitate more emphasis on direct supervision and lead to the

upward rationalization to managers of relatively low level tasks that had previously been completed by the IT users.

In general, there are numerous questions and issues that are yet to be resolved in pursuit of a fuller understanding of the relationships between IT use and user empowerment. In light of the increased investments in IT implementation and continued managerial interest in building an empowering work environment for their employees, the nature of this relationship is crucial. Popular assumptions about the role of computers in supporting meaningfulness of work-related tasks, competence, and self-determination, while, at the same time, distributing information and influence throughout the organization must be subjected to more than critical speculation. It is the duty of academic researchers to propose and test explanations of this relationship, not only to expand the academic literature, but most importantly to support the efforts of business practitioners as they strive to add value to their organizations, their industries, and their communities.

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IMAGE EVALUATION
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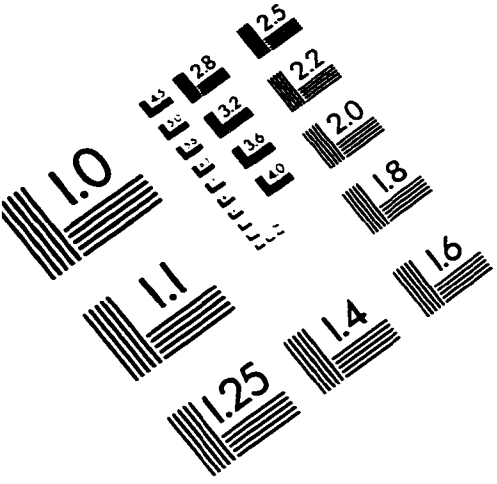

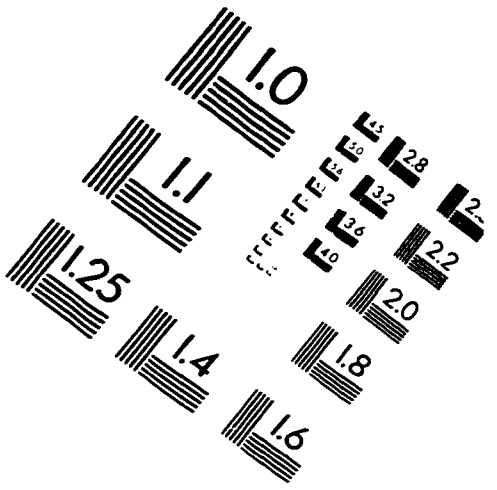

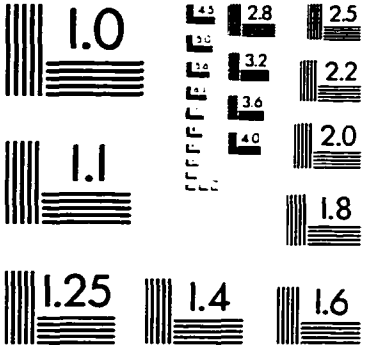

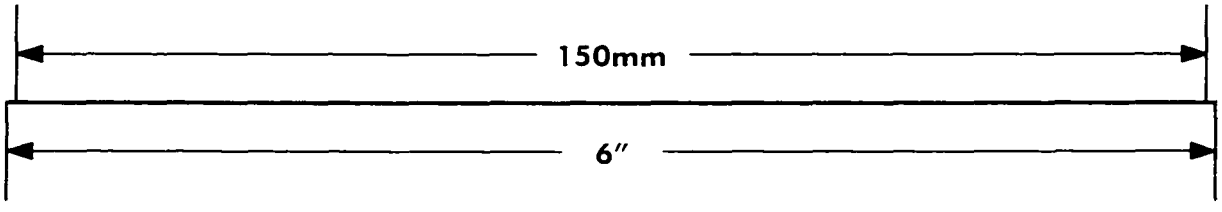

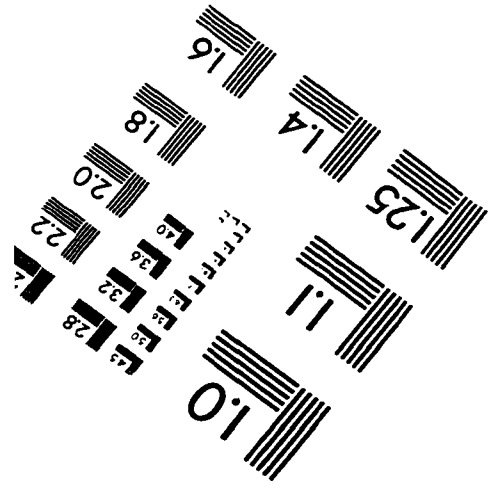

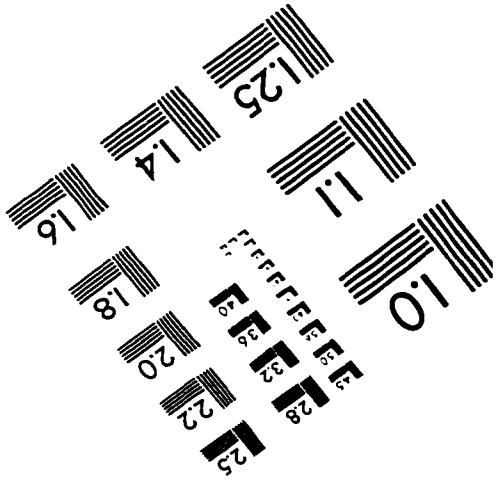

APPLIED IMAGE, Inc
1653 East Main Street
Rochester, NY 14609 USA
Phone: 716/482-0300
Fax: 716/288-5989

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