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Computerized Performance Monitoring And Control Systems: Impact On Canadian Service Sector Workers

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COMPUTERIZED PERFORMANCE MONITORING AND CONTROL SYSTEMS: IMPACT ON CANADIAN SERVICE SECTOR WORKERS

by

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ABSTRACT

Corporate survival in the competitive service sector demands continuous improvement in employee productivity. Thus, managers of labor-intensive businesses are always searching for new tools to increase productivity. One tool gaining popularity, and notoriety, is the computerized performance monitoring and control system (CPMCS). Proponents say that CPMCSs increase the consistency, accuracy, and fairness of performance measurement, and improve productivity. Opponents argue that productivity improves at the expense of customer service, quality of work life, and employee health. Despite the importance of these issues, few researchers have studied the effects of computerized performance monitoring.

This two-stage research study examined CPMCS impact on service workers and their perceptions of work. In the first stage, a case study compared monitored and unmonitored claims processors in three offices of a major insurance company. Interviews, surveys, and performance data demonstrated effects of low-level monitoring.

The second stage surveyed service workers in 51 Canadian firms to test a causal model of CPMCS impact. This model demonstrated the impact of work environment and four dimensions of monitoring on the importance employees attach to production and interaction. The four design dimensions

were: (1) extent of monitoring; (2) measurement frequency; (3) recipients of data; and (4) objects of measurement. The model also showed that the credibility of computers as measurement devices moderated system design effects.

The study made three major research contributions. First, it provided an in-depth, qualitative analysis of CPMCS impact in a single firm. Second, it demonstrated combining case and survey field research to develop and test theory. Third, it produced a causal model of CPMCS impact, with good explanatory and predictive power.

The research concluded that:

1. Monitors are multidimensional control systems. Design decisions should be made independently for each dimension, and research should differentiate among the dimensions.

2. The importance attached to production depends, in part, on acceptance of monitor data and its importance to the employer.

3. Monitoring, the importance of other job dimensions, the nature of the work, and the employer's criteria all contribute to attitudes about service importance.

4. Monitors do not replace or improve upon human supervisors, except in a very narrow sense. Nor does more monitoring necessarily mean better control. Supervisors play a crucial role in controlling qualitative aspects of the work.

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This thesis is dedicated to my parents, Lovertia and Arthur Grant, who have created a home where academic achievement matters and learning is a worthy goal, and to my husband, David, who shared the process and the values it represents.

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CHAPTER 1 - INTRODUCTION

North American service firms face steady pressure to prosper in an increasingly competitive environment. The labor intensity of service industries means that employee productivity is a crucial factor in an organization's survival. Thus, new tools and technologies to improve productivity find ready markets among these firms.

One technology gaining popularity, and notoriety, is the computerized performance monitoring and control system (CPMCS). In 1984, the National Association of Working Women (9to5) estimated that some 20% of clerical employees in the United States were monitored (Nussbaum, 1984). By 1987, the use of such of monitors had increased to include approximately 25-35% of all clerical workers in the U.S. (U.S. Congress, OTA, 1987). The systems are also used in non-clerical jobs: 13-15% of professional women in one survey reported being computer-monitored (Nussbaum, 1984).

Service firms rely on monitors to collect accurate productivity data and subsequently to increase employee awareness of productivity performance. Proponents point out that CPMCSs increase measurement accuracy and consistency (e.g., Smith et al., 1986; Wright, 1982; Young, 1980). They believe the monitors can improve overall productivity. Opponents to monitoring argue that, even if improvements do result, they will come at the expense of customer service, teamwork and quality of work life (e.g., Gregory and Nussbaum, 1982, and Sheridan, 1980). The result is an ongoing debate over the use of CPMCSs.

This chapter introduces research studying the effect of CPMCSs on workers and work performance. It begins by defining a CPMCS and then examines the research environment and issues surrounding monitor use. It next describes the specific questions addressed by this research, followed by the research approach and contributions. The chapter concludes by outlining the organization of the dissertation as a whole.

1.1 CPMCS DEFINED

There is no widely-accepted definition of computerized performance monitoring. Terms like "worker monitoring," "electronic surveillance," "performance monitoring" and "worker surveillance" have been used to describe diverse system designs and uses. The Office of Technology Assessment (OTA) proposed a continuum of monitoring (U.S. Congress, OTA, 1987), shown in Exhibit 1. This scheme differentiates among

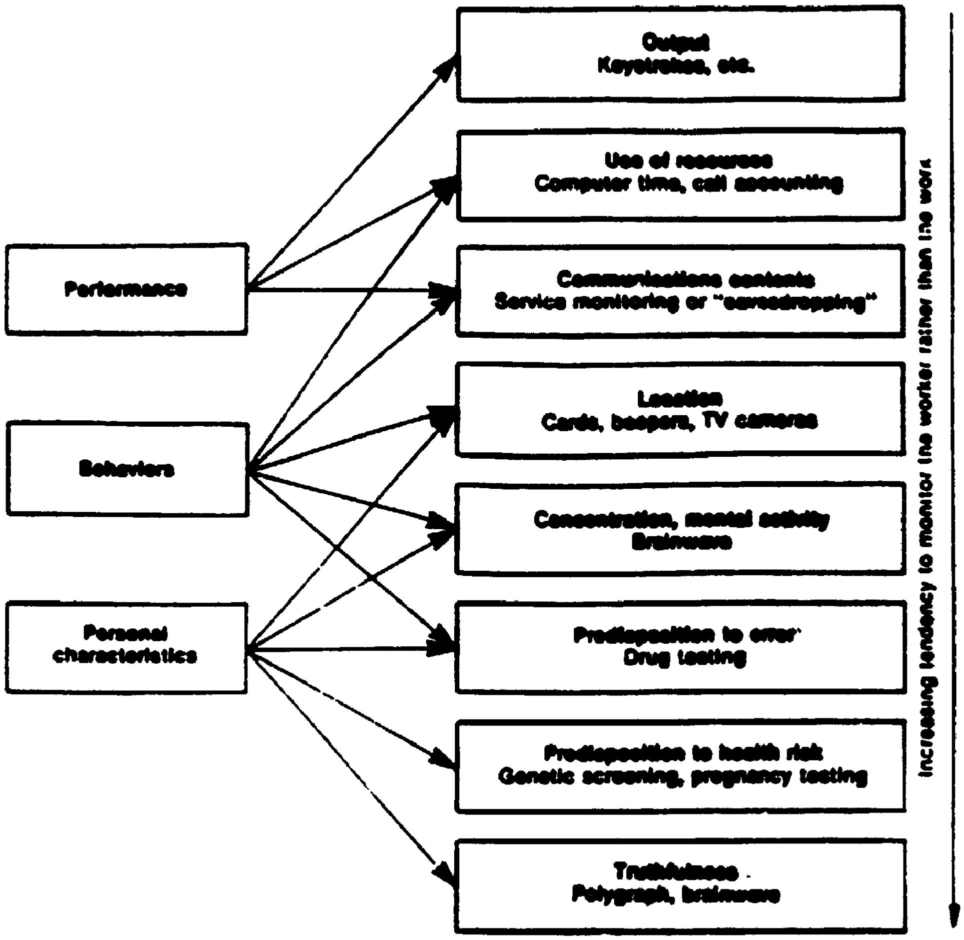

Exhibit 1. Categories Subject to Monitoring, Measurement or Testing
(Source: U.S. Congress, OTA, 1987)

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techniques aimed at performance, behaviors and personal characteristics.

Westin (1986) suggested that the purpose and methods of monitoring are important factors in characterizing and classifying monitor systems. Typical purposes included:

> "(a) to provide group data for planning and operations;

(b) to evaluate individual work performance and use for individual personnel decisions...;
(c) to provide personal and property security at the work site;
(d) to investigate specific incidents of misconduct or crime;
(e) to increase management control, discourage union organizing activities, identify dissidents, etc." (Westin, 1986)

Methods included:

"(a) human, visual observation (with or without...documentation equipment);
(b) listening-in on telephone transactions, either with or without recordings being made;
(c) microphone overhearing of worker conversations...;
(d) photographing of work, by still camera;
(e) video camera observations, with or without video-tape recording;
(f) machine-generated data collection on operators' work performance, whatever type of machine being used;
(g) recording data on the entry, movement, or location of the employee on the work premises...:
(h) automatic recording of the telephone numbers called by individual employees, for use in administration of telephone usage rules." (Westin, 1986)

The Westin (1986) and OTA (U.S. Congress, OTA, 1987) schemes cover the full range of monitoring and testing (e.g., polygraph and lie detector) technologies. They include both audio-visual and computer-based systems. They also encompass systems with any one of three objectives: (1) monitoring worker performance; (2) monitoring resource use; and (3) testing employee fitness for work.

This study concentrates on computerized systems intended to track work and worker performance. Thus, for the purposes of this research, the term 'computerized performance monitoring and control system (CPMCS)' refers to a **system using computer-generated data on individual or group work for performance evaluation or planning**.

The simplest monitors, such as word-processor logs, count lines or keystrokes and accumulate them into periodic summaries (Wright, 1982). More sophisticated designs can alert supervisors when a worker is not connected to the system. They may also compare actual performance to productivity standards on a minute-by-minute basis (Carey, 1985).

The use of monitors runs along a spectrum from simple to sophisticated. Simple monitors merely feed performance data back to the employee to facilitate self-control. Sophisticated systems can virtually replace a firm's traditional "work standard" appraisal mechanisms, producing quantitative measures by which pay and promotions are distributed.

There are three elements of the CPMCS which are crucial to understanding their use and effects. First, the monitor is nothing more or less than a set of computer programs and a sensor which detects the activity to be measured. Any work activity which can be captured and defined in terms a computer can interpret can be monitored. The CPMCS will handle activities precisely as specified in its instructions, regardless of the source or frequency of those activities.

Second, CPMCSs are capable of executing a variety of tasks. Some systems merely collect statistics about performance. Others evaluate those statistics, while still others actually direct work to employees. There is no single design which represents the typical CPMCS.

Third, CPMCSs address only computer-mediated activity. Computer-mediated activity may be performed directly on a computer. On the other hand, it may be manual work which creates a transaction subsequently captured by a computer. For example, an insurance claims processor may work with an interactive system which uses her input to calculate and pay a dental claim. The entire activity of paying claims is potentially visible to the monitor. A retail employee, on the other hand, may do personal selling and register sales on a point-of-sale terminal. In that case, only results (items and amount sold) are reported to an automated system. This means that less of the work is visible to a monitor. CPMCSs can only deal with activities which are reported to an automated system -- other activities are beyond its reach.

This section explained what is meant by a CPMCS and how monitoring is used. The literature suggests that its effects will actually be a function of personal, organizational and technological fa·tors. But the particular interplay of those factors and the resulting effects upon worker attitudes and performance remain largely speculative. Section 1.2 discusses the environment for research on these issues.

1.2 THE RESEARCH ENVIRONMENT

The Labour Canada Task Force on Micro-Electronics and Employment (1982) examined monitoring issues and concluded that,

> "...more research is required on diverse issues we have reviewed concerning quality of work and work environment... Such standards, dealing with equipment, the physical workplace, the job design, and the person-machine relations, should be based on well-documented research recommended to the governments by recognized bodies."

This section examines the specific need for such research in the service sector and the contributions of this study in particular.

1.2.1 The Need for Research

CPMCSs can seem contradictory. They are inanimate, but workers tend to think of them as supervisors. They are called 'objective' and 'unbiased,' but workers cannot explain themselves to or negotiate with them. In addition, workers often believe that the choice of measures demonstrates management's choice of production over customer service. One Air Canada passenger agent, for example, called that company's CPMCS "a psychological whip" and pointed out that they "are only measuring numbers, not selling skills or customer satisfaction" (Oreskovich, 1985).

Critics describe CPMCSs as impersonal, degrading mechanisms which undermine trust, reduce autonomy and fail to measure the real job (Oreskovich, 1985). They predict that monitors will trigger a return to "Taylorism" and turn offices into information "sweatshops" (Garson, 1988; Gregory and Nussbaum, 1982; Menzies, 1981). Supporters of monitoring, however, argue that monitoring substitutes clear, accurate performance measures for stressful, subjective assessments. They argue that such substitution should improve the work environment (Ferderber, 1981; Olson and Lucas, 1982; Smith et al., 1986).

Despite increased adoption of monitors, businesses are actually ill-equipped to anticipate their potential effects or effectiveness. Many companies install a monitor when they introduce a new computer application system or improve an existing one. This makes it difficult to separate the results of monitoring from those of work process changes. For example, the OTA reported to the U.S. Congress that,

> "There is reason to believe that electronically monitoring the quantity or speed of work contributes to stress and stress-related illness, although there is little research separating the effects of monitoring from job design, equipment design, lighting, machine-pacing, and other potentially stressful aspects of computer-based office work." (U.S. Congress, OTA, 1987)

Furthermore, most work on monitoring has concentrated on health and privacy issues (e.g., Garson, 1988; Nussbaum, 1984; U.S. Congress, OTA, 1987; Westin, 1986). There has been little controlled research on monitoring which could provide insight into its effects on role perceptions or actual performance. Consequently, there is a need for research which explicitly addresses the impact of CPMCSs on service work and worker performance.

1.2.2 Research Questions

Service sector workers perform two roles, which this study labels 'production' and 'interaction.' 'Production' refers to the task of producing tangible output units, such as paid claims, filled orders and diagnosed patients. 'Interaction' is a much broader term and encompasses the qualitative elements of service work. It includes direct customer service, teamwork and cooperation, initiative, and creative problem-solving (Smith et al., 1986).

CPMCS designers and adoptors are ultimately interested in the systems' effects on actual performance. It is extremely difficult to obtain and accurately compare such performance data when studying systems in more than one company. Different firms use different evaluation metrics to rate performance, making comparison difficult. Furthermore, companies and employees often consider such data private and are reluctant to provide them to researchers.

However, many studies (e.g., Lawler and Rhode, 1976; Ilgen et al., 1979; Katerberg and Blau, 1983) demonstrate that direction of effort contributes significantly to determining performance. Control systems play a key role in directing effort by influencing the perceived importance of various job factors. Kerr (1975) described how control system design can misdirect effort, while Cammann and Nadler (1977) argued that systems emphasize the importance of what's inspected rather than what's expected. Thus, this study uses perceived importance of production and perceived importance of interaction as dependent variables. These variables would be central to models which extended the causal network to actual performance.

Quantitative measuring systems, such as CPMCSs, most often count and control production. But they are capable of affecting the interaction role as well. This research concentrates on answering two central questions. The first addresses the issue of monitor impact on production, while the second examines its effects on the interaction role. These questions are:

1. How does the design and use of CPMCSs affect the importance service workers attach to production as a factor in overall performance?

2. How does the design and use of CPMCSs affect the importance service workers attach to interaction as a factor in overall performance?

The study examines the design and use of the technical systems within a framework which includes personal and organizational factors.

'Common wisdom' (reflected in the works described throughout this introduction and the literature review) assumes that production takes on increased importance when monitoring is introduced. This 'common wisdom' also holds that CPMCSs reduce attention to customer service. However, these beliefs have not been empirically tested on any large scale.

Anecdotal treatments of monitoring effects tend to treat these two job dimensions as a single question (Gregory and Nussbaum, 1982; Walton and Vittori, 1983). They imply that an increase in attention to production must invariably be accompanied by a decrease in attention to interaction. This research examines them as related but independent issues. In so doing, it examines both absolute and relative importance of these job factors.

The research questions suggest four possible net results of CPMCS use on the perceived importance of these job dimensions (Exhibit 2). 'Trade-off' refers to the outcome where monitoring increases the perceived importance of production, but decreases the perceived importance of interaction. If research suggests that this is the likely outcome, the deci-

		Increased Importance of Production	
		Yes	No
Reduced Importance of Interaction	Yes	'Trade-off'	'Harmful'
	No	'Effective'	'No effect'

Exhibit 2. Possible Research Outcomes

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sion to monitor may depend on the relative importance of interaction and production to each individual company. On the other hand, CPMCSs might increase the perceived importance of production without reducing the perceived importance of qualitative dimensions. This 'Effective' outcome represents the result businesses desire when installing such systems.

There are also two possible dysfunctional outcomes. 'Harmful' refers to an outcome where monitoring reduces the perceived importance of interaction without increasing that of production. Under 'No effect,' neither dimension is affected. Research demonstrating one of these outcomes may encourage companies to rethink CPMCS use entirely. The opposition and labor dissatisfaction which often accompany a system's introduction may or may not subside. If more attention to production cannot be expected, few firms will want to risk the potential negative effects of implementation.

This research looks at factors which may be used to predict the result of using a particular design in a given situation. It also attempts to explain why the outcome occurs and to demonstrate how changing the system could produce a different result.

Finally, the study provides data to study related questions:

a) What are other negative and positive aspects of CPMCS use in the service sector, as perceived by the monitored employee?

b) Does use of a CPMCS encourage supervisors to rely more heavily on production rather than interaction measures when evaluating performance? When is this likely to happen?

c) Does the worker's attitude toward computer technology per se affect acceptance or rejection of the CPMCS? Can this be used to anticipate the impact of a CPMCS on individuals and to guide management in choosing sites where its use will be effective?

1.2.3 Research Contributions

CPMCS research serves industry and the research community. These groups share concerns about monitoring in general, but also look for information about specific issues of interest. This section discusses the contributions this research makes to the two groups.

Industry: Labor and management alike are concerned about the measures incorporated in the CPMCS and the impact of using those measures to evaluate workers. Walton and Vittori (1983) described insurance monitors which caused stress "excessive to the point of interfering with performance, not promoting it." CPMCSs seem to have the potential for functional or dysfunctional effects. Smith *et al*. (1986) concluded,

> "Because good experiences in using electronic monitoring are lacking, it is not possible to define explicitly how the future systems should be designed."

Unless companies understand why dysfunctional behavior arises, they may invest heavily in systems which actually decrease productivity. This research studies automated and manual systems in more than 50 service companies. It examines how varying design factors alters CPMCS impact, to provide a number of practical guidelines for future CPMCS design.

Labor unions must generalize the potential impact of CPMCS on the basis of a few cases of pervasive monitoring. Discussions with the Ontario Federation of Labour indicate that unions are actively seeking studies which help predict CPMCS impact on employees' intentions, behaviors, and work environment. This work describes CPMCS impact in a variety of settings, providing a broader base of information about monitor effects.

Research Community: Zaltman et al. (1982) described the iteration of inductive and deductive reasoning represented by the "Wallace Wheel" (Exhibit 3). In this view, testing inductively or deductively developed theories provides input to empirical generalization, theory refinement and subsequent retesting.

Most CPMCS research to date has concentrated on observing monitors in the field and generalizing from the observations. This is the left side of the Wallace Wheel. Tamuz (1987) made an important contribution by demonstrating how

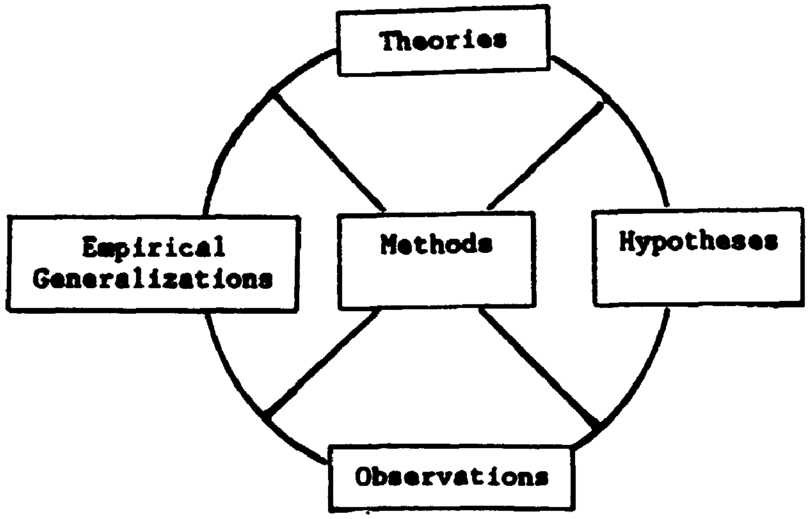

Exhibit 3. Wallace Wheel:
Zaltman et al. (1982)

established theory could be applied in the CPMCS context to predict impact. This dissertation extends that approach by proposing a model in which the independent variables are elements of the monitor, rather than primary effects of monitoring. It thus contributes a framework within which to develop cumulative CPMCS research.

This research includes beliefs about technology per se as a moderating variable, which differentiates it from most other studies of technology impact. The traditional research approach has been to concentrate on program design as the sole technological factor in predicting impact. If a worker's beliefs about computers actually contribute to monitor impact, appropriate design and use of CPMCS will require more than just 'user-friendly' programs. Differentiating between monitors and manual quantitative control may also contribute to guidelines for the transition from manual to automated controls.

The large sample surveys studying CPMCSs to date have concentrated on issues of stress and privacy. This work gathered responses from over 1400 service workers on a variety of monitor-related issues. It thus provides an extensive base of data for ongoing research on monitor impact.

In summary, this research contributes:

a) a qualitative analysis of CPMCSs effects;

b) a tested causal model of the role of CPMCS design in monitor impact;

c) guidelines for managers and implementers involved in designing and using CPMCSs; and

d) an extensive base of data for use in future research on monitor issues.

1.2.4 Research Approach

The research began with a case study designed to explore CPMCS issues qualitatively. This exploratory study held such factors as task, ergonomics and explicit performance standards constant. These factors typically confound interpretation of monitor studies and lead to the problems of separating effects of monitoring from those of work automation (U.S. Congress, OTA, 1987).

The in-depth case study provided qualitative data to build grounded theory (Zaltman et al., 1982). Next, the research used these data to refine the conceptual model drawn from the literature. This process of integrating data with theory suggested fruitful areas for immediate study, as well as future research issues. This produced a detailed research model of CPMCS impact. The case study also helped clarify specific monitor and work characteristics to be captured in a large-scale national survey.

The national survey then gathered data to test the model in a variety of service environments. This is the first such model to depict the impact of CPMCS design on service workers' perceptions of performance importance. The survey data analysis used a split-sample testing technique, which made it possible to test the original version of the causal model and a refined version.

1.2.5 Research Limitations

No single piece of research can completely study an issue as broad and complex as CPMCS impact. Prior research in this area has not been extensive, so the field lacks well-developed theoretical models of monitor impact. Thus, this work is prone to many of the limitations found in exploratory work. Specific limitations are discussed in detail at various points throughout the dissertation. In general, there are three categories of constraints affecting this research.

First, there is little information about the precise extent and location of CPMCS use. This makes an appropriate population difficult to identify. Second, other researchers have not studied CPMCS design factors, so this work uses a number of new scales. Measurement problems emerging after data collection can undermine efforts to interpret statistical results conclusively. Finally, setting the bounds of this research limits the number of factors being examined. This means that it cannot fully explain the dependent constructs in the causal model. Thus, the research findings should be subjected to further study to test the limits of generalization and the role of other factors in the model.

These limitations are not overwhelming. The case study provides an in-depth, qualitative understanding of complex CPMCS issues. It also supplements the statistical findings of the national survey. The causal model is grounded in theory and subjected to two large-sample tests of its explanatory and predictive power. These factors increase confidence in the results, despite the limitations of the work.

1.3 DISSERTATION ORGANIZATION

The organization of this dissertation parallels the development and execution of the research. Chapter 2 reviews the literature related to the issues of CPMCS impact and explains the development of the conceptual model. Chapter 3 presents the exploratory case study and the survey pretest. The research model is developed and the hypotheses presented in Chapter 4. Chapter 5 describes the operationalized research model and the national survey used to test it. The data analysis and findings of the survey are then presented in Chapter 6. The dissertation concludes by discussing management implications and areas for future research. Research instruments, sample letters and comparisons of survey subgroups appear in the appendices.

CHAPTER 2 - LITERATURE REVIEW AND CONCEPTUAL MODEL

Few researchers have conducted large-scale studies of computerized performance monitoring and control system (CPMCS) impact, particularly its impact on the perceived importance of various job performance dimensions. However, a limited number of exploratory and anecdotal works are available for reference. These works demonstrate the overall complexity of monitor issues and reveal an array of contradictory effects. They also raise many new questions. This chapter begins by reviewing these CPMCS studies.

Although there is a paucity of literature on CPMCSs per se, monitors are computerized control systems. Therefore, this research has been expanded to include studies of control systems. The chapter discusses numerous control system models which could be used to organize and evaluate the literature. It presents the rationale for choosing a thermostat model as the organizing framework.

The chapter then examines the literature on control systems, feedback and management information systems within the thermostat framework. The review identifies CPMCS research opportunities, resulting in the role of monitor design being chosen as the focus of the current research. The literature suggests a conceptual model to guide the study of CPMCS impact on job performance dimensions, and the chapter concludes by describing this model.

2.1 CPMCS RESEARCH

CPMCS research falls into two categories. The first category, 'exploratory' or theory building research, focuses on exploring general questions. It seeks to identify significant issues and key constructs. Exploratory research seeks to expose, but not necessarily explain, relationships among factors or to generate hypotheses. The objective of exploratory research is to expand the understanding of a problem for which theory and research are in the early stages. The second category, 'theory testing,' uses empirical data to test explicit hypotheses derived from existing theory and prior research.

Section 2.1.1 examines the research on CPMCS impact reported in the literature. It looks at the contributions that exploratory studies have made to understanding monitoring. It also identifies areas for research suggested by the works. Section 2.1.2 does the same with theory testing research.

2.1.1 Exploratory Research

Walton and Vittori (1983) examined a variety of issues related to the proliferation of information technology. Discussing monitoring in a U.S. insurance company, they described a system which measured the productivity and efficiency of claims processors. They noted that the processors felt pressure to keep up production at almost all costs and called that pressure "excessive to the point of interfering with performance, not promoting it." They concluded that poor measurement design was at the core of these problems, and that the choice of measures contributed to the impact of the CPMCS.

Walton and Vittori (1983) also noted that the system used performance measures which had been the company standard long before automation. They suggested that the monitor had less "legitimacy" than the system it replaced. This occurred because it increased the visibility of individual performance, while decreasing the visibility of supervisors and managers monitoring performance. They essentially described the capacity of CPMCS to radically alter the balance of power between employee and supervisor/manager.

MIS and organizational theorists describe analytic perspectives which focus on these power issues. "Interaction theory" (Markus, 1983) and "segmented institutionalism" (Kling, 1980) are two such perspectives. They reflect the belief that individuals will react to and be affected by the power shifts caused by automation. Such power shifts occur, for example, when a company substitutes electronic mail for telephone conversations. With electronic mail, technical skill in operating the medium may contribute more to effective communications (and thus power) than language or verbal skills. In firms which use pervasive CPMCSs in place of human supervisors, employee responses may indeed be reactions to authority shifting from humans to less flexible machines.

These works suggest that systems which increase the power of the supervisor at the expense of the worker will be resisted or perceived as detrimental. This may not be a universal reaction. In a comprehensive review of feedback literature, Ilgen et al. (1979) argued that more powerful and credible feedback sources would result in greater acceptance of performance measurement. Thus, it may be important to differentiate between acceptance of the system as a whole and of individual measures. The Walton and Vittori (1983) study demonstrates this point. Employees objected specifically to the measures used in the monitor, rather than to using computer monitoring in place of other systems.

Nussbaum (1984) examined monitoring as one of several potential job stressors facing working women. The study used a magazine survey to question women about psychosocial workplace stressors, problematic work relationships, socioeconomic stressors, and coping mechanisms. It concentrated on analyzing data to identify correlations between these factors and health. The research was a "starting point for long overdue study and research" (Nussbaum, 1984) on these issues.

The Nussbaum (1984) study did not test specific hypotheses. Nonetheless, it demonstrated significant correlations between computer monitoring and job stress, as well as health problems. The survey asked,

> "Is your work measured, monitored, 'constantly watched' or 'controlled' by machine or computer?" (9to5, 1984, Appendix A-1)

Because responses were limited to 'yes' or 'no,' it is difficult to assess whether low-level monitors (such as those which merely counted transactions on a periodic basis) would have the same effect as pervasive designs, which continuously monitored all aspects of performance and attendance. Respondents working under unsophisticated forms of CPMCS may have replied 'no,' thinking that the question referred only to pervasive systems which "constantly watched" or "controlled" workers. The opportunity remains to study whether different types of monitors have different effects on stress and health.

Chi-squared tests revealed significant relationships between being monitored and health problems. However, this relationship does not necessarily demonstrate causality. First, commercial software to monitor standardized jobs can be designed more easily and sold at a lower unit cost than systems to monitor jobs which vary from one company to the next. This means that particular service jobs may be more likely to be monitored than others. Second, other characteristics of the work may make them inherently more stressful than jobs which are unmonitored. Monitored workers may come from more stressful environments than unmonitored workers, without the CPMCS being the cause of the stress.

Irving et al. (1986) reported mixed results in their cross-sectional study of CPMCS effects on job satisfaction, supervision and job evaluation. They adopted an exploratory approach on the grounds that,

> "there are no explicit theories of computerized performance monitoring which could be used for generating specific hypotheses." (Irving et al., 1986)

Participants in the research perceived that CPMCSs improved control of quantitative facets of work. At the same time, the employees believed that their firm's ability to control qualitative facets of performance declined with monitor use. Participants also felt that monitoring increased their employer's emphasis on production.

Irving *et al.* (1986) also reported that monitored employees felt more closely supervised than did unmonitored employees. The monitor may not be the reason for this difference, however. Two competing hypotheses come to mind. The first is that monitoring does increase the closeness of supervision and thus is similar to other methods which result in close supervision. The second hypothesis is that firms which traditionally rely on close supervision are more likely to adopt a CPMCS as a cost-effective means of exercising it. In that case, one could suggest that the tendency to supervise closely leads to monitoring, rather than the reverse. Thus, observed effects might actually be the result of close supervision, not of the monitor per se.

The monitored subjects in the Irving *et al.* (1986) study provided information with which to test such competing hypotheses. The researchers asked for retrospective impressions of the work environment before monitoring. These respondents did not recall feeling less closely supervised before the CPMCS. These results, when combined with the difference between monitored and unmonitored perceptions of the current environment, tend to support the second hypothesis. However, the results remain to be tested on a large scale.

Other researchers have explored CPMCS use as a privacy issue (notably, Marx and Sherizen, 1986; Westin, 1986; U.S. Congress, OTA, 1987). These works concluded that CPMCSs have the capacity to significantly threaten privacy and quality of work life. However, they also suggested that there were no consistent effects of monitoring. Instead, the impact seemed to depend on the purpose, methods and use of the systems.

These exploratory studies captured extensive data on CPMCS issues. Their findings described conditions in specific work environments. However, they generally did not link observed effects to the environment or differentiate among conditions on the basis of theory. This makes it difficult to determine how far the results can be generalized or used to predict outcomes in other situations.

Exploratory studies provide ways to identify critical research questions, grasp key constructs and understand relationships at a rudimentary level. The next step in cumulative research integrates the results of exploratory work with the literature to generate theories and testable hypotheses. As Glaser and Strauss (1967) point out,

> "the theorist's task is to make the most of his insights by developing them into systematic theory."

Section 2.1.2 reviews CPMCS research which tests hypotheses grounded in such theory.

2.1.2 Theory Testing Research

Eisenman (1986) studied how the level of monitoring affected supervisory behaviors and employee perceptions of those behaviors. She predicted that perceptions of formalization and supervision would depend on whether work was computer-mediated (regardless of monitoring). She also predicted that available monitoring capability (high, moderate, low or non-VDT) would result in differences in closeness of supervision.

Despite the variety of control systems studied, participants did not differ in their perceptions of the closeness of supervision. Eisenman (1986) discovered that most supervisors actually underutilized the systems available. She emphasized the need to look "beyond monitoring and into other task related factors in assessing employee perceptions."

Eisenman's (1986) study used capacity to monitor as the independent variable. As a result, all computer-mediated work was treated as receiving at least low-level monitoring. Given the finding that supervisors underused the available monitoring capacity, the opportunity remains to examine how actual use affects perceptions.

Tamuz (1987) tested causal hypotheses in examining the effect of monitor use. She studied the behavior of airline pilots reporting safety violations. The most theoretically-grounded of the CPMCS research, her work used longitudinal data to compare the frequency of self-reported incidents before and after a computer system was installed to track specific violations.

Tamuz (1987) proposed that,

> "...The number of incidents reported varies positively with the amount and salience of sanctions....
>
> ...An increase in the completeness and precision of performance measurement is positively related to the number of incidents reported about those activities being measured....
>
> ...Strong professional norms increase the number of incidents reported about deviations from professional safety standards."

Her research did not explicitly incorporate the CPMCS into the model of impact. Nor did it measure the independent variables of salience, norms, and attention to monitored factors. Instead, the work measured the dependent variable (reported incidents) over time. Tamuz (1987) drew on theory to attribute changes in the number of reported incidents to changes in salience, attention and norms. She further theorized that the results observed occurred because monitoring systems increase the amount and salience of sanctions, have no effect on professional norms, and selectively increase attention to monitored factors.

As predicted, total reported incidents increased over time. This largely reflected an increase in self-reports of violations in monitored categories. Surprisingly, the number of self-reported, unmonitored incidents also increased. These findings contradicted literature which asserts that increased attention to measured activities is accompanied by decreased attention to unmeasured activities.

Tamuz (1987) proposed three possible explanations for these findings. The first was that the monitor heightened awareness of measurable activity, which pilots then generalized to safety incidents which were not monitored. Her second explanation suggested that the pilots became more skilled in incident reporting, as a result of increased attention to measured activities. Thus, they also became more adept at reporting unmonitored incidents. Third, she suggested that pilots might have increased reporting unmonitored events to put political pressure on the Federal Aviation Administration. By demonstrating the number of dangerous incidents not captured by the CPMCS, they could conceivably alter the monitoring system. Testing these alternative hypotheses would enhance our understanding of the relationships between monitoring and work behavior.

Finally, Smith et al. (1986) interviewed 41 employees of five firms to uncover CPMCS impact on motivation, performance and job satisfaction. Unfortunately, as the researchers pointed out, their participants could not be considered representative of service workers in general or monitored workers in particular. The workers were all unionized and employed by companies which used extensive monitoring. In addition, the small number from each participating company made it impossible to analyze responses to detect company-specific differences. However, the interviews led Smith et al. (1986) to conclude that,

> "The problem lies not in the actual monitoring, but in the system by which performance is monitored and the way in which the monitoring is applied to control and motivate worker behavior."

2.1.3 Research Opportunities

The research discussed in these subsections described many aspects of what is observed when a company uses a CPMCS. Different studies looked at the effects of monitoring on:

- stress;
- supervisory styles;
- perceptions of the workplace;
- effective control; and
- worker performance.

These works raise many questions of why CPMCSs have the effects observed. This suggests that an explanatory model would make an important contribution to knowledge about monitoring. It could also provide a framework for ongoing research, as well as practical guidelines for monitor implementation.

Debates over monitor impact on performance focus on whether it leads to increased production and, if so, whether increases come at the expense of customer service, teamwork and initiative. None of the research to date proposes hypotheses to explain why anecdotal evidence is contradictory. A model of impact on direction and strength of performance would help clarify and explain effects on performance.

Furthermore, none of the CPMCS studies compare various types of monitors. The research suggests that different effects may be due, in part, to different monitor designs. But CPMCS research has not yet identified or tested which design dimensions actually affect perceptions of work. A study that did so could increase understanding of impact and lay a foundation for research studying design impact on other aspects of work and work life.

After reviewing the CPMCS literature, this research chose to concentrate on explaining how monitor design and use affect performance. Service roles depend on satisfying both production and interaction objectives. Since debate centers on how monitoring affects performance in each of these areas, it would be appropriate to focus the study of monitoring on its impact on production and interaction.

CPMCS research findings must be combined with literature in related areas to develop a theoretical model of impact. Sections 2.2 to 2.9 review literature about control systems, feedback and management information systems to build the conceptual model for this research.

2.2 CONTROL SYSTEM MODELS

Whisler (1970) defines control as the process whereby systems or individuals restrict, constrain or direct the freedom and discretion another individual can exercise in performing a job. Whether it is used to plan staffing or evaluate employee performance, a CPMCS operates as part of an organization's performance control system.

Control systems demonstrate a wide range of designs. So do CPMCS designs. It is important, therefore, to begin with a framework or classification scheme which allows one to describe CPMCSs in relation to other control systems. Using such a framework shows how various systems are alike and how they differ. It also indicates where theory and data from other fields can contribute to understanding the monitors.

Static models categorize control systems in terms of their features of application. Dynamic models, on the other hand, depict the process of control. They demonstrate the results, rather than simply the design, of the system. Beginning with the static frameworks, this section examines the components of these two types of models and their relationship to CPMCSs.

2.2.1 Static Models of Control

Landy and Farr (1983) advocated a three-dimensional framework of control. They argued that varying each dimension altered the effects of control systems. Their approach classified performance measurement systems on the basis of (1) the specificity of measures employed, (2) the time span of the measures, and (3) the proximity of the measured component to organizational goals. Proximity to organizational goals would depend on the value of monitored tasks. Monitors could be classified according to frequency (time span) of measurement. Specificity would depend on the degree to which the system captured individual versus group performance and the frequency of that measurement.

Woodward (1970) described control techniques as existing on a scale from personal to impersonal modes of control. Impersonal modes of control rely on the use of mechanistic systems to identify, measure, evaluate and direct behavior. Personal modes use direct observation of employees and the work in process. A CPMCS is an impersonal control technique, while traditional evaluation systems generally use more personal modes of control.

Slocum and Sims (1980) described three, increasingly impersonal, modes of control to guide and measure performance:

developmental, discretionary and systematized. Systematized control is most effective where tasks are well-defined and the pace of incoming work is predictable. In other cases, they argued, more personal and less rigid control systems are appropriate. CPMCSs fall into the systematized category.

Taxonomies and static models are very useful for describing or comparing system features. However, they do not capture the process of control well. This research emphasizes explaining a process, which makes dynamic models preferable as a basis for a conceptual model.

2.2.2 Dynamic Models of Control

Taylor *et al*. (1984) suggested the dynamic model of control shown in Exhibit 4. It depicts behavior triggered by a comparison process. In this process, feedback about performance (the achieved state) is compared to a desired state or performance standard. If the desired and achieved state do not match, the employee acts to bring the two more into line with one another.

The Taylor *et al*. (1984) model may obscure details of the control processes and design which differentiate a CPMCS

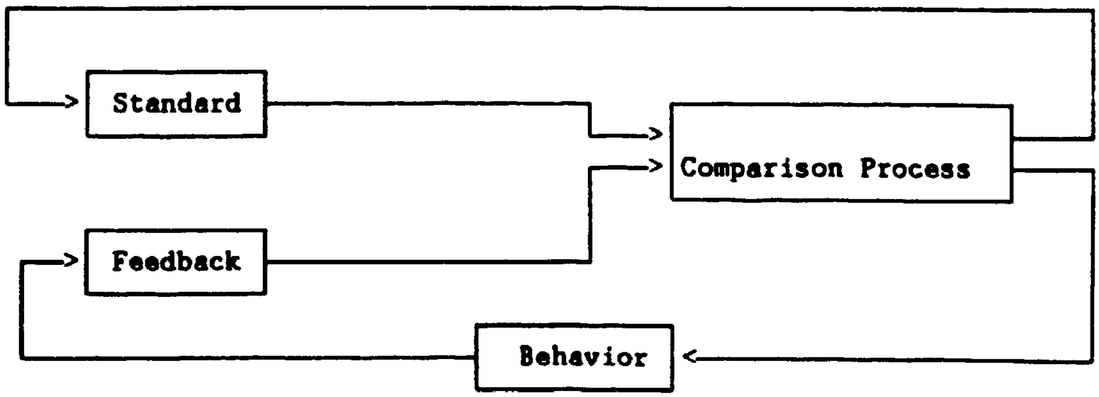

Exhibit 4. Dynamic Model of Control:
From Taylor et al. (1984)

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from other systems. For example, the 'comparison process' may involve the public, the supervisor, the employee or any combination of the three. 'Behavior' may be determined autonomously or directed by the supervisor or the monitor. In each case, one would want a more detailed model to compare control system designs, uses, and effects.

Ilgen et al. (1979), in their seminal review of feedback literature, derived a process model of control and feedback systems (see Exhibit 5). They proposed that control systems influence performance via the messages they convey to employees and the way those messages are perceived. The feedback model concentrates on the process of interpreting the message. It provides a detailed framework to look at perceptions and the process of translating them into action.

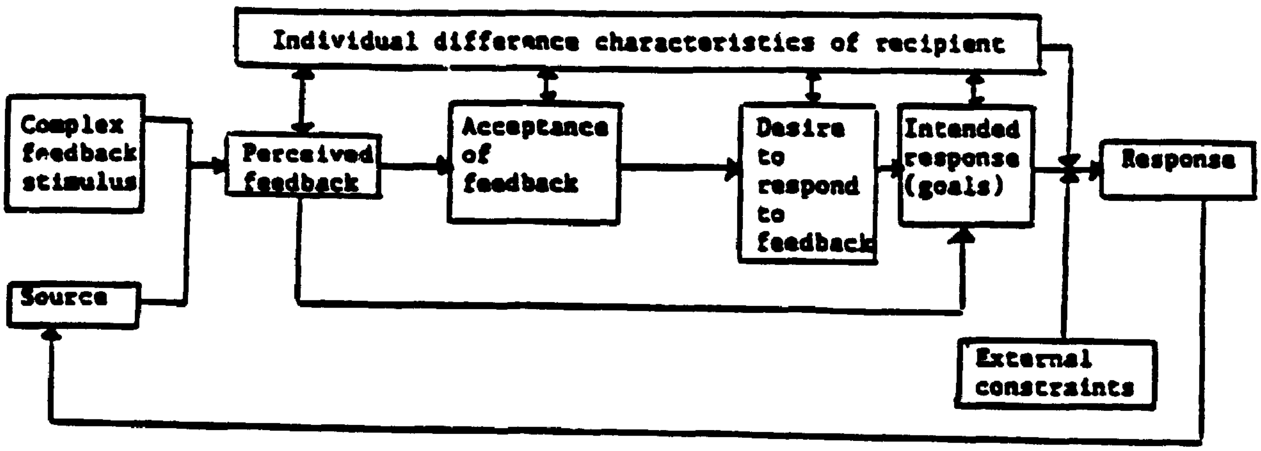

Exhibit 5. Process Model of Feedback:
Ilgen *et al.* (1979)

The model also focuses on the employee's reaction to feedback, rather than on the control system's role in producing that feedback. This is a useful perspective for research explicitly studying the response to feedback. However, it is less helpful for research exploring the role of the control system, i.e., the role of the stimulus and the source.

Lawler and Rhode (1976) proposed a process model which concentrated on the components of the control system. Building on the work of Eilon (1962) and McKelvey (1970), they described these components in terms of a thermostat. This view of control systems focuses on the components and processes depicted in Exhibit 6. This dynamic model can be ap-

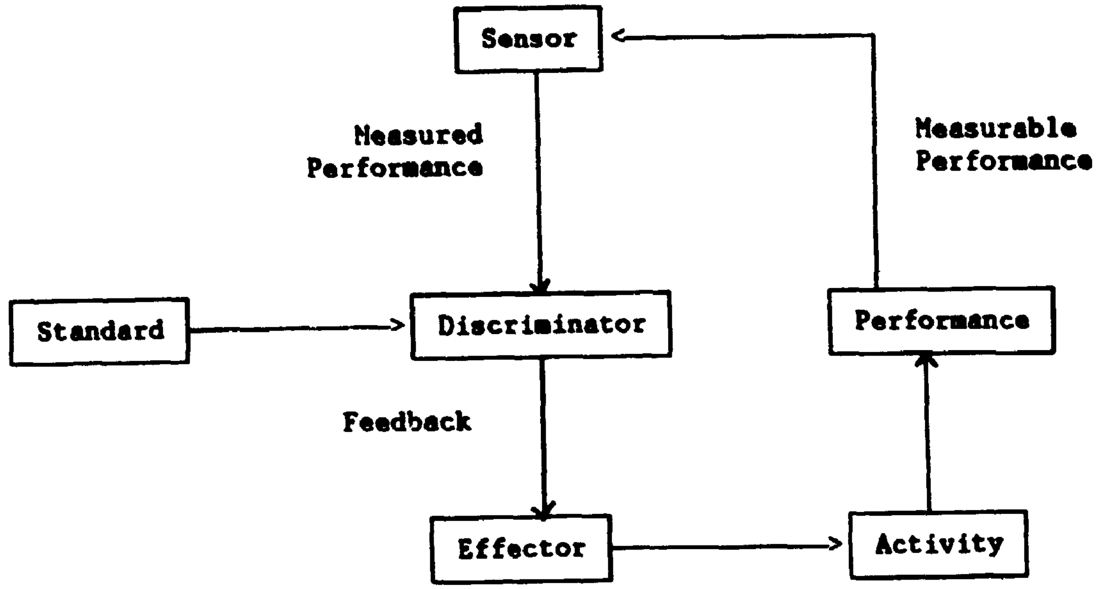

Exhibit 6. Thermostat Model of Control Systems: Adapted from Lawler and Rhode (1976)

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plied equally well to systems which incorporate a monitor and those which do not.

In the thermostat model, the sensor (a control device) measures the performance level. It communicates that measurement to a 'discriminator' (such as the supervisor) who compares it to a standard. The results of this comparison are then communicated to the 'effector' (the employee) responsible for initiating activities which produce measurable performance.

CPMCS roles in this model can vary considerably. A simple monitor may act strictly as the sensor, while many pervasive designs incorporate the sensor, discriminator and effector roles. For example, unobtrusive word processing logs merely sense performance. Systems which direct incoming calls to particular operators incorporate all three roles within the CPMCS.

There may also be more than one discriminator. A monitor might report daily production counts directly to the employee and average monthly productivity to the supervisor. In that case, the employee and supervisor each generate messages for the 'effector' about the type and level of activity required.

The thermostat model provides an effective way to study the literature for insights into CPMCS design and impact issues. The detailed roles make it possible to consider how different designs might fill these roles and to hypothesize effects. In essence, it complements the perspective of the research questions. Thus, this model serves as a framework for the review of non-CPMCS literature. The sections which follow examine each component of the thermostat model in turn.

2.3 THE SENSOR: WHAT PERFORMS THE MEASUREMENT?

One important stage in designing a control system is choosing one or more devices to measure, evaluate and report performance. Qualitative systems generally rely on humans to carry out these roles. Quantitative systems may incorporate machines or humans for each role. This section examines how the choice of sensor may contribute to monitor impact.

2.3.1 The Computer as a Sensor

Long before widespread availability of CPMCSs, Whisler (1970) wrote,

> "One wonders whether an individual feels more controlled when he has to respond to cues from a machine system [as opposed to cues from human supervisors]."

This remains a question, since few studies explicitly treat beliefs about or attitudes toward computers as a causal factor in control system impact.

Typically, studies which address this question look at computer attitudes and beliefs in one of two ways. The first is as a dependent variable. Studies which examine the formation of computer attitudes (such as Ives et al, 1983; Turkle, 1984; Zuboff, 1982) fall into this category. Other works, such as Morrison (1983) and Kammire (1984) concentrated on developing scales to measure either beliefs or attitudes, without reference to their role in a causal model.

The decision whether, and how, to include these elements as causal factors in a model involves the researchers' perspectives on technological impact. There are three general orientations which, consciously or unconsciously, tend to influence the decision. They are: technological determinism; technological neutrality; and the socio-technical perspective.

Technological determinism is the belief that "technology itself has a determinative impact" (Turkle, 1984). This is the view that computer technology triggers predictable reactions. These reactions would be seen in virtually any use of such technology. Understanding the specific technology used in a given situation would thus contribute to predicting its effects.

While not aligning themselves strictly at the polar extreme of technological determinism, Turkle (1984) and Zuboff (1982) have produced seminal studies on the impact of computer mediation.

Turkle (1984) studied 400 children and adults, researching the 'relationships' people form with computers. She classified modes of relating as "metaphysics" (is the machine alive?), "mastery" (can I beat it?) and "identity" (how does the computer make me feel?). She concluded that computers have the power to fundamentally alter human self-perception and development. This study was primarily intended to elaborate understanding of human personality. However, it made a strong argument for including the computer itself as an influential component of automated systems.

Zuboff (1982) conducted an intensive study of 200 service-sector employees, managers, supervisors and professionals in three countries. The subjects worked for firms which used a broad range of systems with various built-in performance monitors. She concluded that automation affected:

1. the focus of managerial control (by encouraging emphasis on quantitative, output-oriented measures); and
2. the nature of organization and management (by reducing the need for face-to-face interaction between supervisor and subordinate, allowing managers to incorporate values and attitudes directly into the technology, and affecting the modes of worker communication and interaction).

These conclusions suggest that automated technology can incorporate new values and shift the emphasis of the control system. They imply that using computers, rather than humans, to sense performance can change reactions to the control process.

An important caveat is in order in extrapolating from Zuboff's study. Golembiewski et al. (1976) and Mohrman and Lawler (1985) suggested that productivity changes take three forms:

1. alpha change: a change in the level of output or phenomenon, while the evaluation criteria remain unchanged;

2. beta change: the type of activity or output being measured remains the same, but the measurement level criteria change (i.e. a pre-automation output of 200 transactions per hour was considered 'high'; post-automation, 200 transactions per hour is considered an 'average' level of output); and

3. gamma change: outputs are produced differently and seem to be different in nature, resulting in a change in evaluation methods.

In every case, the new applications Zuboff (1982) studied had been introduced primarily to automate particular tasks. In doing so, they fundamentally altered the execution of the job being measured. Thus, Zuboff's subjects were in an environment of gamma change, whereas CPMCS systems track alpha change. It may be misleading to generalize her findings to workers whose automated tasks are subsequently monitored by CPMCS.

Zuboff (1982) reported definite non-neutral impacts of computerization. She commented,

> "Employees can tend to see technology less as an instrument of authority than a source of it."

However, she did not conclude that these effects are universal in character. Like Turkle, she suggested that responses to technology reflect more subtle manifestations of human, task and technological factors.

Morrison (1983) examined the attitudes of Australians toward computers and their potential impact. He derived four factors from his survey instrument, which seemed to characterize the way subjects looked at man-computer interaction. The emergence of these factors indicates that Morrison's subjects formed opinions about the 'awesome,' 'thinking machine' and 'negative outcome' aspects of the technology. These factors were separate from the 'application' factor. This supports an argument that people attribute qualities to computers per se, separate from their uses.

Finally, Whisler (1970) believed that the problem is,

> "not so much the 'dehumanizing' of the individual as the 'humanizing' of the computer by subconsciously attributing to it human personality traits... Machines do not really control -- they just hound people until they do what they are supposed to do. Yet, the individuals affected often see machines as demanding and controlling."

This is apparent in popular press titles such as "The Boss That Never Blinks" (Koepp, 1986) and "Big Brother Is Watching You Work" (Carey, 1985). Such 'humanization' may produce the perception among workers that supervision has increased under CPMCS.

At the opposite pole is the view that technology per se is neutral. This position says that technology is merely a tool. Its effects, therefore, result entirely from the applications for which it is used. The neutralist asserts that the technology itself explains none of the attitudinal or behavioral impact of automation.

Technological neutrality is most often demonstrated in data processing and industrial engineering literature, but with little rigorous empirical support. It generally takes the form of implicit assumptions about systems implementation. Wright (1982), Young (1980) and Ferderber (1981) described designs of performance measuring and monitoring systems for service roles (word processing operators, clerical staff and hospital para-professionals). These designs were essentially manual work-standards measurement devices, automated to take advantage of the speed or pervasive qualities of the computer. Discussions of their designs did not acknowledge that the computerized system might be perceived as being significantly different from its manual counterpart.

The prevalent focus among computer scientists and M.I.S. theorists or practitioners is less extreme. Olson and Lucas (1982) exemplify this 'middle ground' of a socio-technical perspective of automated systems, namely that,

> "the tools of automation are neutral; the social, task and structural factors combine with technical factors to influence the nature of the work activity."

They stressed the potential for positive outcomes of increased automation and explicity stated that "a management philosophy stressing careful design will prevent these negatives outcomes" of automation. Inherent in this perspective is a belief that the employee affected will respond primarily to the application, not the technology.

There is little evidence of work which explicitly asks the question, "What effect does holding certain beliefs about computers have on man-machine interactions?" This seems to be a crucial question. If beliefs about computer technology do not contribute to the impact of CPMCS, a traditional model of control system impact should explain and predict most of the behavior observed in research to date. If they do contribute, however, then a CPMCS is a very different control system and must be managed as such. Explicitly testing the effects of such beliefs on the control process would make a significant contribution to this field.

2.3.2 Sensor Credibility

The effect of measurement on eventual performance is also contingent upon acceptance of that measurement. Acceptance is more likely if the sensor, whether a monitor or a supervisor, is considered credible and the measure accurate (Ilgen *et al*., 1979).

CPMCSs are highly structured and facilitate remote (rather than direct or personal) sensing. The Slocum and Sims (1980) framework would suggest that CPMCSs can make observation and measurement more systematized. In environments of high task or workflow uncertainty (such as direct customer service jobs), one would expect workers to consider impersonal sensors less accurate and credible.

Ilgen *et al*. (1979) cited the source of feedback (i.e. the discriminator) as a factor influencing acceptance of the feedback. The employee judges the discriminator's expertise and trustworthiness. Part of this judgement is based on the data provided by the sensor and the discriminator's use of those data. Ilgen *et al*. (1979) summarized the feedback literature in saying that employees must believe that:

- the sensor accurately senses the performance;
- the sensor accurately measures the performance it senses; and

- the performance being measured represents the important aspects of the job.

There is strong reason to expect that these beliefs will also apply to monitoring systems. Walton and Vittori's (1983) subjects resented measures which did not capture crucial, qualitative aspects of their work. Similarly, the Air Canada agent cited in the introduction complained that the airline's monitor did not measure "selling skills or customer satisfaction" (Oreskovich, 1985). Albrecht's (1979) parole officers resisted monitoring on the grounds that a computer could not accurately detect or measure their performance. Thus, the perception that monitors sense and measure important work activities should be a significant factor in their impact.

2.4 THE PERFORMANCE: WHAT IS MEASURED?

The choice of behaviors to measure and the ways in which they are measured are widely recognized as factors contributing to the impact of a control system. CPMCSs can only measure computer-mediated activity, in quantitative terms. They must capture interaction roles via surrogate measures (e.g., with group production figures used as a measure of effective teamwork). This may or may not capture the major part of a particular service sector job.

Walton and Vittori (1983) emphasized the importance of having a control system which supports attributes valued by the organization. They cautioned,

> "The measurements will be resented if they ... are seen as emphasizing the quantifiable aspects of the work at the expense of equally important but nonmeasurable aspects."

The productivity measures had been a source of contention in the company they studied, even before the computer monitor. The performance indices made no allowance for complexity or quality of processing. Many operators considered them inadequate, inappropriate and unfair. CPMCSs which incorporate less complete or less appropriate measures than those used prior to monitoring should result in less acceptable control systems.

As early as 1960, Whisler and Shultz (1960) forecast dysfunctional effects when predicting the impact of computer-mediated control. They wrote,

> "The techniques themselves feed on numbers and on systems, the elements of which are explicit and unambiguous. Wherever these techniques are adopted, they will bring with them increased emphasis on quantification about the firm's operations and environment ... important danger may result from overemphasis on the kind of informa-

tion that can be made explicit in a quantitative sense."

Laudon (1974) and Albrecht (1979) presented case studies of efforts by service sector employees to directly influence measures incorporated in a computerized performance monitor. Laudon investigated four law enforcement and social welfare branches of state and county governments, while Albrecht examined efforts to implement performance monitors in a parole office.

Albrecht (1979) described an elaborate (and successful) process carried out by the parole officers to eliminate measures of their activities from the proposed system. It was triggered in large part by the officers' beliefs that their activities were qualitative and therefore could not be measured properly by an automated system. Similarly, Laudon (1974) found the strongest resistance to automated measurement among those units with primarily qualitative outputs and a tradition of unit self-control and evaluation.

Laudon used comparative analysis among units in his work. In essence, he studied a single system in multiple, quasi-independent units. He then analyzed results among and across groups. This use of comparison strengthened his conclusion that the choice of performance to monitor and the measurement criteria will affect the outcome of control systems.

Ovalle (1984) proposed that multiple monitoring systems in a single organizational unit led to conflict and dysfunctional outcomes. In particular, he cited units with both behavior and output controls. Multiple performance control systems confuse the link between performance and rewards. In so doing, they weaken the motivating power of the component systems. This is especially important when the source of motivation is largely extrinsic. One would expect conflicting motivation when the CPMCS measures only output (production), while the reward system also relies on a number of behavior (interaction) measures.

Ouchi (1977) proposed that the effect of behavior and output controls will vary according to the task and organizational climate. He argued that output control is effective in service roles if there is a form of implicit behavior control in the organization. This condition exists, for example, among accountants subject to a professional code of ethics or retail employees in stores with 'active' clients. This conclusion was based on an assumption that shoppers in the stores studied did exert effective behavior control on the retail clerks. Such an assumption may not have been reasonable. Nonetheless, the work supports the concept that work environment and an employee's personal standards of appropriate performance may augment or counteract the effect of monitoring on direction of effort.

Numerous other authors (e.g., Irving et al., 1986; Kerr, 1975; Landy and Farr, 1983; Lawler and Rhode, 1976; Walton and Vittori, 1983) have implied that including some factors while excluding others also biases an employee's response. They suggested that employees believe the presence or absence of control along a given dimension indicates how important that dimension is to their employer. In the absense of strong qualitative systems, one would expect monitored employees to believe that their firms value output more than service or interaction.

To summarize, the explicit measurement of an aspect of the job focuses attention on that aspect. The reaction to its measurement should depend on:

- the perceived importance of the factor being measured;

- the perceived completeness, accuracy and appropriateness of the measure;

- the degree to which the measure discriminates individual, controllable performance; and

- how closely the rewards are linked to the measurement.

2.5 THE DISCRIMINATOR: WHO PERFORMS THE COMPARISON?

Employees rarely evaluate feedback independent of its source. They make judgements about the credibility of that source which influence their reactions. The discriminator, by interpreting monitor data, will be an important factor in the impact of any monitor.

There are four discriminator scenaria possible with monitoring. First, the monitor may be the sensor, the supervisor the discriminator and the employee the effector. Common insurance company monitors which count and report monthly production illustrate this design. The monitor collects performance data and relays them to the supervisor. The supervisor then evaluates the data and discusses the results of that evaluation with the employee. In these cases, employees may not even be aware that they are being monitored by a computer.

In the second scenario, the monitor is the sensor and the employee the discriminator and effector. Here, the monitor measures performance and relays data directly back to the employee. The employee can then compare the data to standards (personal, corporate or both) and decide what activities should be undertaken as a result.

In the third case, the monitor acts as sensor and discriminator, while the employee remains as the effector. The monitor not only collects performance data, but also evaluates the data and reports that evaluation to the employee or supervisor. Monitors which interactively send messages like "you are working too slowly" or "Your error rate is unacceptable" fall into this category.

The fourth case represents the most pervasive form of monitoring. It incorporates machine-pacing into a system where the monitor acts as sensor, discriminator, and effector. Systems which route phone calls or customers to specific workers are examples of this case. Even in this scenario, however, the service sector employee plays the final effector role in deciding how much time or what kind of attention to give to work directed to her workstation.

These system variations rely on three different discriminators: the employee, the supervisor and the monitor. Their effects on activity and performance will depend on the employee's perception of the discriminator's credibility and intentions (Ilgen et al, 1979).

Bannister (1986) used Ilgen et al.'s (1979) process model (Exhibit 5) to examine the importance of source credibility on feedback acceptance. Satisfaction with feedback is greater and the feedback judged to be more accurate, he concluded, if the source seems credible. He said,

> "When it comes time in an appraisal process to provide directive feedback, the individual's perceptions of the source's qualifications to provide that feedback become critical to their intentions to use the feedback."

Employees can view their jobs as being qualitatively different from the way the company defines them. Or they may give different priorities to the components measured by the appraisal system. For example, a travel agent may see her job as one of providing complete travel advice to clients (interaction), while the agency sees it as generating a dollar volume of ticket sales (production). Taylor et al. (1984) predicted that, in situations where standards or measurement criteria conflict, feedback from the discriminator will have little effect on behavior. They wrote,

> "When qualitative differences exist, feedback is predicted to have little impact on recipients' behavior because it is likely to be perceived as useless information."

Thus, one would expect workers who see quantity as a relatively unimportant aspect of the job to have little concern for the monitor or its message. This attitude should be even stronger if the supervisor (as the discriminator) seems to share the worker's view of the work.

Neutral feedback, such as simple transaction counts, forces the employee to act as the discriminator. He may be unable to discriminate accurately, due to lack of information or inappropriate standards. As a result, the feedback message an employee receives may also reflect his own efforts to evaluate the meaning of the actual feedback. This suggests that monitors which do not play the role of discriminator will have less predictable effects on performance. In such cases, the supervisor's or employee's evaluative standards will be a much stronger determinant of effect.

To summarize, control system effects also depend on perceptions of the discriminator. To accept measures, employees must believe the discriminator:

- has the expertise to evaluate performance;
- is a reliable evaluator; and
- holds a view of the job consistent with that of the employee.

2.6 THE FEEDBACK: WHAT IS THE MESSAGE?

Control systems influence perceptions when they feed performance information back to the employee. Ilgen *et al.*'s (1979) model illustrates that the individual responds to perceived, rather than actual, feedback in a complex manner.

The raw data or explicit message comprising the feedback is only one important factor. Perceived feedback is also a function of the feedback source and the 'perceiving' individual.

This section examines the characteristics of the message which seem to bear on its interpretation.

Ilgen et al. (1979) asserted that the message must provide increased knowledge of performance in order to have an effect. Consider a system in which terminal operators receive their own production or accuracy counts each day. Receiving reports of monthly average production should have little effect because it provides little new information. This theory also suggests that a monitor which reported monthly averages directly to employees who kept their own manual counts on a weekly basis would be ineffective in improving productivity.

Employees judge the importance of each aspect of their jobs on the basis of personal standards, employer standards, and/or employer reward systems. Taylor et al. (1984) demonstrated that employees tend to ignore feedback about job factors they consider unimportant. For example, feedback about group performance in a company which ties salary increases to individual output may have no effect on the direction of performance intentions.

Taylor _et al_. (1984) also concluded that employees are more likely to believe that feedback is accurate if it is provided frequently. Furthermore, increasing frequency also seems to increase the perceived fairness and acceptability of evaluation systems.

The chance of interpreting feedback correctly improves if the feedback occurs as close to the measured event as possible and is received frequently (Ilgen _et al_., 1979; Lawler and Rhode, 1976). This suggests that the effectiveness of a control system, particularly as an extrinsic motivator, will depend on the regularity of data collection and evaluation. CPMCS use makes it practical to collect data more frequently and consistently (U.S. Congress, OTA, 1986). This has the potential to improve effectiveness.

However, Ilgen _et al_. (1979) pointed out that increasing feedback frequency can often increase the sense of being controlled and thus decrease the desire to respond. This result is enhanced if the feedback is low in new information content. Thus, one would expect the interaction of timing (frequency) and content to be a factor in CPMCS impact.

Albrecht (1979) and Laudon (1974) demonstrated resistance to systems which transmitted performance data to parties outside the work group. Their subjects believed that the increased availability of data would increase external control over their work. Other studies (Tamuz, 1987; Walton and Vittori, 1983) have tied this increased availability of performance data to perceived changes in power and reliance on the information.

Ilgen et al. (1979) suggested that feedback provides valuable information about the concerns of others toward performance, i.e., the appropriate direction of response. They noted that,

> "In the absence of explicit information about performance, the individual often is left to infer what is desirable behavior from the outcomes (positive or negative) that are administered. That is, the outcomes become feedback for behavior." (Ilgen et al., 1979)

In addition, they proposed that the supervisor's attitude toward the value of performance would moderate the desire to respond.

Properly designed monitors should improve the perceived and real accuracy of data (Huff et al., 1987). This suggests that a decision to use monitors rather than humans would improve acceptance of measures. But message 'accuracy' goes well beyond the mere correctness of the numbers. The perception of accuracy refers primarily to the consistency of the message with the employee's self-perception and the belief that it accurately reflects her own performance. Ilgen et al. (1979) noted that "whether or not that belief is itself correct is inconsequential to acceptance."

Smith et al. (1986) reinforced this idea. They pointed out that control system data must be perceived as being fair if they are to influence performance. Necessary conditions for fairness include measurements which have value to the worker and provide timely information. In other words, the system must tell workers promptly about performance they can control.

Finally, Zmud (1978) categorized acceptance of information as depending on four factors. These were: (1) its quality or appropriateness; (2) its relevancy (accuracy, factual quality, completeness, timeliness); (3) the quality of its presentation; and (4) the quality of its meaning.

In summary, the major additional factors known to affect interpretation and acceptance of feedback are (1) the perception of the message's accuracy, (2) the frequency of the feedback, and (3) the amount and importance of new information contained in the message. Thus, the content and presentation of CPMCS data may affect perceptions of the message.

2.7 THE ACTIVITY: WHAT IS THE EMPLOYEE'S RESPONSE?

As noted earlier, one objective of a CPMCS is to motivate and measure employee productivity. Service sector roles typically comprise a number of different tasks, and employees generally have some latitude in the priority they give to each one. Therefore, the issue of the direction in which a CPMCS motivates employees is a significant one.

Katerberg and Blau (1983) noted that the difference between success and failure at a job may come down to the allocation of energy between relevant and irrelevant activities. In their study of sales agents, they found that including a directional component of motivation contributed significantly to predicting performance.

Kerr (1975) also discussed how the effect of control systems on effort direction can be dysfunctional when rewards are tied to systems which imperfectly measure the desired behavior. Insurance companies, for example, often use systems which track payment turnaround time as a surrogate of customer service. Such companies may be rewarding clerks who

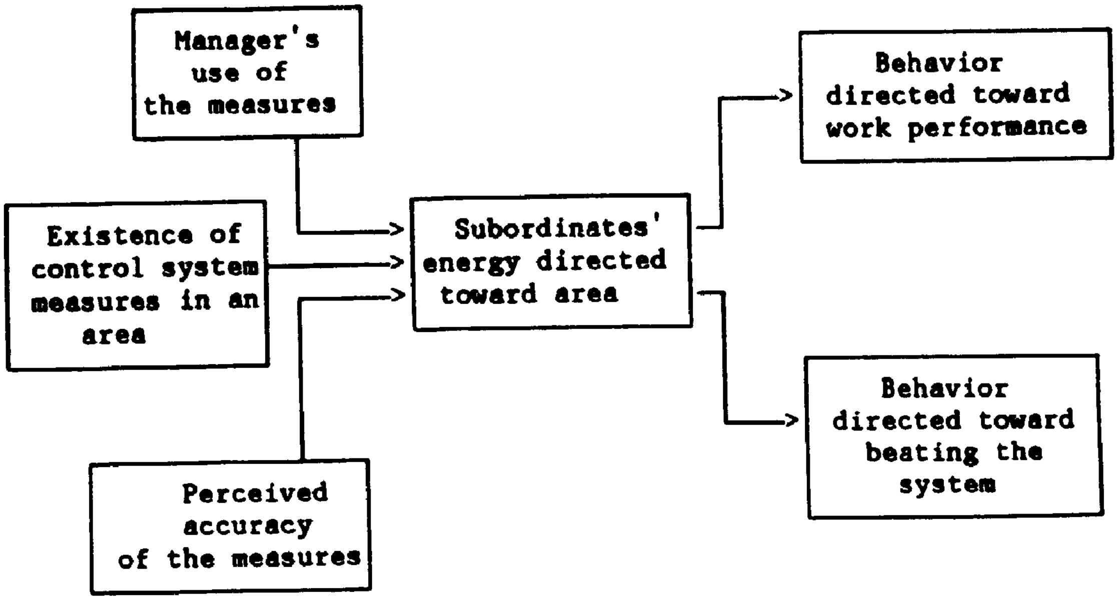

Exhibit 7. Control Effects on Effort Direction: Cammann and Nadler (1977)

give priority to paying all claims quickly, while penalizing those who give priority to establishing the legitimacy of the claim. Yet, this latter group is improving the firm's profitability and thus meeting another important objective.

Cammann and Nadler (1977) depicted the potential of control systems to influence direction (see Exhibit 7). They said that employees direct most of their attention and efforts toward areas which are measured, particularly if the control system relies on extrinsic motivation to produce results. This is the tendency to do what is "inspected" more often than what is not (Irving <u>et al</u>., 1986). CPMCSs cannot adequately or economically capture all facets of a service job. Even the most pervasive monitors must focus on quantifiable aspects of work. This suggests that monitored employees will direct their effort at production and other quantified forms of performance, unless the company uses equally strong systems to measure service or interaction.

Lucas (1975) studied California bank branch managers. He concluded that the likelihood of taking action on the basis of computer information was positively correlated with (1) the belief that compensation depended on meeting defined goals, and (2) favorable attitudes toward computer information in general. One could hypothesize that the impact of messages incorporating CPMCS measurement will depend on the employee's belief that (1) the goals are appropriate and important and (2) the automa ed system supports reaching those goals. This is particularly significant in service sector roles in which the CPMCS measures output (production) while the organization claims to stress behavior (interaction).

Lawler (1976) reviewed studies of 'bureaucratic behavior.' This is the practice of doing things which

> "look good in terms of the control measures but that are dysfunctional as far as the generally agreed upon goals of the organization are concerned."

In such cases, the control system is directing effort toward measured components, at the expense of unmeasured activities. Claims processors who ignore customer enquiry telephone calls, in favor of entering transactions, exemplify this behavior. Lawler (1976) concluded that such behavior is most likely to occur when:

- control system measures are not inclusive or are incomplete;
- the discriminator has reward power;
- there is a high level of subunit identification among workers; and/or
- the system information is used as the basis of valued rewards.

In summary, the literature suggests that the control system design will interact with the perceived importance of various performance factors to influence the strength and direction of the employee response. The qualitative evaluation systems are potentially as important in this process as the quantitative systems.

2.8 DESIGN DIMENSIONS

A key element in systems design is 'equifinality.' This is the concept that there are many alternative ways to design systems to meet desired objectives (Lucas, 1985; Davis and

Olson, 1985). This section examines the dimensions along which one may develop alternative CPMCS designs and the role of these dimensions in CPMCS impact. It begins by defining the dimensions, and describes them in terms of a continuum of control (Sheridan, 1980) from unobtrusive to pervasive systems. It then explains how each dimension relates to the thermostat model components.

2.8.1 CPMCS Dimensions

Westin (1986) suggested studying five elements of design when examining socio-legal monitoring issues. These elements were:

> (1) the place(s) where activities are observed:
>
> (2) the person and activity being observed;
>
> (3) the observation technique(s);
>
> (4) the use of the information gathered; and
>
> (5) the privacy safeguards in effect.

Marx and Sherizen (1986) suggested eight dimensions to consider, specifically when analyzing the privacy effects of CPMCSs and more pervasive forms of surveillance. Their eight criteria are shown in Exhibit 8. They are equally appropriate when applied to manual control systems.

Criterion	Range
Degree of Intrusiveness	High ----------------> Low
Frequency	Continuous -----------> Rare
Relevance to Performance	Indirect -------------> Direct
Visibility	Low ------------------> High
Focus	General --------------> Specific
Targeting	Categorical ----------> Individualized
Nature of Data Collected	Substantive ----------> Transactional
Accuracy	Low ------------------> High

Exhibit 8. Criteria for Analyzing Privacy Effects (Adapted from Marx and Sherizen, 1986)

Other works investigated how the dimensions of an information system's design affect the use of its data. The 'Minnesota Experiments' (Dickson et al., 1977) focused on three characteristics of the information system: format, time and decision aids. Firth (1980) studied the use of MIS data to evaluate performance. He suggested three different dimensions: level of aggregation, presentation style and data collection period or frequency. These works concluded that information system designs had measurable effects on the interpretation and perceived importance of data. They dealt with the impact on evaluators and decision-makers, rather than on those being evaluated. Nonetheless, the research suggests that similar dimensions would be appropriate in this study.

	Unobtrusive ——————————> Pervasive
Object	Business Unit —> Work Group —> Individual Employee
Period	Regular, Infrequent -> Regular, Frequent -> Immediate
Recipient	Employee ——> Supervisor/Manager ——> Public
Tasks	Track Results —> Track Process —> Assign and Track

Exhibit 9. Dimensions of Control System Design

The elements of these frameworks relevant to performance measurement can be distilled into four dimensions. As shown in Exhibit 9, the design may vary along the following dimensions: object, reporting period, recipient, and task. These four independent facets of the control system can be described in terms of continua of pervasiveness of control. These continua facilitate later discussions comparing various designs.

Object of Measurement: The first dimension is the <u>object</u> of measurement. Systems may be designed to collect information about individual employees, such as the retail sales of each salesclerk or the daily collections of each loan officer. Such systems represent the most pervasive approach, i.e., tracking and attributing performance at the level of the individual employee. Less pervasive systems might aggregate performance for an entire work group, while an even less pervasive design uses the business unit as the object of measurement. In a retail chain, for example, point-of-sale systems can be configured to report the sales of individual sales clerks separately, to produce total sales by department or to report only totals by store. These choices determine the person or group to which performance is attributed, and thus who will be held responsible for maintaining or improving that performance. The more directly a control system attributes performance to an individual, the more pervasive its design.

Reporting Period: The second key monitor dimension is the choice of reporting period or frequency. A supervisor may be able to query the system at any time and obtain an up-to-the-minute report of the status of monitored performance. As an alternative, the system may be configured to automatically and immediately report unacceptable variances in performance. For example, a CPMCS can alert a supervisor when a telephone operator has been disconnected from the switchboard for more than five minutes. Or it can send a message to a group leader, telling her that the group's error rate has exceeded 3% for the morning. These are pervasive designs. Less pervasive designs report on historical activity. They tell the recipient about performance at regular, fixed intervals such as hourly, daily or weekly. The more immediate the availability of monitor data, the more pervasive the system.

Recipient of Data: A third dimension is the recipient of the data. CPMCSs can be designed to provide feedback directly to the employee. These designs help the employee track and evaluate personal performance, without relaying that information to anyone responsible for overall performance evaluation. More pervasive designs might make the data available to the immediate supervisor or area manager. The most pervasive designs 'broadcast' information, making it available to anyone in the workplace. For example, posting the results of all monitored individuals or groups in a central location, or allowing anyone to access the data via the computer, exemplify pervasive designs. In general, the broader the audience for the data, the more pervasive the monitoring system.

Choice of Tasks: Finally, systems designers have leeway in a fourth dimension, the choice of monitored tasks. A CPMCS can monitor virtually any computer-mediated activity. The application system may determine whether it is the complete process or only the results of an employee's activities which are captured. The monitor, however, can be designed to differentiate among types of captured information. It may count completed transactions, error rates, completion time or a combination of performance characteristics. It may also be an integral part of a pacing system which directs work to particular employees at predetermined intervals. Such monitors can then track the non-response rate of individuals or groups who fail to act on work directed to their station. The greater the coverage of the process of directing and completing work, the more pervasive the control system.

The descriptions above illustrate how the four design dimensions can vary in a control system which incorporates a monitor. These same four dimensions apply to systems without monitors. Thus, one can compare CPMCS designs to one another and to manual systems on the basis of recipient, object, period, and choice of measured tasks.

2.8.2 Design Dimensions and Thermostat Elements

The first four elements of the thermostat model (Lawler and Rhodes, 1976) each capture the impact of one or more of the

	Object	Period	Recipient	Tasks
Sensor				X
Performance	X	X		X
Discriminator		X	X	X
Feedback	X	X	X	X
Activity	X	X	X	X

Exhibit 10. Relating the Thermostat Elements to the Design Dimensions

CPMCS design dimensions. As shown in Exhibit 10, the 'sensor' is defined largely by the choice of tasks being evaluated and whether they are evaluated manually or by computer. The character of 'measured performance' will be a function of the tasks and reporting period chosen and whether the system measures individual or group performance. As discussed in Section 2.5, the 'discriminator' may be the employee, the supervisor, or the system, depending upon the choice of monitored tasks and the recipient of the data. The tasks and period will determine whether the discriminator has adequate data to make a realistic evaluation. Similarly, the 'feedback' depends upon the object of the evaluation, the recipient of the data, and the frequency of maeasurement. This feedback will also depend upon the tasks monitored, since that determines whether the monitor reports raw data or discriminated evaluations. Finally, the 'activity' is shaped by the first four elements of the thermostat and hence by the control system design. The thermostat model is thus a vehicle by which the static design features of the control system can be incorporated into a dynamic process affecting performance.

The literature demonstrates that control system impact is a function of the work, the worker, and the organization, as well as of the system design itself. A large body of research explores how perceptions of system feedback are affected by the work, the worker, and the organization. Such research provides knowledge about the role of these three elements in a model of impact.

Fewer studies look at the process of generating the feedback. They show that quantitative and qualitative systems generate different messages, which can have different effects on performance. They also show that both systems play a role in determining perceptions of job performance.

The effect of specifically using a computer as a central feature of the quantitative system has been largely ignored.

However, the fundamental elements of a CPMCS impact model can be derived. The thermostat model demonstrates the crucial processes of a control system and the role of design dimensions in shaping them. These processes can then be integrated with knowledge about the role of the individual, the job, and the organization to produce a conceptual model of CPMCS impact. Section 2.9 discusses integrating the literature reviewed in this chapter into such a model.

2.9 CONCEPTUAL MODEL OF CPMCS IMPACT

This chapter has examined theory and research which could explain and predict the effects of CPMCSs. Each piece of literature dealt with one or more elements of control system impact. Together, they lead to a model in which monitors affect productivity and interaction primarily through their effects on employee attitudes. Exhibit 11 presents the conceptual model underlying this dissertation.

2.9.1 Components of the Model

'Personal Performance Attitudes' is the dependent construct in the conceptual model. This construct refers to the importance the employee attaches to interaction and production

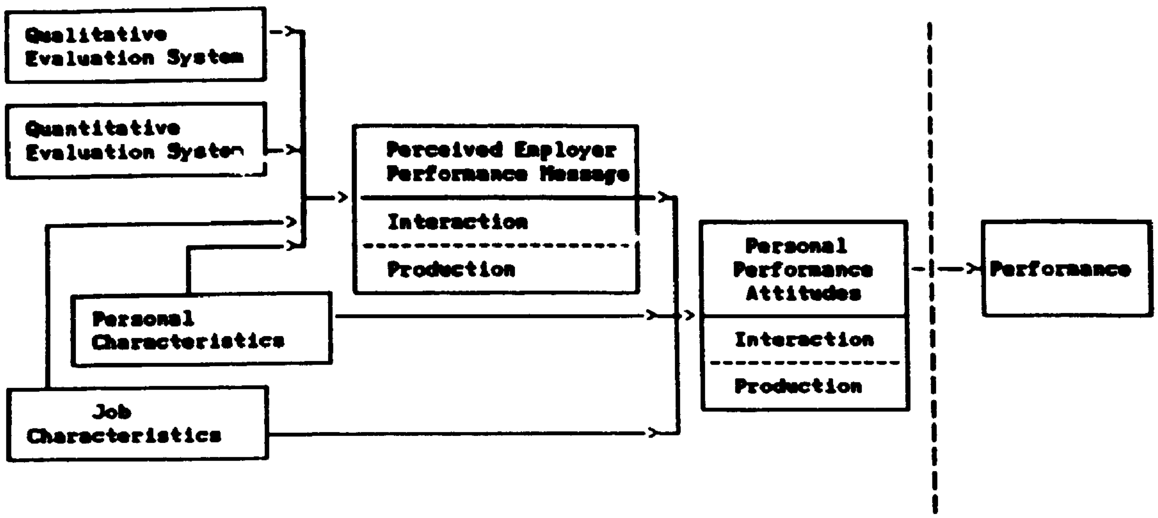

Exhibit 11. Conceptual Model

===

as elements in the overall performance of a particular job. These attitudes evolve from the answers to three questions:

1. What does my employer seem to want me to do? (Perceived employer performance message)

2. Who am I and what do I know about doing this job? (Personal characteristics)

3. What does the job seem to demand? (Job characteristics)

'Perceived Employer Performance Message' is itself a function of four concepts:

- the qualitative evaluation system;

- the quantitative evaluation system;

- the personal characteristics of the employee; and
- the way the employee perceives the job.

The 'Quantitative Evaluation System' refers to the mechanisms which objectively or quantitatively measure and report performance. In firms which monitor employee performance, the 'Quantitative Evaluation System' includes the CPMCS. In unmonitored situations, other quantitative systems (such as manual production tallies or error counts) perform this objective evaluation.

'Qualitative Evaluation System' refers to the mechanisms which use subjective or qualitative measurements to assess performance. Supervisors, co-workers and customers are primarily sources of qualitative performance feedback.

Perceptions of the message will also depend on the individual's reaction to it. Age, work experience and personality can influence how much confidence the employee has in her own evaluation of her performance. Familiarity with monitoring may contribute to perceptions of its credibility. Thus, 'Personal Characteristics' play a role in determining perceptions of the message and the personal importance of job dimensions.

Finally, message credibility and value also depend on the job and the way the employee perceives it. The credibility of the sensor and the discriminator depend on the perception that the system is capable of detecting performance and accurately measuring it. The acceptance of feedback further depends on the belief that the performance measured is important. These factors will be determined, in part, by the employee's perception of the job. For example, does the employee believe it is primarily production or customer service? Is the work itself routine or are exceptions commonplace? These and other 'Job Characteristics' will thus affect control system impact.

The correlation between attitudes and behavior is never perfect. An employee may feel that production is important. Despite her desire to produce at a maximum, she may be constrained by limited ability or resources. Thus, the model does not suggest that there is an unmoderated relationship between 'Personal Performance Attitudes' and the performance achieved. That relationship is the subject of extensive research by itself. This dissertation concentrates on how CPMCSs contribute to the development of perceptions of the important factors in one's job, as discussed in Section 2.2.3.

2.9.2 Using the Model

The first step in resolving debates over impact is to establish that monitoring does have a distinct effect in the workplace, and that it is different from that of manual, quantitative systems. This is important for two reasons. First, if monitoring is really no different from quantitative systems which rely on human supervisors, there is abundant research into its effects.

Second, the arguments between supporters and opponents of computer monitoring may not be based on monitoring issues at all. The majority of anecdotes, studies and arguments focus on a few, well-known examples from the 'pervasive' end of each design dimension. These examples come close to being electronic surveillance of the worker, rather than CPMCSs as defined here. It is important to understand whether those who predict dire outcomes from CPMCS use are studying reactions to intensive electronic surveillance or to degrees of computer monitoring. This argues for research which begins by studying impacts of low-level monitoring.

Furthermore, each of the concepts in the conceptual model is multidimensional. It is impossible to test causal relationships among them unless the research uses a lower level of abstraction. The concepts must be simplified, and the exact nature of their causal relationships must be delineated. The model does, however, represent the important abstract concepts of system/employee interaction identified in the literature.

This research progressed from model development to a case study. The case study identified the undimensional constructs and causal paths required before hypothesis testing could proceed. The execution and results of that case study are discussed next, in Chapter 3.

COMPUTERIZED PERFORMANCE MONITORING AND CONTROL SYSTEMS: IMPACT ON CANADIAN SERVICE SECTOR WORKERS

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Doctor of Philosophy

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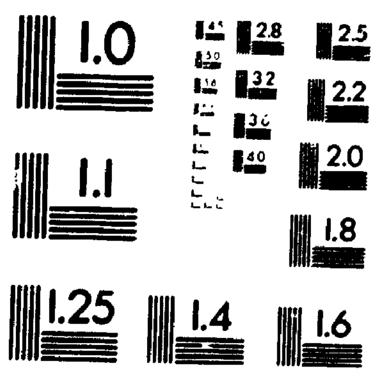

CHAPTER 3 - EXPLORATORY CASE STUDY

Chapter 2 discussed the literature underlying the conceptual model of computerized performance monitoring and control system (CPMCS) impact. It described opportunities for research on CPMCS effects and concluded by proposing a conceptual model of impact.

This chapter presents the exploratory work undertaken as the first stage of this research. This exploratory work was designed to:

(1) establish whether unobtrusive monitoring affects employee perceptions and attitudes;

(2) examine how the effects might differ from those of manual control systems;

(3) identify shortcomings in the conceptual model; and

(4) develop an instrument for a national survey.

The case study was chosen as the best method to meet these objectives, for several reasons. First, case studies allow researchers to study complex processes and interactions in a natural setting (Benbasat et al., 1987). The depth of study possible in a single site provides a rich contextual base of data. Second, this depth of study can be combined with the opportunity to hold specific factors, such as job content, constant. The rich data base and opportunity for control support efforts to hypothesize causal relationships from a cross-sectional view of implementation (Cook and Campbell, 1979). Finally, the case approach provides for passive observation. In this research, such observation revealed possible causal factors which had not been anticipated, and which are described in more detail in this chapter.

3.1 THE RESEARCH DESIGN

This section discusses the design and execution of the case study. It first describes the research site and participants. It then examines instruments and procedures used to collect data.

3.1.1 The Research Site and Participants

The case study took place in the Group Claims Division of a large insurance company. The division's CPMCS accumulated a daily count of claims paid to arrive at a monthly total for each processor. The monthly total was divided by the number of working days in the month to arrive at an 'average daily production' count for each employee. Each supervisor received a report of the average production for each of her subordinates, which she distributed or discussed with each one. The company also calculated average production on a quarterly and an annual basis and used these figures as the 'productivity' component of the employee's performance evaluation. Employees kept manual logs of unmonitored tasks such as letters written and telephone calls answered.

The unmonitored claims processors were subject to precisely the same measures of productivity. They prepared manual tallies of the tasks mentioned above. Their supervisors then counted the claims paid and calculated monthly, quarterly and annual 'average daily production' figures.

Monitored and unmonitored claims processors worked side-by-side; one group handled health claims, while the other paid life claims. Thus, the principal difference between the two groups was the use of a relatively unobtrusive, computerized measurement system for monitored employees and an equivalent manual system for unmonitored employees.

The case study research site was chosen deliberately. The primary objective was to study a group of monitored service sector workers by comparing them to unmonitored workers. This meant identifying employees of each type within a single organization, if not a single department. Organizations which meet such a requirement are not common, so the case study site had to be chosen carefully.

The Group Claims staff consisted of 81 non-supervisory employees (57 monitored, 24 unmonitored), 12 unit heads, one department supervisor (in Toronto) and two department managers. The host company agreed to allow staff to participate in the study during working hours. This made it feasible to include all Group Claims employees in the research. Such a census was preferable to a sample, since unit heads in this company managed small work groups. Only a few employees were exposed to any one unit head's supervisory style. As a result, it was important to include as many members of each unit as possible.

Branch clerical staff (three each in Montreal and Calgary) also took part in the study. Their interview comments were included in the qualitative analysis, but their work groups were too small to permit statistical analysis by unit. Consequently, their surveys were dropped from the analyses.

3.1.2 Research Instruments and Data Collection

This study used three data collection instruments: (1) a structured, closed-item questionnaire, (2) a semi-structured, open-item interview guide, and (3) a performance tally sheet (see "Appendix A - Case Study Data Collection Instruments" for copies of these instruments).

Two versions of the closed-item questionnaire and the open-item interview guide were used. The first version of each applied to non-supervisory personnel. It concentrated on workers' attitudes and perceptions. The second version of each instrument was used with supervisory personnel. It was used to gather facts about actual tasks, environment, supervisory style and control systems.

Using two versions made it possible to compare employee perceptions with the supervisors' descriptions of the control system. It also indicated the degree to which supervisors understood the impact of monitoring on their staff and the attitudes employees held about management's performance priorities.

Data collection followed the same pattern in all three branches. Questionnaires were administered on-site in a company conference room. This approach minimized turnaround time and maximized response rates. The latter was particularly important, given the limited number of unmonitored subjects.

A 45-minute semi-structured interview with each participant then provided further data. Employees and supervisors elaborated on survey responses during the interviews. They also answered open-ended questions about the monitor and the work environment.

The case study was designed to explore and clarify poorly understood issues. It provided statistical and qualitative data, as well as information from passive observations and informal conversations. These features enhanced the ability to interpret results and to draw conclusions (Cook and Campbell, 1979). They also suggested directions for the national survey. In addition, studying monitored and unmonitored workers in such similar roles strengthened arguments attributing differences to CPMCSs.

3.1.3 Confidentiality

Any research which examines a company's appraisal practices, supervisor - employee relationships, and employee performance data touches on personal and private issues. Therefore, the study incorporated numerous procedures to protect confidentiality.

First, each survey and interview guide was identified by a 5-digit code. The first three digits indicated the respondent's unit and personnel level. The final two digits were sequentially assigned to differentiate among participants in the same unit. This code categorized responses by unit, branch and job category. It also matched interview comments to survey responses and actual performance data. In addition, the coding scheme made it possible to compare monitored and unmonitored workers, regardless of unit or branch. To preserve confidentiality, data related to individual participants were stored and identified only by a code number. No names were retained in computer files of survey data, performance data or interview transcriptions. Nor has the company ever been identified by name in any presentation of the research.

Collecting actual performance data also raised ethical issues. It was inappropriate to directly examine personnel records. Instead, each unit head used a tally sheet listing the names and code numbers of the employees in the unit. The names were printed on a tear-strip along the left side of the sheet. The unit head (who had regular and legitimate access to all of the desired data) coded the information onto the tally sheets. Unit heads also received directions to remove the tear-strip before returning the tally sheets for analysis.

Employees and unit heads were concerned that interview comments might be repeated to management. They felt this could jeopardize the employee's relationships and position in the company. Steps were taken to minimize both the possibility of such an outcome and the perception that it was possible. Interviews were conducted on a unit-by-unit basis, beginning with the unit head. By starting with unit heads, it was clear that employees' comments could not be discussed during the supervisor's interview.

Management's report of findings did not include any data or tables which would identify individual respondents. For instance, the limited number of male employees and processors over the age of 45 would have made it easy to attribute remarks or survey responses to particular individuals. Thus, management did not receive any breakdowns by age or gender.

Finally, each participant received an explanation of the techniques being used to protect confidentiality. They were explicitly told that they had the right to refuse to answer any question on the survey or during the interview.

3.2 FINDINGS

The research instruments used in the case study were designed to gather demographic and perceptual data for a number of interested parties, as well as to explore the research questions posed in this dissertation. The discussion in this section is confined to the results which relate directly to the case study objectives.

This section first examines differences in the importance of interaction to monitored and unmonitored employees. The discussion then turns to differences in the importance of production between the two groups. The section concludes by summarizing the major information the case study contributed to the design of the national survey. Other facets of the research are discussed at length in Grant (1988), Grant et al. (1988) and Higgins et al. (1987).

3.2.1 Differences in Importance of Interaction

The case study revealed differences between monitored and unmonitored employees in their view of interaction importance. This section discusses evidence of differences in the way employees looked at service, teamwork, unmonitored activities and role definition.

Customer Service: Customer service in this company had two components: (1) the fast and accurate payment of claims, and (2) courteous and effective contacts with customers who telephone for information or problem resolution. The company had a long-standing reputation in the industry for rapid turnaround of claims.

Few employees seemed to know if or how the company evaluated customer service quality. Some suggested that the monthly accuracy audit was the principal check on quality. Others believed it was reviewed by exception. That is, if no customer complained about a processor, management simply assumed the service was acceptable. Only eight processors mentioned having supervisors review and discuss field service evaluations (prepared by sales representatives) or directly observe and comment on the way processors handled themselves on the telephone.

Employees saw the company regularly monitoring production, but believed it rarely reviewed personal service quality. This affected their attitudes toward the relative importance of service. Many monitored processors expressed the view that if an aspect of their work wasn't counted by the monitor, it wasn't an important part of the job. They remarked, "people don't want to handle problems, because it slows them down." One monitored processor explained this by saying,

> "I like the challenge of solving customer problems, but they get in the way of hitting my quota. I'd like to get rid of the telephone work. If ... [the company] thought dealing with customers was important, I'd keep it [the phone work]; but if it's just going to be production

that matters, I'd gladly give all the calls to
somebody else."

Another said,

"Most processors will cut a customer off the phone if the call gets long or starts undermining their production."

This stands in contast to the comments of unmonitored employees, typified by one who said,

"Why is my work important? Because good customer service improves the company's image. You're building up clientele."

Monitored processors also thought that the emphasis on production degraded the processing quality for difficult or special claims. Referring to such claims as 'scrapwork,' they described a common practice whereby non-standard claims or those requiring special processor evaluation were set aside. They were then handled "when I hit a day when I'm ahead of my quota." There was neither visible evidence nor reports of such scrapwork in unmonitored units.

Teamwork: The same aversion to difficult claims surfaced in complaints of eroded teamwork and cooperation among monitored processors within a unit. They pointed out that if someone had time to help a co-worker, the 'helper' frequently sifted through the available work, looking for the most straightforward claims. As one complained,

> "I don't need that kind of help. It only makes her count higher and leaves me with all the hard work. The computer can't tell how hard the claim was, so I end up looking bad."

The monitoring system used in this company measures performance, but cannot discriminate among claims according to difficulty. These comments suggest that this inability to discriminate types of performance has detrimental effects.

The 'claims-sifting' practice had reached the point where two supervisors established and enforced a rule that 'helpers' must take claims from the top of a co-worker's stack and complete every claim taken. But monitored processors still suspected the nelp did more harm than good:

> "she's still going to try to work fast...I'm the one who has to correct the mistakes in the end, so she doesn't really care."

Unmonitored processors, on the other hand, had no such complaints. A typical comment came from the unmonitored processer who said,

> "We get along well. The team has a group sense of responsibility."

The importance of teamwork in unmonitored units surfaced in comments about production. One unmonitored processor said,

> "Sure we talk about volume, but only generally. Like 'I sure didn't accomplish much this week.' It's more important that you're pulling your weight in the unit."

Another agreed, saying,

> "Does volume count? Only at the extremes...like when someone is doing far too little or considerably more than others in the group."

Unmonitored Activities: In addition to telephone work, customer service involved preparing letters and coverage estimates (called 'predeterminations' or 'preds'). When a client expected a large or unusual claim (such as root canal or physiotherapy), the processor received a description of the proposed treatment. She then gave the client an estimate of the coverage applicable to that potential claim. This involved individual attention to complex coverage information. It did not immediately create a claim cheque, so it was not monitored by the computer.

Employees submitted manual counts of these tasks, and management tried to assign contracts to ensure an even distribution of unmonitored work. Monitored employees complained that these activities were not taken into account in evaluating productivity. Again, they suggested, "It can't be very important if the computer doesn't count it."

Unknown to head office, the monitor did count preds in one branch. There, staff processed the estimate as a claim, then overrode the final step of the program to void the cheque. These processors believed that everyone used this method. They assumed so because "preds are a big part of our job and otherwise they don't get counted in our production."

Unmonitored processors, on the other hand, felt comfortable that their unit heads recognized the time and effort spent on preds. In fact, one unmonitored processor said it was fun doing the manual part of the pred. She liked doing tasks in which "the computer doesn't do all the thinking for you."

Role Definition: Both monitored and unmonitored processors did essentially the same job, for different types of coverage. Each processor had extensive contact with customers over the telephone and in writing. Management used the term 'customer service' repeatedly to describe the work of both groups. However, employees in the two groups differed significantly when describing their own work. One processor (who had worked in both types of unit) said,

> "This is just a production job -- not like processing in Life [the unmonitored unit] where you were doing customer service."

Another went so far as to say that customer service wasn't an important aspect of the job and was of interest to management only if it was "really bad."

When asked "What are the most important factors in evaluating your work?," 44 of the monitored employees (80.0%) replied 'production quantity.' Only three unmonitored employees (14.3%) cited productivity as the most important factor; the other 18 cited 'quality of customer service' and 'teamwork' as primary determinants of performance. These two factors were rarely mentioned by the monitored units (see Exhibit 12).

	Monitored Workers	Unmonitored Workers
Production Quantity	44 (80%)	3 (14.3%)
Work Quality (Service, Teamwork, etc.)	11 (20%)	18 (85.7%)

Chi-squared = 25.096 alpha < 0.0000

Exhibit 12. Most Important Evaluation Factor

These results suggest support for the conceptual model's assertions that:

(1) the design and technology of the quantitative evaluation system affects perceived production and interaction messages; and

(2) the design of the qualitative evaluation system also affects perceived production and interaction messages.

3.2.2 Differences in Importance of Production

When discussing performance evaluation criteria and influences during interviews, all unit heads and employees agreed that productivity was an extremely important factor in performance appraisal. But the case study still revealed differences between monitored and unmonitored employees in their view of production importance. This section examines differences in perceived pressure to produce and perceptions of quotas. It also discusses differences in actual production among monitored workers.

Production Pressure: This case study revealed evidence that monitoring tended to focus employee attention on output. When asked to explain the role of the CPMCS in evaluating performance, monitored respondents emphasized the importance of "the count." They said,

> "People are always comparing themselves to each other on production,"

> "They [management] don't trust us to work unless the computer's counting," and

> "It's always push, push, push to make your quota every day"

Unmonitored employees, on the other hand, believed that the manual counts they submitted were used primarily to "make sure everyone's doing her fair share of the group work" and to ensure that no one processor was being overloaded.

Quotas: All processors had a quota of 65 paid claims per day. Every monitored processor knew this, although they differed on the exact number (65 being the minimum reported in interviews). None of the unmonitored processors believed they had individual quotas, however. They talked about group turnaround targets instead. These targets were more like customer service than production goals. For example, where a monitored employee might say she had a personal quota of 80 claims per day, the unmonitored employee talked about "2-day turnaround" of the group's work. On busy days, this could translate into 95 claims per processor, while slow days meant 35 claims.

Accual Differences in Production: Comparing actual output of monitored and unmonitored staff depended on having actual performance data for both groups. Unfortunately, the supervisors in the unmonitored units had discarded their manual statistics after the annual performance review. This made comparison impossible.

However, some analysis of monitored results was possible. Exhibit 13 shows the mean 'average daily production' for each monitored unit. There is considerable difference among units, with means ranging from 57 to 96.75 claims per day.

One reasonable explanation for differences among monitored units would be supervisor emphasis. The literature suggests that processors who believed their unit head relied heavily

Unit	Mean AVDAYQ	Std. Dev.	Min. AVDAYQ	Max. AVDAYQ
1	71.00	9.35	60.00	86.00
2	68.63	14.34	45.00	85.00
3	66.12	14.58	48.00	95.00
4	69.25	19.28	51.00	96.00
5	96.75	19.45	75.00	116.00
8	58.00	17.15	42.00	80.00
9	57.00	11.64	37.00	68.00
10	79.50	17.39	63.00	113.00

* AVDAYQ = average daily production for most recent quarter

Exhibit 13. Mean Production by Unit

	Importance of Quantity to Company	Importance of Quantity to Employee	Reliance on Quantitative Measures
Correlation with Average Daily Production	-.033	.410	.161
Significance	.81	.002	.25
N	55	55	53

Exhibit 14. Output Correlated with Importance of Production and Quantitative Measures: (Monitored Employees Only)

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on monitor data would try to produce more to ensure good ratings (Cammann and Nadler, 1977; Ilgen et al., 1979; Lawler, 1976). The case study provided data about perceived reliance on monitor data and the employee's actual production. This made it possible to test the relationship between importance of monitor data and output.

Employees indicated (on a scale from '1' to '7') the degree to which they believed their unit head relied on quantitative data, such as productivity and accuracy statistics, in evaluations. Contrary to the literature, the case study showed no significant correlation between this perception and the employee's actual production (Exhibit 14). Nor was production significantly correlated to the importance they believed the company attached to production.

Further analysis revealed that output was significantly correlated to the importance the employee gave production in personally judging work. These results supported the conceptual model's assertions that:

(1) the link between 'Employer Performance Message' and 'Performance' is not direct;

(2) the link between the 'Quantitative System Characteristics' and 'Performance' is not direct; and

(3) factors other than 'Employer Performance Message' also contribute to the development of 'Personal Performance Attitudes.'

3.2.3 Contributions to the Field Study

The case study made numerous contributions to the development of the national survey. The qualitative findings demonstrated differences between the perceptions of monitored and unmonitored subjects. They also demonstrated areas which had not been addressed in the survey and which appeared to be significant indicators of possible impact.

For example, the survey did not ask employees to indicate whether they thought they had a customer service job. It assumed employees agreed with management's description of their jobs. One of the first interviews revealed this disagreement. Subsequent interviews included the question, capturing the results discussed above. The national survey also included this question.

A second contribution of the case study was identifying the need to clarify 'customer service,' particularly for monitored employees. Interviews revealed that many employees limited their thinking to rapid payment of claims when asked about customer service. The national survey would have to explicitly tap more aspects of service. For example, "answering customer questions well" and "solving customer problems well" appeared in the national survey.

In addition to these contributions, the exploratory work suggested a number of CPMCS effects. These included:

1. **The use and scope of CPMCS measures appeared to directly affect workers' attitudes toward performance evaluation.** Workers expected to see consistency between the collection of monitored data and its use in evaluating their performance. To be acceptable, measures had to be (a) complete, (b) accurate and (c) appropriate. Furthermore, monitored employees had to perceive that these criteria were met. Otherwise, the result seemed to be dissatisfaction with the supervisory and appraisal process.

2. **CPMCS measures which cannot appropriately measure an important aspect of performance seem to promote bureaucratic behavior.** The effects of inappropriate measurement appeared in three forms in the case study. First, customer interaction quality was subordinated to production quantity. Second, tasks requiring special attention became scrapwork (despite assertions by processors that these were the tasks which they found most challenging and intrinsically satisfying). Third, processors became suspicious of the motives of co-workers trying to relieve a heavy workload. These effects degraded the quality of service offered to the customer and the work environment within the processing division.

3. **If it isn't counted, it doesn't count.** It has been suggested that a CPMCS reduces the need for human or direct supervision. However, systems which do not completely monitor a job give the impression that unmonitored activities are not being evaluated. This suggests that the degree to which the monitor 'covers' the full scope of the job will contribute to its positive impact. This may be especially true if the supervisor does not make evaluation of unmonitored activities explicit.

4. **'Objective' measurement of performance is not necessarily *fair* measurement.** Interviews brought out frequent dis-

cussion of a 'yeah, but...' syndrome. Processors countered criticism of their monitored performance with "Yeah, but you don't know how difficult my claims really are," "Yeah, but I had to spend a lot of time with customers on the phone," or "Yeah, we count other things manually, but no one ever looks at that." Supervisors acknowledged that most of the "yeah, but..." explanations were realistic, rather than merely attempts to justify inactivity. The fact that monitors measure performance more objectively does not mean that they are more fair. Increased objectivity may not improve acceptance of feedback if qualitative systems fail to take other aspects into account when evaluating performance.

5. **Monitored workers who internalize the CPMCS standards, and gain intrinsic motivation from the system feedback, may function more comfortably and productively in the monitored environment than those who do not.** Workers who felt that the quotas prevented the intrinsic satisfaction provided by giving good customer service tended to comment more often on the stress of being monitored and the sense of being constantly watched by an inanimate boss. These workers felt a conflict between their personal objective of satisfying customers and the externally imposed objective of "hitting the quota every day." On the other hand, processors who considered the standards attainable or saw quantity as an impor-

tant objective in itself reported little concern about being monitored.

The pretest survey included three dimensions of job characteristics: autonomy, variety and the quantitative nature of work. The case study interviews suggested that autonomy and variety were linked to overall job satisfaction. However, only 'quantitative nature of work' figured in reactions to monitoring.

6. CPMCSs do not appear to reduce the need for human supervision. Human supervisors contribute to employees' perceptions that the appraisal process is fair and reasonable. This contribution seems to be even more important when companies use monitors than when they do not. Monitored workers, for example, repeatedly pointed to their unit head's attitude as a key factor in their own reaction to, or relationship with, the monitor.

The supervisor played a critical role in determining whether the process of being monitored would be stressful to the employee and whether the feedback received about performance would promote or undermine the intrinsic satisfaction of the job. Perceived fairness of the evaluation process and general satisfaction with it seemed closely related to positive feedback from supervisors, discussions about performance, and the direct supervision an employee received. All of these elements are functions of the personality, actions and attitudes of the unit head. Qualitative systems, therefore, seem to be an important factor in the overall impact of monitoring.

This section discussed effects of monitoring observed in the case study. Elements of these effects relating to the conceptual model were incorporated into the research model presented in Chapter 4. The case study also suggested revisions to the questionnaire which would make for a more effective national survey. Section 3.3 explains the results of pretesting the questionnaire with case study participants.

3.3 SURVEY PRETEST

One objective of the case study was to evaluate the questionnaire proposed for the national survey. The questionnaire represented an initial effort to capture the numerous dimensions of the constructs in the conceptual model. Many of its scales were created specifically for this study. Others appeared in previous research, although not precisely as used in this study. Finally, researchers had originally designed some of the items as interview questions. These conditions made it important to pretest the design and wording of the instrument before using it as a national survey.

3.3.1 Operationalizing Constructs in the Conceptual Model

"Appendix A - Case Study Data Collection Instruments" presents the survey pretested in the case study. The survey comprised 15 groups of related items, or 'scales.' Each scale measured one dimension of a multidimensional construct in the conceptual model. Exhibit 15 indicates the specific questions comprising each scale.

Section I - Performance Messages and Intentions: This section was based on Porter and Lawler's (1968) scale of distributive justice. Its questions tapped the many dimensions of service sector roles. The two scales in Section I were designed to uncover the criteria by which employees judged their own work and their perceptions of the criteria by which the employer judged it. Questions 1 - 10 measured 'Personal Performance Attitudes,' while questions 11-20 addressed 'Employer Performance Message.'

Section II - Message Acceptance and Reliance: Section II was an elaboration of Irving _et al_.'s (1986) questionnaire on

Name of Scale	Questions Included in Scale
Personal Importance of Interaction	Q1, Q2, Q5, Q6, Q10
Personal Importance of Production	Q3, Q4, Q7, Q8, Q9
Employer Importance of Interaction	Q11, Q12, Q15, Q16, Q20
Employer Importance of Production	Q13, Q14, Q17, Q18, Q19
Acceptance of Quantitative Measures	Q29-Q34
Acceptance of Qualitative Measures	Q35-Q44
Direct Supervision	Q25, Q26
Indirect Supervision	Q27, Q28
Motivation Strength	Q48-Q51
Automation Impact on Jobs	Q53, Q55, Q59
Enjoyment of Automated Work	Q52, Q57, Q58
Fallibility of Computers	Q54, Q56
Variety in Job	Q72-Q74, Q78
Autonomy in Performing Job	Q61, Q66, Q67
Quantitative Nature of Work	Q68, Q71, Q75

Exhibit 15. Survey Questions Assigned to Scales

attitudes toward supervision and feedback. Irving et al. (1986) administered a shorter version of this scale in face-to-face interviews. Section II examined the employee's perceptions of direct and indirect supervision (Q25-Q28) and acceptance of information used to evaluate performance (Q29-Q44).

Section III - Motivation Strength: Section III of the survey was design to measure the strength of motivation. It was based on Patchen's (1965) scale of motivation. This scale was included to supplement the direction of intention represented by 'Personal Performance Attitudes.'

Section IV - Beliefs About Computers: Questions Q52 to Q59 concentrated on exposing the employee's beliefs about the inherent impact of computer use, independent of the specific application. This scale was designed specifically for this study.

Section V - Perceptions of Job and Work Environment: This section measured perceptions of the task and work environment. It addressed factors of autonomy, quantitative nature of work, stress, task interdependence, and general work environment (Q61-Q64, Q66-Q69, Q71-Q78).

The autonomy, stress, task interdependence and general work environment scales were adapted from the Job Diagnostic Survey (Gandz, 1985; Hackman and Oldham, 1975). The quantitative nature of work scales were developed specifically for this study. The items of interest in this research reflected skill variety (Q72-Q74, Q78), autonomy (Q61, Q66, Q67) and quantitative nature of work (Q68, Q71, Q75).

Only one type of monitor was used at the case site, so the pretest survey did not include measures of the quantitative design. The national survey captured descriptive and categorical data about the four dimensions of system design (task, period, recipient, and object) discussed in Chapter 2.

3.3.2 Pretest Results

Pretest analysis concentrated on three aspects of survey use: (1) missing or incomplete responses; (2) scale reliability; and (3) ease of survey completion. This section examines each of these aspects and describes the steps taken to solve problems identified.

Missing Values: The first step in analyzing pretest results was to examine the responses for missing values. Two patterns might have signaled instrumentation problems. The first would be individual surveys containing numerous item non-responses. This would suggest that the respondent had difficulty understanding many of the items. One must question the reliability of all responses on such a survey. The respondent might have left many confusing questions unanswered, but also might have guessed at others in an effort to be helpful or to avoid embarrassment.

The second warning of instrumentation issues would surface as numerous non-responses to a single item. This would imply that the item was unclear, inappropriate or perhaps offensive to the respondents. Any of these conditions would indicate that such items should be reworked.

The pretest provided survey data from 81 non-supervisory employees. Each pretest survey contained 97 items, for a total of 7,857 (81*97) possible item responses. Out of this total, there were 73 non-responses (<1%). These 'missing values' were distributed across questions and surveys. No single item was the subject of more than 4 missing or invalid responses (<4%). Thus, this test did not pinpoint any items with particular problems of clarity or content.

Scale Reliability: Common methods of reliability assessment, such as 'test-retest' and 'alternative form' (Nunnally, 1978) require that two instruments be tested on the same group of respondents at different times. Such tests were not feasible in the case study. Instead, Cronbach's alpha was applied.

Cronbach's alpha represents the expected correlation between the instrument used and a hypothethical alternative instrument (Nunnally, 1978). It is equal to the mean inter-item correlation of all possible two-test splits of the actual

Name of Scale	Coefficient Alpha
Personal Importance of Interaction	.56
Personal Importance of Production	.74
Employer Importance of Interaction	.68
Employer Importance of Production	.70
Acceptance of Quantitative Measures	.90
Acceptance of Qualitative Measures	.95
Direct Supervision	.68
Indirect Supervision	.79
Motivation Strength	.40
Automation Impact on Jobs	.62
Enjoyment of Automated Work	.60
Fallibility of Computers	.54
Variety in Job	.75
Autonomy in Performing Job	.62
Quantitative Nature of Work	.46

Exhibit 16. Results of Reliability Analysis: Cronbach's Alpha of Scales

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survey instrument. This statistic is considered a conservative estimate of reliability (Carmines and Zeller, 1979).

Calculating Cronbach's alpha for each of the scales described above pinpointed areas for additional work (see Exhibit 16). A common rule of thumb for reliability advises that scales should have a coefficient alpha of 0.80 or better for broad-based empirical research (Carmines and Zeller, 1979). Only two scales in the pretest survey met this criterion, suggesting extensive modifications prior to the national survey.

The 'Motivation Strength' scale was poor. Robinson et al. (1969) reported test-retest correlations of 0.80 for the first two items. No figures were reported for the full four-item scale. The case study pretest indicated very low reliability (0.40). The first two items were poorly correlated with the second two, suggesting that they measured different constructs. The items actually seemed to capture a construct like 'commitment' or 'organizational involvement,' rather than strength of performance intentions. As a result, the scale was dropped. Instead, the national survey looked at the relative, as well as the absolute, importance of production and interaction.

The 'Quantitative Nature of Work' scale also demonstrated low reliability (.46). It was completely rewritten for the national survey.

The next modification was to improve questions which seemed to degrade the reliability of the scales in question. Q58, for example, severely reduced the reliability of the 'Enjoyment of Automated Work' factor. Analysis indicated that the alpha would increase to 0.70 if that item were dropped. This also made theoretical sense: questions Q52 and Q57 dealt with work characteristics, while Q58 asked about job preferences. These constructs may be related, but they are not necessarily the same. Therefore, Q58 was replaced by items more consistent with Q52 and Q57 in the revised survey.

Q54 and Q56 (the 'Fallibility of Computers' scale) both used double negative constructions. This probably hampered their reliability. Q56, for example, asked respondents to agree or disagree with the statement, "You can't prove a computer is wrong." Respondents could easily become confused trying to decide what 'Strongly Disagree' or 'Strongly Agree' meant for such a question.

Another common approach to improving reliability is adding more items to the scale in question. The number of additional items required is determined by applying a modified Spearman-Brown prophesy formula:

$$N = \text{rho}_{xx}''(1-\text{rho}_{xx}')/\text{rho}_{xx}'(1-\text{rho}_{xx}'')$$

where N = the length multiplier, rho_{xx}'' is the desired reliability, and rho_{xx}' is the reliability of the existing scale (Carmines and Zeller, 1979).

Applying this formula produced the recommendations for scale length shown in Exhibit 17. As these results would suggest, additional items could contribute to the reliability of these scales. However, there were three constraints to consider before adding questions.

First, the scales for 'Employer Performance Message' and 'Personal Performance Attitudes' had to be parallel. That is, the 'production' and 'interaction' scales for 'Employer Message' had to contain the same items as the equivalent scale for 'Personal Attitudes.' Increasing or rewording items in one scale meant making the same changes in the complementary employer or personal scale.

A second constraint occurs because additional items only increase scale reliability if they are at least as reliable as the original scale items. This is often difficult to accomplish in practice.

Third, the national survey had to include sections not required in the case study. While the case study examined a single monitor, the national survey was sent to 51 firms with different evaluation systems. Therefore, the national survey included items capturing the design dimensions of the systems in use. It also included respondent demographic items, to permit description of the response group.

Following the recommendations of the Spearman-Brown formula would have produced a survey of 100 items. These 100 items would not include questions needed to categorize the control systems, describe the respondents, and gather data requested by the funding agency. Instead, the revised survey (see

Factor	Current Number of Items	Multiplier	Required Number of Items
Personal Att. (Interac'n)	5	3.14	16
Personal Att. (Product'n)	5	1.40	7
Employer Msg. (Interac'n)	5	1.88	10
Employer Msg. (Product'n)	5	1.71	9
Direct Supervision	2	1.88	4
Indirect Supervision	2	1.37	3
Automation Imp. on Jobs	3	2.45	8
Enjoyment of Auto. Work	3	2.67	8
Failibility of Comp.	2	3.41	7
Variety in Job	4	1.33	6
Autonomy in Performing	3	2.45	8
Quantitative Nature	3	4.70	14
		Total	100

Exhibit 17. Spearman-Brown Prophesy Formula Results

"Appendix B - National Survey") combined improvements to existing questions with additional items.

Survey Administration: Participants in the case study took between 15 and 25 minutes to complete the questionnaire. Thus, the estimate of 30 minutes provided to companies participating in the national survey seemed reasonable.

Section II of the pretest survey prompted negative comments. Specifically, participants found questions Q29-Q43 bothersome. They said the length of each question (which resulted in four pages of the survey devoted to those 15 items) made them tedious. This could produce a methods effect, with respondents circling the same response to the entire series. The national survey addressed this problem by using a very different format.

This chapter has discussed the case study execution and findings. Qualitative data contributed to a more explicit causal model of CPMCS impact on job perceptions. They also suggested issues for future research in this area. The survey pretest demonstrated areas for improving the research questionnaire. These quantitative and qualitative contributions were integrated into the model elaboration described in Chapter 4.

CHAPTER 4 - RESEARCH MODEL AND HYPOTHESES

This chapter describes the research model development. It first discusses the process of elaborating the conceptual model into a testable research model, using theory and case study findings. Next, it defines each component construct. It concludes by specifying the hypotheses embodied in the research model.

4.1 DEVELOPING THE RESEARCH MODEL

Chapter 2 examined a conceptual model of computerized performance modeling and control system (CPMCS) impact on job perceptions (see Exhibit 18). This model provides a useful general view of CPMCS issues. However, its high-level concepts are too abstract to define or measure precisely. The degree of abstraction also obscures important relationships among lower-level constructs which are opposite to one another in effect. As a result, the national survey needed a more explicit, testable model.

This section examines each abstract concept in the conceptual model and breaks it down into simpler, measurable constructs. Later sections explicitly define these simpler constructs.

4.1.1 Quantitative and Qualitative Evaluation Systems

Quantitative and qualitative evaluation systems use different means to evaluate performance. The former focuses on numeric measures of performance. The latter uses unquantified data (such as customer comments, subjective assessments of effort, or direct observation of work procedures) to

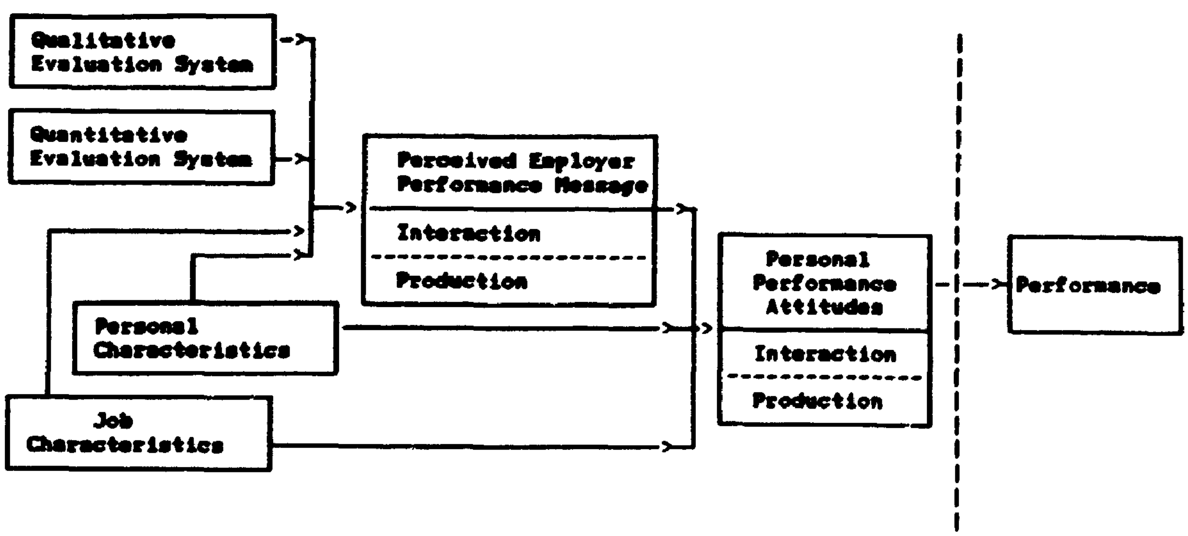

Exhibit 18. Conceptual Model

evaluate performance. Any task which can be quantified can theoretically be measured by the quantitative system. Virtually any task can be assessed by a qualitative system.

Supervisors, customers and co-workers are all possible 'actors' in qualitative systems. They may also add interpretation to quantitative results, thus changing the impact of the quantitative system (Smith et al., 1986). Employee attitudes toward the qualitative system will depend, in part, on the credibility they attach to the individual(s) evaluating and reporting on performance.

CPMCSs are only found in the quantitative system, since monitors cannot perform true qualitative evaluation. Humans may be part of both systems, depending on the means by which they evaluate performance. Supervisors in particular may be part of quantitative systems, in the case of manual designs which track quantified performance. Thus, quantitative system sensors may be human or computer. The employee's attitudes toward the system will depend in part on the credibility they attach to its sensor(s).

The research model must capture four design dimensions of the quantitative and qualitative evaluation systems. It must also depict the relationships among them. The four dimensions are represented by:

- the tasks evaluated by each system ('Tasks Quantitatively Measured' and 'Tasks Qualitatively Measured');

- the period, captured by the frequency with which tasks are evaluated ('Frequency of Quantitative Measures' and 'Frequency of Qualitative Measures');

- the recipient of the activity measurement data ('Recipient of Quantitative Measures' and 'Recipient of Qualitative Measures'); and

- the object (individual or group) being evaluated ('Object of Quantitative Measures' and 'Object of Qualitative Measures').

It must also capture the content of the messages conveyed by the two systems. The message content is represented by 'Quantitative Message' and 'Qualitative Message.' Message content affects acceptance, reliance, and perceived employer messages.

Finally, technological determinism and socio-technical systems approaches suggest that the sensor device (human versus computer) may influence reactions to measurement systems. The employee's beliefs about computers may well moderate the effects of monitoring. In particular, the individual's beliefs about the ability of a computer to accurately and appropriately measure performance could be factors which moderate quantitative system effects. These factors are labeled 'Computer Fallibility' and 'Computer Appropriateness,' respectively.

4.1.2 Job Characteristics

The case study demonstrated that unmonitored and monitored employees have different perceptions of their jobs. These differences arose despite the fact that the actual job characteristics were the same. As a result, the detailed conceptual model includes constructs representing aspects of the job.

While the case study survey tapped three dimensions of job perceptions, only one is included in this detailed model. 'Autonomy' and 'Variety' were included in the survey for future research on job satisfaction. However, only 'Quantitative Nature of Work' is proposed as a factor in monitor impact. Thus, two constructs in the detailed model deal with the nature of the work being controlled. They are 'Job Characteristics' and 'Quantitative Nature of Work.'

4.1.3 Perceived Employer Performance Message

The 'Perceived Employer Performance Message' represents the employee's interpretation of the evaluation messages. It answers the question, "What does my employer think is important in this job?" Researchers have demonstrated that it is not the actual feedback which determines response (e.g., Ilgen, *et al*., 1979; Lawler, 1976; Taylor *et al*., 1984). Instead, it is the perceived message. The perception depends on:

- the degree to which the employee accepts the measurement and message ('Acceptance of Quantitative Measures' and 'Acceptance of Qualitative Measures');
- the personal characteristics of the employee; and
- the perceived characteristics of the job.

These elements all influence the employee's interpretation of performance measurement.

Employees also act on controls which they do not accept, if they believe the control measures are important to the employer (see, for example, Cammann and Nadler, 1977; Whisler, 1970; Lawler and Rhode, 1976). Thus, 'Perceived Reliance on Quantitative Measures' contributes to the perceived employer performance messages. Similarly, the 'Perceived Reliance on Qualitative Measures' will be an element in the impact of qualitative systems.

These perceptions lead the employee to form attitudes about the importance of various job factors to the employer. The research questions focus on the problems of directing effort at production *and* interaction. The model must differentiate between the perceptions of production and of interaction messages. The two constructs representing these perceptions are 'Perceived Production Message' and 'Perceived Interaction Message.'

4.1.4 Personal Performance Attitudes

The concept of 'Personal Performance Attitudes' represents the employee's performance criteria. It answers the question, "What do I think is important in this job?" It depends on the perceived job characteristics, the perceived employer message and the individual's personal characteristics. Just as the employer message consists of two constructs, there are two personal attitude constructs. They are 'Personal Importance of Production' and 'Personal Importance of Interaction.'

Analyzing the abstract model produced the detailed conceptual model of Exhibit 19. It has disaggregated 'Quantitative Evaluation System' into seven component parts representing the message content, the design dimensions of the system, and beliefs about computers. 'Qualitative Evaluation System' comprises five simpler constructs, representing the message content and system design dimensions. 'Perceived Employer Performance Message' consists of six constructs: two representing acceptance of system measures,

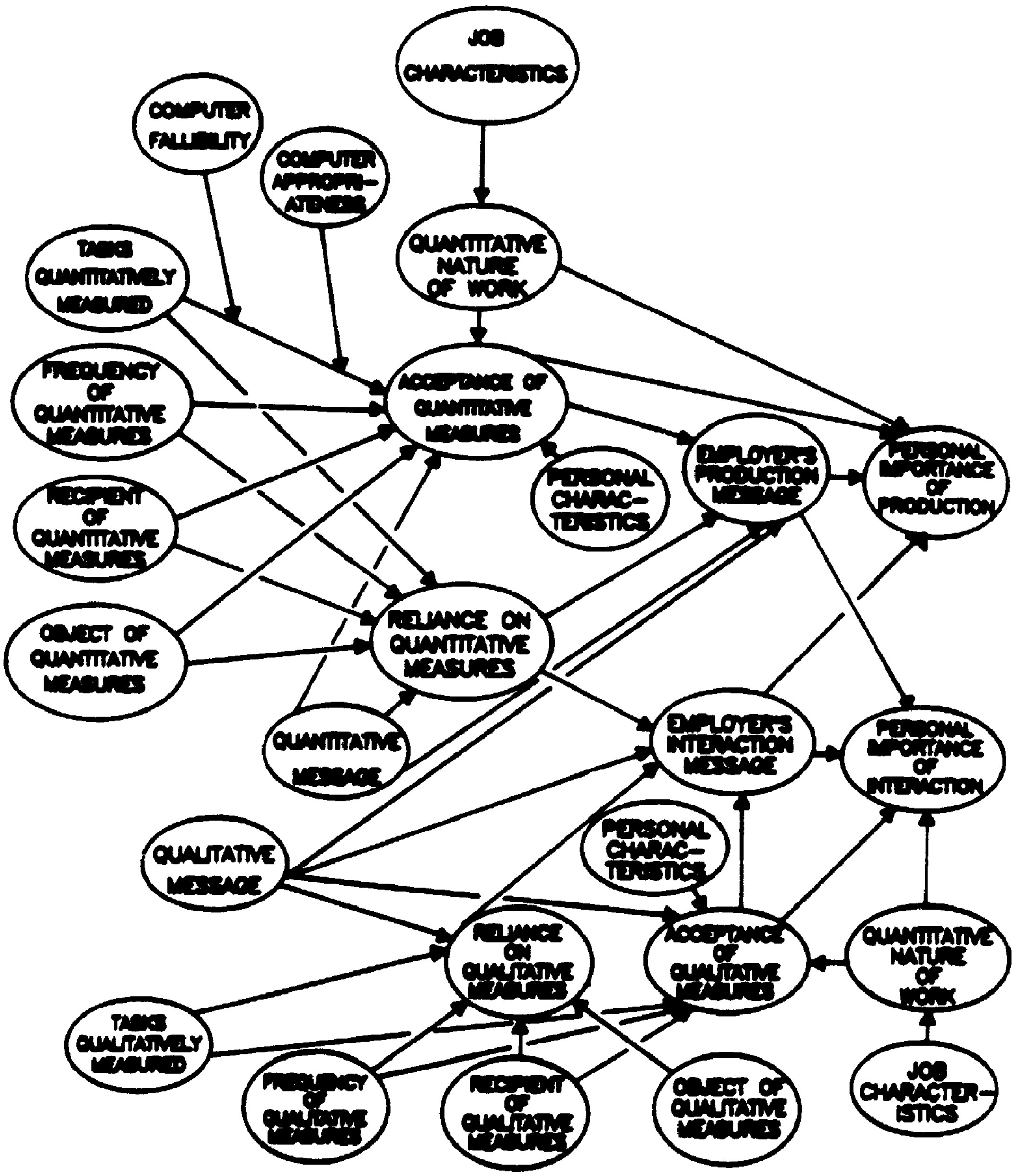

Exhibit 19. Detailed Conceptual Model

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two representing perceived reliance on those measures, and two representing the perceived messages about importance of job factors. 'Job Characteristics' consists of two constructs. One represents the actual job characteristics, while the other represents a perception of the quantitative nature of the work. Finally, 'Personal Performance Attitudes' is broken down into the importance of production and the importance of interaction.

4.1.5 Setting the Research Boundaries

The detailed model shown in Exhibit 19 is complex. It incorporates effects of two evaluation systems, the job, the employee, and the work environment. In defining this research, it was necessary to delineate a manageable portion of this model for immediate study.

This dissertation focused on the impact of quantitative system design. Its research questions asked how the design and use of CPMCSs affect perceptions of factors important to the job. This perspective argues for setting boundaries on the research model to specifically study quantitative system impact. The following discussion describes the process of setting these boundaries.

Message Content: The research questions asked how computerized monitoring affects employee attitudes. In other words, does using a computer (rather than a human supervisor) as the source of quantitative evaluation change an employee's response to the message?

One way to isolate the effect of message source would be to hold message content constant. A second alternative would be to collect the content of messages and include these data in model testing. The third alternative would be to concentrate on the message variables which have direct impact on personal attitudes, namely, the perceived messages.

The national survey set the boundary to examine perceptions of the quantitative message in terms of acceptance, reliance, and employer importance of job dimensions. Similarly, the research concentrated on capturing perceptions of qualitative system messages. This excluded 'Quantitative Message' and 'Qualitative Message' from the research model. The discussion of findings in Chapters 6 and 7 recognizes that some variance in perceived messages remains unexplained because of these decisions.

Job Characteristics: The research questions focus on monitor-related performance attitudes. They are concerned with the role of job perceptions, rather than how those perceptions developed. Thus, the study boundaries were set to include 'Quantitative Nature of Work' as an exogenous construct, but to exclude 'Job Characteristics.'

Personal Characteristics: Demographic and personality variables should play a role in the process of interpreting feedback (Ilgen et al., 1979). However, practical constraints limited the survey length. Rather than examine how demographics and personality affected attitude development, most of the survey concentrated on other constructs.

Some personal variables were collected. These variables consisted of age, gender, native language and work experience. With the exception of native language, they represent the personal factors believed to influence feedback perception (Ilgenet al., 1979). However, they were primarily chosen to describe respondents, rather than to analyze demographics as causal factors in the model of impact.

Qualitative Perception Development: This work studied how perceptions of quantitative systems develop. Perceptions of qualitative systems contribute to this development. At the same time, how perceptions of the qualitative systems develop was not a key issue in this study. Therefore, the research boundary was set to include 'Perceived Reliance on Qualitative Measures' and 'Acceptance of Qualitative Meas-

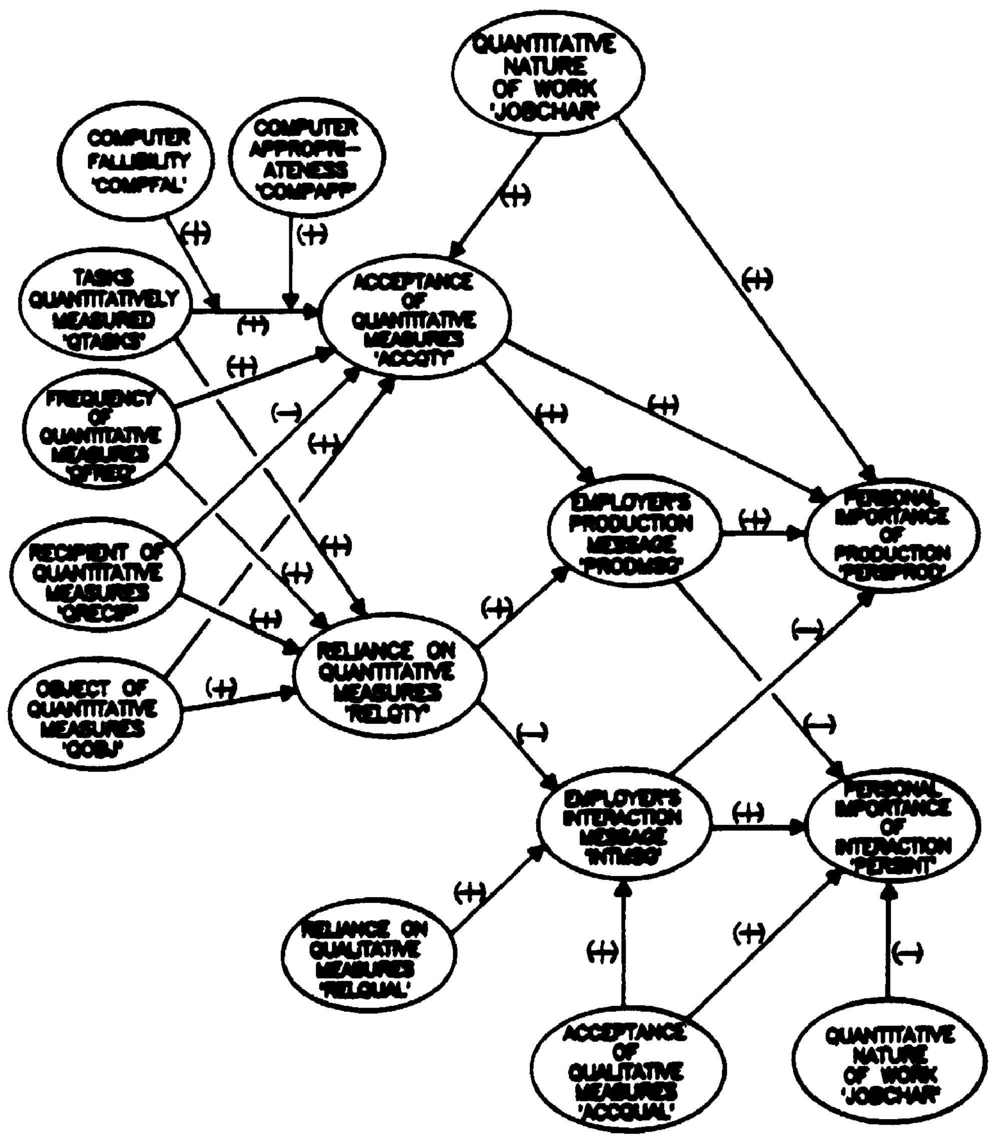

Exhibit 20. Research Model of CPMCS Impact

ures' as exogenous constructs. This excludes 'Tasks Qualitatively Measured,' 'Frequency of Qualitative Measures,' 'Object of Qualitative Measures,' and 'Recipient of Qualitative Measures.'

These modifications produced the research model shown in Exhibit 20. The remainder of this chapter explicitly defines each construct in the model and discusses the hypotheses represented by the causal paths.

4.2 DEFINING THE CONSTRUCTS IN THE MODEL

This section defines each construct in the research model. It begins with the independent, or exogenous, constructs, then proceeds to define the intervening and dependent constructs.

4.2.1 Definitions of Independent Constructs

'Tasks Quantitatively Measured' ('QTASK'): The degree to which the respondent believes the range of work activities is quantitatively measured, regardless of the measurement device. This construct represents Lawler's (1976) dimension of 'measure inclusivity.' Descriptions of monitoring systems (Ontario Ministry of Labour, 1979; U.S. Congress, OTA, 1987; Westin, 1986) revealed general activities which could be monitored. This construct translates those activities into a continuum of monitor pervasiveness (Sheridan, 1980), ranging from no quantitative measurement to computer measurement of all activities.

'Frequency of Quantitative Measures' ('QFREQ'): The frequency with which quantitative performance data are available. This construct captures the 'period' dimension of design by looking at how often performance is measured. It represents Lawler and Rhode's (1976) 'speed and frequency of communication' and Ilgen _et al_.'s (1979) 'timing of feedback.' The construct is a continuum from 'periodic' data which are collected or reported only once per evaluation period to 'interactive' data which are available on demand.

'Recipient of Quantitative Measures' ('QRECIP'): The degree to which performance data are made available to various parties in the workplace. This construct represents Lawler and Rhode's (1976) 'recipients of communication.' It is a continuum from 'private' data available only to the employee to 'public' data available to anyone in the workplace (including management and non-supervisory employees).

'Object of Quantitative Measures' ('QOBJ'): The object of data collection -- individual employee versus work group or department. This construct draws on Lawler's (1976) and Ilgen et al.'s (1979) assertions that ownership or responsibility for the measured performance is a factor in control system impact. It captures the ability of the system to differentiate between individual and group performance.

The four constructs represent employee perceptions of each system design dimension. As an alternative to perceptions, this research could have used data on the system actually in use and coded responses according to that data. Eisenman (1986), for example, assigned her research subjects to descriptive monitor categories: surveillance, high monitoring, moderate monitoring, low monitoring, non-VDT work. The assignment was based on her assessment of the system's design. She had anticipated that,

> "...employee perceptions would not accurately reflect the actual level of monitoring, but rather that the daily use of a VDT would result in a perception of constant monitoring, regardless of the actual monitoring which was performed."

However, Eisenman's (1986) own analysis subsequently showed that supervisors did not use all of the monitoring capability at their disposal. Furthermore, Ilgen et al.'s (1979) framework demonstrated that perceptions of the control system and its messages drive responses. This research, therefore, used employee perceptions of the control system.

In addition to the design features of the control system, perceptions of its value are important. Ilgen et al. (1979) discussed 'source credibility' as a factor in the impact of feedback systems. Lawler and Rhode (1976) described the credibility of the 'source of discrimination' and of the 'sensor' as factors. This study specifically looks at how the credibility of computers influences acceptance of monitored data. The case study interviews and survey pretest suggested that, of the items measuring beliefs about computers, only the perceived fallibility and their appropriateness would affect acceptance. Thus, the two independent constructs dealing with monitor technology correspond to Ilgen et al.'s (1979) 'source reliability' and 'source expertise'. The two constructs are:

'Computer Fallibility' ('COMPFAL'): The employee's belief that computers produce accurate information, independent of the application or environment.

'Computer Appropriateness' ('COMPAPP'): The employee's belief that a computer is an appropriate device for measuring their performance.

The research model includes three other exogenous constructs:

'Quantitative Nature of Work' ('JOBQTY'): The employee's perception of the degree to which the job is quantitative and routine in nature. This is a construct developed for this research. Discussions in the literature (e.g., Camman and Nadler, 1977; Kerr, 1975; Lawler, 1976) contend that the control system's ability to measure must be compatible with the important aspects of the job to be effective. In other words, qualitative jobs should be measured by qualitative systems, while quantitative roles are measured by quantitative systems.

'Acceptance of Qualitative Measures' ('ACCQUAL'): The employee's perception of the quality of the qualitative system data, in terms of accuracy, completeness and appropriateness. This construct integrates the dimensions of information acceptance (accuracy, completeness, relevance, timeliness, and quality) discussed by Zmud (1978) and Ilgen et al. (1979).

'Reliance on Qualitative Measures' ('RELQUAL'): The employee's perception of the degree to which the employer relies on qualitative system data in assessing performance. This construct integrates Lawler's (1976) description of the 'use' of control system data and Taylor *et al*.'s (1984) 'standard importance.'

4.2.2 Definitions of Intervening Constructs

'Acceptance of Quantitative Measures' ('ACCQTY'): The employee's perception of the quality of the quantitative system data, in terms of accuracy, completeness and appropriateness. This construct parallels 'Acceptance of Qualitative Measures.'

'Reliance on Quantitative Measures' ('RELQTY'): The employee's perception of the degree to which the employer relies on quantitative system data in evaluating performance. This construct parallels 'Reliance on Qualitative Measures.'

'Employer's Production Message' ('PRODMSG'): The employee's assessment of the absolute importance of production factors to the employer. This construct integrates Cammann and Nadler's (1977) 'what's expected,' Kerr's (1975) 'what's hoped for,' and Lawler's (1976) 'appropriate behavior.' Without explicitly defining the terms, these authors presented the concept of the value of tasks or performance dimensions to the employer. This construct refers specifically to the value of production tasks to the employer.

'Employer's Interaction Message' ('INTMSG'): The employee's assessment o. the absolute importance of interaction factors to the employer. This construct parallels 'Employer's Production Message,' but is confined to the value of interaction.

4.2.3 Definitions of Dependent Constructs

Lawler and Rhode (1976) described 'activity,' while Ilgen et al. (1979) referred to 'intention to respond,' as products of control systems. Cammann and Nadler (1977) discussed 'energy directed toward area.' Each of these concepts incorporates attitudes toward the value of dimensions or activities and the intention to perform in accordance with control system feedback.

This research concentrates on the importance of job dimensions. Its dependent constructs address perceptions of importance separate from the intention to respond. The two dependent constructs are thus defined as:

'Personal Importance of Production' ('PERSPROD'): The absolute importance the employee attaches to production factors as part of the job.

'Personal Importance of Interaction' ('PERSINT'): The absolute importance the employee attaches to interaction factors as part of the job.

4.3 RESEARCH HYPOTHESES

The principal objective of the national survey was to test a causal model of CPMCS impact. Causal models do not simply specify relationships among variables of interest. They also indicate direction or causality embodied in those relationships (Asher, 1983). Each path in the research model can be expressed as a causal hypothesis, as explained below.

H1: The more extensive the quantitative measurement of performance, the greater the acceptance of quantitative performance measures.

Acceptance includes the notion that measures are complete and accurate. Quantitatively measuring more tasks should increase the belief that measures are complete. The use of computers, rather than humans, to capture data should increase the perceived accuracy and objectivity of measures (Irving *et al*., 1986; Long, 1987; Tamuz, 1987). It should also increase the sense that more performance along those dimensions is 'observed' and consequently that measures are more complete (Irving *et al*., 1986; Tamuz, 1987; Walton and Vittori, 1983). Finally, Smith *et al*. (1986) pointed out that evaluative feedback from a machine is more easily accepted than feedback from another individual.

H2: **The more extensive the quantitative measurement of performance, the more employees will believe employers rely on the quantitative data.**

Measuring more dimensions will suggest that measures are more comprehensive. This should lead employees to believe that the employer relies more on these data than would be the case with less comprehensive measures (Higgins *et al*., 1987; Whisler and Shultz, 1957).

H3: **The shorter the measurement period, the greater the acceptance of quantitative performance measures.**

Acceptance of performance measures varies with the proximity of the measurement to the actual performance (Lawler and Rhode, 1976). If quantitative data are captured and reported more frequently, the employee is more likely to believe that they accurately reflect the performance (Taylor et al., 1984). Frequent reporting also increases the opportunity to respond to the feedback, thus increasing the acceptability of the message (Ilgen et al., 1979).

H4: The shorter the measurement period, the more employees will believe employers rely on the quantitative data.

Again, more frequent data collection and reporting should increase the extent to which employees believe supervisors rely on the data (Ilgen et al., 1979).

H5: The broader the audience for the evaluation data, the lower the acceptance of quantitative performance measures.

Increasing the audience for the data increases the number of discriminators evaluating performance. This reduces the relative importance of self-discrimination (Lawler and Rhode, 1976). Second, it makes deviations from the group norm (such as 'rate busting' or below average production) more public. Third, it increases the opportunity for comparisons between co-workers. Walton and Vittori (1983) pointed out that system designs which strain relationships in ways such as these are rarely accepted by employees.

H6: The broader the audience for the evaluation data, the more employees will believe employers rely on the quantitative data.

Increasing the audience for the data beyond the employee or immediate supervisor suggests that other parties have a 'need to know.' This will lead employees to believe that this broader audience also relies on these data in some way (Lawler and Rhode, 1976).

H7: The more specific the object of the evaluation, the greater the acceptance of the quantitative measures.

Acceptance of performance measures increases when the data clearly reflects performance the individual can control (Lawler, 1976). Measuring the performance of the individual employee increases the 'ownership' of the performance and thus its acceptability (Ilgen et al., 1979; Lawler and Rhode, 1976; Sheridan, 1980). Including both individual and group measures should increase its acceptance further as it allows 'ownership' of performance belonging to the individual alone and as part of the group.

H8: The more specific the object of the evaluation, the more employees will believe employers rely on the quantitative data.

Having data for the individual should make employees believe it is more important in their evaluation, since the employer is gathering more detailed information (Lawler, 1976). Extending that to gather both group and individual data should make the employee believe it is even more important.

H9: The more accurate monitored employees believe computers to be, the greater their acceptance of monitor data.

- and -

H10: The more appropriate monitored employees believe computer measurement to be in their jobs, the greater their acceptance of monitor data.

Acceptance of performance measures also depends on the credibility of the source (Ilgen et al., 1979; Irving et al., 1986; Zuboff, 1982). In the case of monitored employees, this means their perception that the computer is (1) an accurate device and (2) an appropriate tool to measure their performance.

Beliefs about computers will not directly affect acceptance of quantitative measures. Instead, they will moderate the effects of monitoring on acceptance. The literature (Long, 1987; Smith et al., 1986; Tamuz, 1987) points out that increasing the tasks quantitatively measured should increase acceptance of quantitative measures. However, this will only be the case if the sensor, or measurement device, is credible (Ilgen et al., 1979; Lawler, 1976). Thus, the credibility of computers will moderate the monitored employee's reaction to increased quantitative measurement.

H11: **Employees who perceive their jobs to be quantitative or routine in nature will demonstrate greater acceptance of quantitative measures than will those who do not.**

Acceptance includes the appropriateness of the measures to the job (Ilgen et al., 1976; Taylor et al., 1984). The more quantitative the employee perceives the job to be, the more appropriate quantitative measurement will seem (Ilgen et al., 1976; Laudon, 1974; Zuboff, 1982). This relationship was also demonstrated in the case study.

H12: **Greater acceptance of quantitative measures will result in stronger personal production importance.**

Taylor *et al*. (1984) asserted that quantitative measures and feedback influence an employee's performance standards. Feedback can prompt employees to change standards, if the data are perceived as accurate, complete, and appropriate. These are the dimensions of acceptance (Ilgen *et al*., 1979). Hence, increasing acceptance of quantitative data should increase the importance of the dimensions they measure.

H13: Greater acceptance of quantitative measures will result in a stronger perceived production message.

- and -

H14: Greater perceived reliance on quantitative measures will result in a stronger perceived production message.

The perceived performance message depends upon the employee's belief that the measurement system reflects the performance criteria of the employer (Ilgen *et al*., 1979; Taylor *et al*., 1984). This in turn depends on (1) accepting the measurements and (2) believing that the employer relies on them (Cammann and Nadler, 1977; Kerr, 1975; Ilgen *et al*., 1979). Thus, the quantitative measures will influence the employee's perception that production elements are important.

H15: Greater perceived reliance on quantitative measures will result in a weaker perceived interaction message.

The argument is also made that what is not measured or used is an important message (Kerr, 1975; Irving _et_ _al_., 1987; Cammann and Nadler, 1977). Heavy reliance on quantitative measures, at the perceived expense of qualitative measures, should reduce the perceived importance of qualitative (interaction) elements.

H16: The perception that a job is quantitative or routine in nature will result in stronger personal production importance.

Performance attitudes are also a function of job perceptions, particularly when feedback is general or infrequent (Ilgen _et_ _al_., 1979). Personal attitudes toward the importance of production and interaction will be influenced by the employee's view of the job being monitored. Specifically, if the job seems quantitative in nature, the employee will consider production elements to have major importance. They will use the feedback provided by the job itself and their view of it to infer importance (Ilgen _et_ _al_., 1979).

H17: Greater perceived reliance on qualitative measures will result in a stronger perceived interaction message.

- and -

H18: Greater acceptance of qualitative measures will result in a stronger perceived interaction message.

These two hypotheses parallel H13 and H14. Interaction dimensions of customer service and interpersonal skills are captured by qualitative systems. The belief that the qualitative measures are acceptable and relied on will thus increase the perceived importance of interaction.

H19: Greater acceptance of qualitative measures will result in stronger personal interaction importance.

This hypothesis parallels H12 in proposing that acceptance of measures increases the personal importance of the dimensions they measure.

H20: The perception that a job is quantitative or routine in nature will result in weaker personal interaction importance.

This hypothesis counters H16. The more quantitative the job seems to be, the less importance the employee will attach to non-quantitative roles (Ilgen et al., 1979).

H21: A stronger perceived production message will result in stronger personal production importance.

- and -

H22: A stronger perceived interaction message will result in stronger personal interaction importance.

The value the employer attaches to job dimensions or activities is a key factor in employee standards (Cammann and Nadler, 1977; Lawler, 1976; Walton and Vittori, 1983). The greater the perceived importance of production to the employer, the more importance the employee should attach to it. Similarly, the greater the perceived importance of interaction, the more highly employees will value interaction. However, as the case study demonstrated, other factors will contribute to the development of personal importance. These other factors are represented by hypotheses H16, H19, H20, H23 and H24.

H23: A stronger perceived production message will result in weaker personal interaction importance.

- and -

H24: A stronger perceived interaction message will result in weaker personal production importance.

Increasing the importance of production does not necessarily mean the employee will decrease the importance of interaction by an equal amount. For example, an employee may attach a certain level of importance to interaction. This level could remain constant, even if the perceived importance of production were to increase. However, arguments against monitoring contend that it can increase the importance of production to the employee to the point that it reduces the importance of interaction (Zuboff, 1982; Whisler, 1970; Long, 1987). The exploratory work indicated that this may be true when discussing relative importance. In other words, interaction may seem less important than production although the employee continues to consider them both very important.

This chapter derived the research model and defined its components. Each construct was translated into operational measures suitable for a field study. Chapter 5 describes the design of the national survey and the instruments used to collect these operational data.

CHAPTER 5 - NATIONAL SURVEY RESEARCH METHODOLOGY

The second stage of this research was a large-sample test of the causal model described in Chapter 4. It used a mail survey to collect cross-sectional data from employees performing service jobs in 51 Canadian companies. This chapter describes the methodology for the national survey.

The chapter first presents the operational measures of each construct in the research model. Section 5.2 then discusses the research design. It explains the rationale for and development of the judgement sample. Following the data collection methods, it examines the demographics of the survey respondents and describes the control systems used to measure their performance. The chapter concludes by discussing the statistical methods used to test the causal model.

5.1 OPERATIONALIZING THE MODEL

This study used items from the survey in "Appendix B - National Survey" to measure each construct in the causal model. Chapter 3 discussed the results of pretesting the survey items and format during the case study. This pretest indicated areas for revision, which were addressed before undertaking the national survey. This section describes the use of revised items to measure the constructs in the research model.

Except where noted, the survey items used 7-point Likert-type scales.

5.1.1 Measures of Independent Constructs

'Tasks Quantitatively Measured' (QTASK): QTASK measured the extent to which various elements of the job were quantitatively measured in the formal control system. It was derived from questions 7 to 14 in Section C of the survey. These items were recoded as follows:

Q7:	'Y' = 2	'N' = 0	'X' = 0	
Q8 to Q14:	'C' = 2	'S' = 1	'M' = 0	'N' = 0

Summing recoded items for each respondent produced an interval scale ranging from 0 (no quota, no items quantitatively measured) to 16 (quota and all items measured by computer).

'Frequency of Quantitative Measurement' (QFREQ): QFREQ consisted of questions 6 and 7 in Section D of the survey.

These items asked how often the supervisor examined the quantity of completed work, ranging from 1 = 'Never' to 5 = 'Daily.'

'Recipient of Quantitative Measures' (QRECIP): QRECIP consisted of two items, derived from questions 2 and 4 in Section D of the survey. These questions asked who had access to data on individual and group performance, with response options ranging from '1 = I am the only person ... ' to '6 = Results are posted for everyone to see.' Response '7' ("I do not know or am not sure") in both questions was recoded to '0'. Non-responses from individuals whose employer did not measure the performance in question also became '0' to distinguish them from missing values.

'Object of Quantitative Measures' (QOBJ): This construct used a single summative measure, derived from the answers to questions 1 and 3 in Section D. The scale took on four values between 0 and 3, such that

'0' = no performance tracked
'1' = only group performance tracked
'2' = only individual performance tracked
'3' = both group and individual performance tracked

'Quantitative Nature of Work' (JOBQTY): This construct represented the degree to which the employee believed her job was quantitative in nature. It consisted of six measures: questions 5, 10, 16, 22, 24, and 25 of Section F.

'Reliance on Qualitative Measures' (RELQUAL): The survey used two measures to capture this construct: questions 10 and 15 of Section D. They asked how much the supervisor relied on observation and personal judgement to evaluate work.

'Acceptance of Qualitative Measures' (ACCQUAL): ACCQUAL used six measures. These were questions 3, 4, 7, 8, 11, and 12 of Section B. Each asked the respondent to rate the information used to evaluate customer service or interpersonal skills in terms of its completeness, accuracy or appropriateness.

5.1.2 Measures of Moderating Constructs

The conceptual model proposed that the two constructs, 'Computer Fallibility' (COMPFAL) and 'Computer Appropriateness' (COMPAPP), would moderate the relationship between 'Tasks Quantitatively Measured' (QTASK) and 'Acceptance of Quantitative Measures' (ACCQTY) among monitored employees. This research used interaction terms to estimate these moderating relationships.

Interaction terms capture joint effects of two or more variables. A regression equation incorporating an interaction term would take the form,

$$Y = a + b1*X1 + b2*X2 + b3*X1*X2$$

This research proposed that fallibility and appropriateness would affect acceptance among computer-monitored workers. This says that, for monitored workers,

$$ACCOBJ = a + b1(QTASK) + b2(fallibility) + b3(appropriateness) + b4(QFREQ) + \ldots$$

but for unmonitored workers,

$$ACCOBJ = a + b1(QTASK) + b4(QFREQ) + \ldots$$

The interaction terms estimated this effect by setting a variable (qcomp) equal to '1' if any tasks comprising QTASK were monitored. The variable was set to zero if none of the tasks were monitored. This was similar to the regression equation:

$$ACCOBJ = a + b1(QTASK) + b2(qcomp*fallibility) + b3(qcomp*appropriateness) + b4(QFREQ) + \ldots$$

For monitored employees, qcomp equals '1' and the equation reduces to:

ACCOBJ = a + b1(QTASK) + b2(fallibility)
+ b3(appropriateness) + b4(QFREQ) + ...

For unmonitored employees, qcomp equals zero and the equation reduces to:

ACCOBJ = a + b1(QTASK) + b4(QFREQ) + ...

'Computer Fallibility' and 'Computer Appropriateness' were operationalized as follows:

'Computer Fallibility' (COMPFAL): This interaction term was derived from questions 4 (reverse scored), 7 (reverse scored), 9, 19 and 22 in Section E. The answers to the Section E questions were summed, then multiplied by 'qcomp.' As explained above, 'qcomp' equaled '1' if any of the items comprising QTASK (Section C, questions 8 to 14) were monitored by computer or zero if no tasks were monitored.

'Computer Appropriateness' (COMPAPP): This interaction term also estimated a moderating effect. It was formed by multiplying the answer to question 3 in Section F ("A computer could measure my performance fairly") by 'qcomp.'

5.1.3 Measures of Intervening Constructs

'Reliance on Quantitative Measures' (RELQTY): This construct paralleled 'Reliance on Qualitative Measures' (RELQUAL). The two items used, questions 12 and 14 of Section D, measured the degree to which supervisors relied on quantitative results to evaluate work.

'Acceptance of Quantitative Measures' (ACCQTY): This construct used six measures parallel to those of 'Acceptance of Qualitative Measures' (ACCQUAL). Questions 1 2, 5, 6, 9, 10 of Section B asked respondents to rate the information used to evaluate work quantity or accuracy in terms of its completeness, accuracy or appropriateness.

'Employer's Production Message' (PRODMSG): This construct used six items to measure the extent to which production factors were important to the company in doing a job well. These items, questions 18, 19, 21, 22, 25 and 27 of Section A, included work quantity, accuracy, group productivity, speed and attendance. They were based on the items pretested in the case study.

'Employer's Interaction Message' (INTMSG): This construct used eight measures of interaction importance to the employer. These items, questions 16, 17, 20, 23, 24, 26, 28 and 29 of Section A, included service, effort, getting along with others, solving problems, answering questions, cooperating, and overall performance. They were based on elaborating the items pretested in the case study.

5.1.4 Measures of Dependent Constructs

'Personal Importance of Production' (PERSPROD): This construct used the same six items as 'Employer's Production Message' (PRODMSG), but asked how important the employee considered them in doing the job well. They were questions 3, 4, 6, 7, 10, and 12 of Section A.

'Personal Importance of Interaction' (PERSINT): This construct used the eight items of 'Employer's Interaction Message' (INTMSG), but asked how important the employee considered them in doing the job well. They were questions 1, 2, 5, 8, 9, 11, 13, and 14 of Section A.

5.2 RESEARCH DESIGN

5.2.1 Selecting Participants

This research used judgement sampling to select survey participants. As with any nonrandom selection method, this technique raises concerns about th study's external validity, or "generalizability of a causal relationship to and across populations of persons, settings, and times" (Cook and Campbell, 1979).

Research design decisions often involve trade-offs between concerns of internal and external validity, as steps to improve one can reduce the other. This research required such a trade-off: monitoring is not so widespread that random sampling could guarantee adequate variance in the model constructs. Thus, efforts to optimize external variance could threaten internal validity.

The decision was made to concentrate first on internal validity -- that is, to focus on testing theoretical relationships before exploring their generalizability. The study, therefore, deliberately sampled firms and industries likely to provide a variety of control system designs and service roles.

The selection of participants began with 245 Canadian firms from service industries listed in Dun and Bradstreet's (1987) Canadian Key Business Directory. Ten of these companies were dropped, since they had the same chief executive officer as another company on the list. Fifteen provincial liquor commissions and health insurance programs, not included in the Dun and Bradstreet (1987) directory, were added to the list.

In October, 1987, letters went out to the chief executive officers of the 250 companies (see "Appendix C - Mailing to Chief Executive Officers"). They were asked to authorize participation in the project and to name a contact person for the research. The contact person subsequently provided the names of employees who performed computer-mediated work and had direct contact with customers.

Of the firms contacted, 105 responded. Twenty-three of these declined to participate. Another 15 companies withdrew after agreeing to take part. Reasons for withdrawing included union and/or management concerns about the sensitivity of the issue, the timing of the study and internal corporate conditions. Five organizations failed to provide the necessary mailing list, despite repeated telephone follow-ups. Eleven other companies withdrew because they did not have an appropriate group of employees.

As a result of attrition, 51 firms (20.4% of those initially contacted) ultimately provided mailing lists. These firms provided mailing lists ranging from 3 employees in the case of a small public utility company to over 150 employees from some insurance companies and Crown corporations. (In the interest of keeping the duties of contacts in large firms within reason, a limit of 250 participants per company was suggested to the contacts.)

The participating companies were promised anonymity, due to the sensitivity of monitoring issues. They represented 14 major industries and 20 subindustries. These companies included examples of unmonitored sites, as well as a range of monitored designs from unobtrusive to pervasive.

	Number of Companies	Percent of Original Sampling Frame
Companies contacted	250	100.0%
Undeliverable	12	4.8%
No response	133	53.2%
Declined	23	9.2%
Agreed to participate	82	32.8%
Full participation	51	20.4%

Exhibit 21. Corporate Participation Breakdown

The industries represented included:

- Newspapers/publishing
- Postal, courier and delivery services
- Airlines
- Telephone/telecommunication services
- Public and private utilities
- Liquor control boards
- Banks and trust companies
- Credit unions
- Investment services
- Life, auto and casualty insurance carriers
- Health and medical insurance carriers
- Insurance brokers/agents
- Holding companies

5.2.2 Data Collection

Survey mailings began on January 5, 1988; the last company to provide a mailing list received its packages on March 9, 1988. April 1, 1988, was the cutoff for including surveys in the model test. This cutoff date was dictated by the deadlines of the external funding agency.

Each employee received a sealed, individually addressed envelope marked: 'Personal and Confidential.' The envelope contained a prenumbered survey, a business reply envelope, and a personalized cover letter ("Appendix D - National Survey Cover Letter") explaining the research. All mailings for a single company were sent to its designated contact for distribution through the organization's internal mail.

Individual company response rates varied from a low of 17.4% in one insurance firm to rates in excess of 90% for other companies. Contacts in each company with a response rate less than 50% received a telephone follow-up. These calls produced some additional returns. Cost prohibited direct contact with employees who had not returned surveys. Nonetheless, the survey yielded a response in excess of 50%, which is considered high for a survey of this type (Alreck and Settle, 1985).

The 51 firms provided a total of 2,692 employee names (2,508 to receive English surveys, and 184 to receive the French translation). As of the cutoff date, 1,532 participants returned surveys (56.9%). Only eight questionnaires arrived after the cutoff. Ten surveys were lost in transit when a company contact changed jobs and failed to receive them. Eliminating voided and incomplete returns left a base of 1,498 questionnaires. The effect of these eliminations is summarized in Exhibit 22.

5.2.3 Respondent Demographics

The survey categorized respondents according to age, gender, and language. While personal characteristics were dropped in defining the research model, Ilgen *et al*. (1979) sug-

	Number of Surveys	Percent of Surveys Originally Sent
Sent	2,692	100.0%
Returned	1,532	56.9%
Employee left company	16	.5%
Survey voided	18	.6%
Usable	1,498	55.7%

Exhibit 22. Survey Response Rates

gested that they influence perceptions of employer messages. Thus, the review of demographics sought to ensure that there was variance along these dimensions. 'Language' was collected to satisfy the external funding agency that both French and English groups had participated in the study.

Exhibit 23 provides a breakdown of the respondents by gender, language and age. The majority of the respondants (82.6%) were English-speaking. Two-thirds of the respondents were less than 35 years old, with almost one-half between 25 and 34.

Over 85% of the respondents were female. This does not necessarily indicate a response bias. The Office of Technology Assessment pointed out,

> "The clerical work force is predominantly female...Similarly, women are more likely to be employed in the lower levels of professional work, such as routine computer programming or routine insurance underwriting, rather than in higher levels of those professions. Because monitoring is most likely to be applied to precisely these lower level jobs, work monitoring is a topic that especially affects women..." (U.S. Congress, OTA, 1987)

Exhibit 24 shows the work experience of respondents in their present company, department and job. They tended to have considerable experience working for their present employer (59.5% indicating '5 years or more' in the current company), and slightly less in their current department and job. These results indicated that respondents were familiar with

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Gender:	Female	1,290 (86.1%)
	Male	208 (13.9%)
First Language:	English	1,238 (82.6%)
	French	172 (11.5%)
	Other	88 (5.9%)
Age:	> 64	2 (.1%)
	55 - 64	55 (3.7%)
	45 - 54	132 (8.8%)
	35 - 44	336 (22.4%)
	25 - 34	701 (46.8%)
	< 25	268 (17.9%)
	Not given	4 (.3%)

Exhibit 23. Respondent Gender, Language and Age

Length of Time With Present Company

	Number of Respondents	Percent of Total
5 years or more	891	59.5
2 to 5 years	328	21.9
7 months to 2 years	220	14.7
4 to 6 months	41	2.7
3 months or less	15	1.0
Missing/Invalid	3	.2

Length of Time in Present Department

	Number of Respondents	Percent of Total
5 years or more	607	40.5
2 to 5 years	421	28.1
7 months to 2 years	354	23.6
4 to 6 months	75	5.0
3 months or less	34	2.3
Missing/Invalid	7	.5

Length of Time in Present Job

	Number of Respondents	Percent of Total
5 years or more	523	34.9
2 to 5 years	407	27.2
7 months to 2 years	396	26.4
4 to 6 months	113	7.5
3 months or less	55	3.7
Missing/Invalid	4	.3

Exhibit 24. Work Experience

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the work and the evaluation processes which they were asked to rate. This was important, since the survey asked for perceptions and opinions of these elements.

Finally, this research concentrated on workers doing computer-mediated work. This was done to ensure that the study looked at roles which were comparable (in terms of monitoring potential) across companies. In other words, the research looked at employees whose work could be monitored. More than 65% of respondents spent at least one-half of their work day using a computer terminal (see Exhibit 25).

Percent of Day Spent Using Terminal

	Number of Respondents	Percent of Total
100%	209	14.0
75% - 99%	503	33.6
50% - 75%	301	20.1
25% - 50%	215	14.4
<25%	234	15.6
None	32	2.1
Missing/Invalid	4	.3

Experience Using Terminal in Present Company

	Number of Respondents	Percent of Total
More than 2 years	954	63.7
1 to 2 years	263	17.6
6 months to 1 year	144	9.6
Less than 6 months	87	5.8
Do Not Use Terminal	47	3.1
Missing/Invalid	3	.2

Exhibit 25. Computer Use and Experience

Forty-seven respondents said they did not use a terminal. This occurred despite instructing contacts to name only employees performing computer-mediated work. These 47 surveys were removed from the data base prior to model testing.

5.2.4 Characteristics of Quantitative Evaluation Systems

This research sought to include employees working under a variety of control system designs. Sections C and D of the national survey asked respondents to indicate (1) how various tasks were measured, (2) how often they were measured, and (3) whether group or individual measures were used.

As shown in Exhibit 26, 68.5% of the respondents worked in firms which tracked individual performance. Companies tracked group performance for 56.3% of the respondents. Finally, slightly over one-third of the respondents had production quotas.

The survey specified seven common CPMCS uses, as shown in Exhibit 27. It provided four response categories for each: (1) measured by computer; (2) measured by supervisor; (3) measured by employee; and (4) rarely or never measured. To capture the features of formal performance measurement, 'employee' and 'never' collapsed into a single category of 'not

	Yes	No	Not Sure
Employee has production quota	559 (37.3%)	850 (56.7%)	78 (5.2%)
Company tracks individual performance	1,026 (68.5%)	284 (19.0%)	181 (12.1%)
Company tracks group performance	844 (56.3%)	354 (23.6%)	288 (19.2%)

(N.B.: May not total 100%, due to item nonresponse.)

Exhibit 26. Supervisory Environment Characteristics

measured.' This reflected the position that someone or something other than the employee must evaluate an activity for it to be part of the formal measurement. The figures in Exhibit 27 give the breakdown of responses on these evaluation techniques.

Exhibit 27 may overstate or understate actual percentages as a result of the decision to rely on worker perceptions of the systems in use. However, they demonstrate the types of monitoring experienced by respondents. Companies most often used CPMCSs to count completed transactions and record idle time. Process activities, such as checking work methods and assigning work, were more often done by a human supervisor, if at all.

This study emphasized internal validity over external validity. At the same time, it captured data from a wide variety of individuals and settings. Lack of data about the extent and location of monitoring makes it impossible to define the

	Measured By		
	Computer	Supervisor	Neither
Counts keystrokes	237 (15.8%)	19 (1.3%)	1,186 (79.2%)
Counts transactions	521 (34.8%)	120 (8.0%)	816 (54.5%)
Counts mistakes	186 (12.4%)	464 (31.0%)	805 (53.7%)
Records idle time	290 (19.4%)	56 (3.7%)	1,102 (73.6%)
Counts transaction completion time	251 (16.8%)	104 (6.9%)	1,095 (73.1%)
Checks the way work is done	79 (5.3%)	717 (47.9%)	664 (44.3%)
Directs work to the workstation	152 (10.1%)	622 (41.5%)	679 (45.3%)

Exhibit 27. Self-Reported Prevalence of Measured Functions

population of monitored employees and thus evaluate external validity. However, the variety among respondents suggests that results may be generalizable across numerous individuals and settings. Since the technology is relatively new, the questions of generalizing across times remain.

5.3 MODEL TESTING METHODS

This research used Partial Least Squares (Wold, 1982) to analyze the research model. Partial Least Squares (PLS) is a second-generation, multivariate technique used to estimate the parameters of predictive-causal models. It focuses on the interrelationship of theory and data, while allowing the researcher to specify which of the two will play the stronger role in estimating model parameters (Fornell, 1984). This flexibility makes it particularly useful for early theory testing, such as the testing conducted in this research.

Second generation techniques recognize two components of a causal model. The first is the structural, or inner, model. The structural model consists of the unobservable constructs (the latent variables or LVs) and their theoretical relationships. The second component is the measurement, or outer, model. The outer model comprises the observables (the manifest variables or MVs) and their relationships to the LVs. These two models together form a network of constructs and measures. The estimated path coefficients indicate the strength and sign of the theoretical relationships, while the item weights/loadings indicate the strength of the relationships between the LVs and the MVs.

The flexibility of PLS comes, in part, from the ability to specify different types of manifest variables and different types of theoretical relationships among the latent variables. One can also specify different epistemic relationships between latent and measurement variables. These specifications are based on decisions made by the researcher prior to estimating the model parameters with empirical data. They reflect the theory underlying the model and the extent to which the researcher chooses to emphasize theory or data.

This section examines the options available in defining the structural and measurement models. It also indicates the choices made in this research.

5.3.1. Theoretical Constructs

Structural models may incorporate two types of theoretical constructs. The first is the 'defined' construct. A defined construct is one which can be completely captured as a function of its observable indicators. 'Scholastic Achievement' might be such a construct, in a study which defined it as consisting of grade point average, number of academic awards, and highest grade completed.

Latent constructs may also be 'indeterminate.' These are abstract and unobservable constructs. They cannot be expressed as a function of their indicators without including an error term to reflect the unmeasured aspect of the construct. 'Intelligence' is such a construct. Tests, scales and puzzles may capture some aspects of 'intelligence;' other aspects will remain unmeasured even though the sense of the concept is understood.

The decision whether to designate a particular construct as defined or indeterminate depends on the strength of the underlying theory. In cases where the construct is an index composed of identifiable factors, the 'defined' construct could be a natural choice. However, one may also choose to designate other abstract constructs as 'defined' because available theory does not provide strong evidence of their scope. The weaker one's confidence in the theory, the more likely one is to treat a construct as defined. This is because defined constructs are more closely tied to data, than to theory (Fornell, 1984). In essence, using defined constructs says that there is not enough work examining the concept to feel confident that it is anything more than what is captured by the measures in the present study.

PLS can only accommodate defined constructs (Fornell, 1984). Thus, research which uses PLS analysis trades the ability to specify indeterminate constructs for other desirable features of the method.

This research includes six latent constructs which would be 'defined' regardless of the second-generation method chosen. They are: 'Tasks Quantitatively Measured' (QTASK), 'Frequency of Quantitative Measurement' (QFREQ), 'Recipient of Quantitative Measures' (QRECIP), 'Object of Quantitative Measures' (QOBJ), 'Computer Fallibility' (COMPFAL), and 'Computer Appropriateness' (COMPAPP).

The first four of these six constructs had never been studied as explicit dimensions of a control system. They were derived from the literature, but their existence as independent, unidimensional constructs had not been established. The literature also discussed general computer attitudes. However, the specific concepts of fallibility and appropriateness were drawn largely from observations in the case study. There could be many aspects to each one, and the literature did not clarify what they should be. Thus, it is too early to claim that they have any meaning beyond that supplied by the data in this research.

The remaining constructs in the research model could have been indeterminate. The literature demonstrates that they exist as abstract concepts with meaning beyond the context of this study. However, PLS analysis treats them as defined. This reduces the amount of theory acknowledged in the estimation procedures. But, it does not prevent incorporating the theory when interpreting the results of the estimation.

5.3.2 Theoretical Relationships

Relationships between the latent constructs may be 'symmetric' or 'directional' (Fornell, 1984). Symmetric relationships indicate a non-directional association. They propose that two constructs are related, but do not distinguish one as being a cause of the other. Correlations exemplify symmetric relationships. 'Directional' relationships, on the other hand, propose causality. In a relationship proposed as directional, changes in an independent construct are expected to produce a change in the dependent construct.

Directional relationships may further be classified as 'recursive' or 'nonrecursive.' The former says that there is a unidirectional relationship (A -> B), while nonrecursive relationships are bidirectional (A -> B and B -> A) or cyclical (A -> B, B -> C, and C -> A).

All of the theoretical relationships in this research model are directional and recursive. The decision to propose direction in each relationship was made on the basis of theory drawn from the literature and empirical evidence from the case study. Furthermore, an objective of this research was to explain how monitoring affects service workers, which argued for directional hypotheses.

PLS programs require that hypothesized models be recursive. Thus, potentially nonrecursive relationships identified in the model (such as the effect of personal importance on acceptance of measures) were eliminated when setting the boundaries of the model. These relationships remain to be tested in future work.

5.3.3 Epistemic Relationships

One must also specify the relationships between constructs and manifest variables (also called 'indicators'). These are known as epistemic relationships.

Epistemic relationships may be 'reflective' or 'formative' (Fornell, 1984). 'Reflective' indicators are measures which are believed to reflect the underlying latent variable. This relationship implies that changes in the unobservable LV are responsible for observable changes in its associated manifest variables. 'Formative' indicators, on the other hand, approximate the LV. In a relationship based on formative indicators, the latent constructs are considered to be a composite effect of the MVs.

Two situations call for formative indicators. In the first situation, the construct has not been widely used or the population of items capturing it is not well-defined. This arises in cases of weak theory, where it is difficult to argue that measures chosen represent the construct well. Formative indicators may be used to acknowledge that, although the LV is indeterminate, there is little theory to suggest how well the MVs cover its various aspects. In the second situation, an LV may be an index. In this case, the latent construct is actually formed as a combination of its observables.

This study used formative indicators to measure the six defined constructs, described above. 'Tasks Quantitatively Measured' (QTASK), 'Recipient of Quantitative Measures' (QRECIP), and 'Object of Quantitative Measures' (QOBJ) used summative measures to create indices. In these cases, the construct was defined by the index of task, recipient or object. 'Frequency of Quantitative Measurement' (QFREQ), 'Computer Fallibility' (COMPFAL), and 'Computer Appropriateness' (COMPAPP) used formative indicators in recognition of weak theory. There were no comparable measures in the literature and few indications of the scope of these constructs. Thus, the decision was made to rely more heavily on the evidence of the data than on theory in defining these relationships for the model.

The remaining constructs used reflective measures. The literature suggested that these were abstract constructs reflected by their observables. It also provided evidence of the scope of the constructs and appropriate measures to capture them. Thus, there was more reason to be confident in the theory related to these elements of the model.

In summary, this study integrated theoretical and empirical work to test new theoretical and epistemic relationships. Few prior tests of these relationships existed. Many of the measures were created specifically for this research, and the hypothesized model had never been tested. Furthermore, a number of the constructs were measured by formative indicators. Finally, this research sought to explain CPMCS impact. PLS provides measures of the variance explained in each construct, which supports the objective of testing the model's explanatory power. These factors made PLS the preferred method of analysis.

5.3.4 Comparisons of First and Holdout Samples

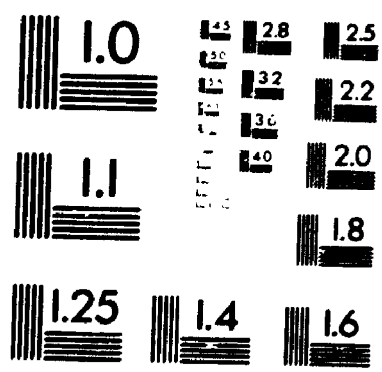
This study used a holdout technique to test two versions of the causal model. First, surveys were divided according to identification number. Those with even numbers were put in one set and those with odd numbers in another. The first sample (even-numbered surveys) provided the input to test the model proposed in Chapter 4. The results of testing that model suggested areas for revision. The second sample (odd-numbered surveys) was held out until the original model was revised. The holdout sample was then used to test the revised model.

There was no significance to odd or even identification numbers, so using these numbers to split the responses into two groups was virtually a random assignment. However, statistical tests were run to ensure that there were no major differences in the composition of the two samples in terms of: variety of quantitative systems designs represented; work experience; and personal demographics. "Appendix E - Comparison of First and Holdout Samples" presents the details of tests comparing the two sample groups.

T-tests on items measuring the four design dimensions (questions 8 to 14 of survey section C and questions 1 to 4, 6 and 7 of section D) showed only one significant difference between the samples. The mean for question 4 of Section D, 'Recipient of Group Data,' was slightly higher in the holdout sample (4.13 versus 4.34). This difference was significant at alpha = 0.04, for a two-tailed test.

Items 1 to 9 of Section I categorized respondents according to work experience, language, age and gender. Chi-squared tests revealed two statistically significant differences between groups on these dimensions. First, respondents in the holdout sample had slightly more computer experience outside their present company (27.2% with more than 2 years' experience in the holdout sample, versus 23.7% in the first sample). This difference was significant at alpha = 0.05

3



(two-tailed). Second, more males returned odd-numbered surveys. Thus, 79 (10.8%) of the surveys in the first sample came from males, compared to 98 (13.8%) in the holdout sample.

These differences were statistically significant, but not substantial. They were unlikely to affect test results dramatically.

5.3.5 Test Execution

The statistical analysis used the PLS programs developed by Lohmoller (1988). PLS programs use iterative regressions to estimate the coefficients for each path in the original model. The path coefficient "indicates the direct effect of a variable hypothesized as a cause on a variable taken as an effect" (Pedhazur, 1982). Iterative regressions also produce estimates for the weights and loadings of the manifest variables on the latent constructs. These estimates reflect the characteristics of the measurement model.

For reflective manifest variables, the loadings of the measures on the construct correspond to the correlation between the MV and the latent construct. These loadings are used to assess the reliability and internal validity of reflectively measured constructs.

Traditional concepts of reliability and validity are difficult to apply when constructs are actually indices. Such LVS are defined by their component measures and thus cannot be assessed in terms of variance shared between a construct and its indicators. Item weights do provide information for evaluating the outer model, nonetheless. Where a construct has more than one formative indicator, item weights can be compared to understand how much each indicator contributes to the empirical definition of the construct. Large differences in weights could suggest multidimensionality or that an indicator with a low weight measures an unimportant facet of the construct. The weights of each indicator in multiple tests of the model also give a sense of the consistency with which the indicator measures a trait from one test to the next. The first step in evaluating the research model examined the weights and loadings to assess the reliability and validity of the measurement model. Chapter 6 discusses this use of the outer model estimates in greater detail.

The next step was to assess the path coefficients. Path coefficients estimate the strength and sign of theoretical relationships. However, the magnitude of the path coefficient alone does not support or refute a hypothesized relationship. To do so, it must first be shown to be significantly different from zero. Thus, this research tested the statistical significance of the estimated coefficients.

Standard tests of significance assume multivariate normality, large samples and interval data (Wold, 1985). An alternative approach is to use jackknifing (Fornell and Barclay, 1986). This is a non-parametric method of testing significance and so does not make such restrictive assumptions. The jackknife routine creates multiple, overlapping subsets of the data by dropping cases from the complete data set (Wonnacott and Wonnacott, 1984). There is no fixed number or percentage of cases which should be dropped, although 5-10% of the sample is a common recommendation (Fornell and Barclay, 1986).

The subsets generated by the jackknife routine are used to produce a distribution for each path coefficient. Based on this distribution, the program tests the hypothesis that each path coefficient equals zero. The test produces a t-statistic representing the probability that the observed coefficient would occur if the true coefficient were zero.

The first sample contained 686 surveys (or 'data points'), of which 23 were dropped to generate 30 overlapping subsets. Similarly, 21 of the 643 data points in the holdout sample were dropped and 30 subsets generated. With 30 subsets, the central limit theorem (Ben-Horim and Levy, 1981) argues that the estimated path coefficients will approach a normal distribution. Jackknifing subsets are not independent, as required by the central limit theorem. To compensate, jackknifing calculates "pseudovalues" for the data which are effectively independent (Wonnacott and Wonnacott, 1984). One can then use the normal distribution tables to determine the significance of the t-statistics produced. The degrees of freedom equal the number of subsamples minus one (Wonnacott and Wonnacott, 1984).

The second stage of model testing combined the results from the first test with a fresh look at the theory to revise the model. The third stage repeated the statistical testing and analysis process, applying the holdout sample to the revised model.

This chapter explained the design of the national survey and examined the demographics of the respondents. It then described the operational definitions of the constructs in the research model and the statistical techniques chosen to analyze the model. Chapter 6 continues the discussion by examining the results of model testing.

CHAPTER 6 - TESTING THE RESEARCH MODEL

Chapters 4 and 5 described the process of developing a testable causal model of computerized performance monitoring and control system (CPMCS) impact. This chapter examines the measurement and structural components of that model and their subsequent revision.

The chapter describes testing and analyzing the model with the first subsample of the national survey data. The findings from this first test produced a revised model. Sections 6.2 and 6.3 then describe the revisions and subsequent use of the holdout sample to test the revised model. The chapter concludes by discussing the explanatory power of the model.

6.1 TESTING THE ORIGINAL MODEL

Chapter 5 described the structural (inner) and measurement (outer) components of PLS models. This section discusses these two components of the CPMCS impact model proposed in this research.

6.1.1 The Measurement Model

One cannot draw conclusions from path coefficients and the significance of the structural model without a good measurement model. A poor outer model can distort the parameters of the inner model. It may also indicate failure to measure the constructs as intended. Thus, the model testing must begin by examining the outer model. This section first discusses the potential effects of missing values, then looks at convergent and discriminant validity.

Missing Values

The PLS program system (Lohmoller, 1988) includes a program, called 'PLSX,' which triggers the jackknifing routine. This program requires casewise deletion of missing values. Thus, any survey with a single missing value for a manifest variable must be deleted from the entire analysis. While this is not necessary for PLS model estimation, it would be meaningless to test the significance of jackknife estimates with a reduced sample of data. Thus, one must maintain consistency in the data used for model estimation and significance testing.

Substituting the respondent's scale mean for missing values circumvents this problem. If the respondent provided an invalid or missing response, the system calculated their mean response to the other items measuring the same construct and substituted that for the missing value.

This approach could increase the reliability of a scale if particular items were subject to high non-response. In this study, no individual question had more than 56 missing or invalid responses (3.7%). Thus, mean substitution would have little effect on reliability. This was confirmed by testing the original model with and without substitution. Eliminating substitution reduced the number of usable surveys by 22%. However, the average variance extracted for three of the nine reflective constructs remained unchanged. The change in the other six constructs was negligible, ranging from .01 to .04. As a result, mean substitution was an acceptable method to maintain sample size without distorting the data.

Convergent Validity with Reflective Indicators

Convergent validity is the degree to which two or more attempts to measure the same construct agree (Cook and Campbell, 1979). Strictly speaking, it is assessed in terms of maximally dissimilar measures (Fornell *et al.*, 1982). However, three elements can be used to determine convergent validity of measured constructs in a single instrument (Fornell and Larcker, 1981):

- the reliability of each item in a scale,
- the composite reliability (or internal consistency) of each scale, and
- the average variance extracted by each construct.

PLS programs standardize measurement variables before analysis. The item reliability, therefore, is the square of its loading on the construct (the communality). Carmines and Zeller (1979) recommend loadings of 0.8 for widely-used scales, although a loading as low as .7 still demonstrates that at least half of the variance in the measure is attributable to the construct rather than error.

Like Cronbach's alpha, composite reliability is a measure of the internal consistency of a scale, based on the inter-item correlations. Composite reliability can be calculated by squaring the sum of the individual item loadings and dividing that by the squared sum of the loadings plus the sum of the error variances. This statistic reflects the overall reliability of the construct.

Neither item nor composite reliability measures the amount of variance in the item explained by the construct, relative to the amount due to measurement error. For that reason, average variance extracted is the preferred measure of convergent validity (Fornell and Larcker, 1981).

The average variance extracted by a construct is a more conservative measure than composite reliability. It shows how much variance the reflective measures share with the construct. If the average variance extracted is below 0.50, the amount of variance in the measures attributable to error is greater than the amount attributable to the construct. Average variance extracted of less than 0.50 suggests that the convergent validity of the construct is weak. This statistic is calculated by averaging the squared loadings (communalities) of the measures on the construct.

The case study pretested many of the items used in the national survey. As discussed in Chapter 3, the pretest identified a number of weak and poorly worded items. Some were dropped and others reworded in constructing the national survey. The pretest also identified scales with more than one dimension. Chapter 4 described the process of determining boundaries for the model and deciding which dimensions should be included in it.

The case study pretest led to improvements in the reliability of survey items. However, the national survey also included new items describing the monitor. These items had not been pretested. Nor had the measurement variables been tested in the context of the structural model.

Because PLS merges theory and data, one cannot rely on measures of reliability and validity determined separate from the theory-laden structural model. Thus, convergent validity analysis began by looking at item reliabilities estimated by PLS.

This research used reflective indicators to measure nine constructs, as explained in Chapter 5. Exhibit 28 and Exhibit 29 show the loadings of the manifest variables on these nine constructs. The majority of indicators loaded highly on their latent constructs. This is the result of the improvements made after the pretest. However, one construct did cause concern: 'Quantitative Nature of Work' (JOBQTY).

'Quantitative Nature of Work' (JOBQTY): The pattern of loadings for the reflective items measuring JOBQTY indicated possible multidimensionality. Item F10 loaded at .47, item F22 at .60 and item F24 at .02. A review of these questions suggested theoretical support for deleting them. F10 ("My performance could be measured against standard production quotas") and F22 ("The higher my productivity, the better

I'm doing my job") seemed more directed at personal performance than job characteristics. Item F24 ("I have a 'piece-work' kind of job") might have captured perceptions of the reward system, the work environment and the employee's iden-

SURVEY QUESTION	JOBQTY	RELQUAL	ACCQUAL	RELQTY	ACCQTY
F5 Qty fair picture	0.78				
F10 Standard quotas ok	0.47				
F16 Amount of work ok	0.68				
F22 Productivity = good	0.60				
F24 'Piece-work' job	0.02				
F25 Speed good measure	0.79				
D10 Amt. direct supervision		0.75			
D15 Supervisor's judgement		0.74			
B3 Completeness - service info.			0.86		
B4 Completeness - interpersonal			0.86		
B7 Accuracy - service info.			0.90		
B8 Accuracy - interpers. skills			0.89		
B11 Appropriateness - service info.			0.86		
B12 Appropriateness - interpersonal			0.87		
D12 Amt. indirect supervision				0.76	
D14 Importance of quant. info.				0.88	
B1 Completeness - quantity					0.84
B4 Completeness - interpersonal					0.83
B7 Accuracy - service info.					0.84
B8 Accuracy - interpersonal					0.84
B11 Appropriateness - service info.					0.84
B12 Appropriateness - interpersonal					0.84

Exhibit 28. Loadings - Initial Measurement Model: JOBQTY - ACCQTY

SURVEY QUESTION	PRODMSG	INTMSG	PERSPROD	PERSINT
A18 Quantity	0.78			
A19 Accuracy	0.76			
A21 Group productivity	0.87			
A22 Dept. productivity	0.83			
A25 Speed of work	0.72			
A27 Attendance	0.75			
A16 Service to customers		0.73		
A17 Effort		0.76		
A20 Getting along w/supervisor		0.78		
A23 Getting along w/co-workers		0.77		
A24 Solve problems well		0.81		
A26 Answer questions well		0.81		
A28 Cooperating w/others		0.81		
A29 Overall performance		0.77		
A3 Quantity			0.74	
A4 Accuracy			0.69	
A6 Group productivity			0.81	
A8 Dept. productivity			0.80	
A10 Speed of work			0.77	
A12 Attendance			0.74	
A1 Service to customers				0.79
A2 Effort				0.77
A5 Getting along w/supervisor				0.67
A8 Getting along w/co-workers				0.72
A9 Solve problems well				0.82
A11 Answer questions well				0.79
A13 Cooperating w/others				0.82
A14 Overall performance				0.85

Exhibit 29. Loadings - Initial Measurement Model: PRODMSG - PERSINT

tification with it, as much as the quantitative nature of the work itself.

These three JOBQTY items were dropped and the model reestimated with the data of the first sample. Exhibit 30 and Exhibit 31 show the item reliabilities, composite reliability, and the average variance extracted for each construct measured by the revised set of reflective indicators.

Convergent validity of reflectively measured constructs was reasonably strong. All but two of the individual measurement variables (A4 on PERSPROD and A5 on PERSINT) loaded above 0.70. The composite reliability of all of the scales exceeded that level. The more conservative 'average variance extracted' suggested that two constructs, 'Reliance on Qualitative Measures' (RELQUAL) and 'Personal Importance of Production' (PERSPROD), could be subject to a high degree of error. However, the constructs still explained, on average, more than 50% of the variance in their measures.

The weak average variance extracted on RELQUAL resulted from measures which were adequate (loading at .74) but not strong. This suggests that future research should look for better measures of the 'Reliance on Qualitative Measures' construct.

The average variance extracted on PERSPROD (and to a lesser degree PERSINT) seemed to have been reduced by one particular measure loading at less than 0.70. While it would have

	LOADING	ITEM RELIABILITY	COMPOSITE RELIABILITY	AVERAGE VARIANCE EXTRACTED
'Quantitative Nature of Work'				
JOBQTY			0.82	0.60
F5	0.80	0.63		
F16	0.74	0.55		
F25	0.78	0.61		
'Reliance on Qualitative Measures'				
RELQUAL			0.71	0.55
D10	0.75	0.56		
D15	0.73	0.55		
'Acceptance of Qualitative Measures'				
ACCQUAL			0.95	0.76
B3	0.86	0.74		
B4	0.86	0.74		
B7	0.90	0.81		
B8	0.89	0.78		
B11	0.86	0.74		
B12	0.87	0.76		
'Reliance on Quantitative Measures'				
RELQTY			0.81	0.67
D12	0.76	0.58		
D14	0.88	0.77		
'Acceptance of Quantitative Measures'				
ACCQTY			0.93	0.70
B1	0.84	0.70		
B2	0.83	0.68		
B5	0.84	0.71		
B6	0.85	0.71		
B9	0.84	0.70		
B10	0.84	0.71		

Exhibit 30. Convergent Validity: JOBQTY - ACCQTY (Original Model)

been possible to drop these weak items, there was no strong theoretical reason to do so. The parallel measures on 'Em-

	LOADING	ITEM RELIABILITY	COMPOSITE RELIABILITY	AVERAGE VARIANCE EXTRACTED
'Employer's Production Message'				
PRODMSG			0.91	0.62
A18	0.78	0.60		
A19	0.76	0.58		
A21	0.87	0.75		
A22	0.83	0.69		
A25	0.72	0.52		
A27	0.75	0.57		
'Employer's Interaction Message'				
INTMSG			0.93	0.61
A16	0.73	0.53		
A17	0.76	0.57		
A20	0.78	0.60		
A23	0.77	0.60		
A24	0.81	0.66		
A26	0.81	0.66		
A28	0.81	0.66		
A29	0.77	0.60		
'Personal Importance of Production'				
PERSPROD			0.89	0.58
A3	0.73	0.54		
A4	0.69	0.48		
A6	0.81	0.65		
A7	0.80	0.64		
A10	0.77	0.59		
A12	0.74	0.55		
'Personal Importance of Interaction'				
PERSINT			0.93	0.61
A1	0.79	0.62		
A2	0.77	0.59		
A5	0.67	0.45		
A8	0.72	0.52		
A9	0.82	0.67		
A11	0.79	0.62		
A13	0.82	0.67		
A14	0.85	0.73		

Exhibit 31. Convergent Validity: PRODMSG - PERSINT (Original Model)

ployer's Production Message' (PRODMSG) and 'Personal Importance of Interaction' (INTMSG) did not show the same weakness. In fact, the composite reliabilities of PRODMSG and PERSPROD were very close, as were those of INTMSG and PERSINT. It was more appropriate to leave these scales intact and simply note the weakness of items A4 and A5.

Convergent Validity with Formative Indicators

Formative indicators are generally evaluated on the basis of their factor weights, rather than loadings. Loadings indicate the reliability of reflective indicators; weights indicate the relative contribution of a formative indicator to the empiri al definition of the construct. Thus, weights clarify the 'sense' of the construct as it is actually captured by the formative indicators. They also contribute to determining whether the research measured the construct as intended. Thi is an effective way to look at defined constructs which are actually indices.

Formative measures are also used when lack of confidence in theory argues against reflective indicators. In these cases, it seems most appropriate to examine loadings rather than weights for interpretation purposes, as one does in canonical correlation analysis (Thompson, 1984). One would eventually like to measure the construct reflectively, and

SURVEY QUESTION	QFREQ	QRECIP	COMPFAL
D6 Looks at amount of work	0.88		
D7 Gets printout of quantity	0.82		
D2 Recipient of individual data		0.91	
D4 Recipient of group data		0.81	
E4 Can't prove computer wrong			-0.26
E7 Make mistakes no human would			-0.03
E9 Make better decisions than humans			0.45
E19 Accurate and precise			0.26
E22 Assume computer answers always correct			0.16

Exhibit 32. Loadings- Initial Measurement Model: QFREQ, QRECIP, COMPFAL

so the evaluation of the current formative measures should parallel that of reflective indicators as much as possible.

Three constructs in this research used formative indicators in place of reflective measures, rather than as components of an index. These three constructs were: 'Frequency of Quantitative Measurement' (QFREQ); 'Recipient of Quantitative Measures' (QRECIP); and 'Computer Fallibility' (COMPFAL). Their roles in the measurement model were examined in terms of loadings. Exhibit 32 presents the initial loadings for these constructs. As the exhibit shows, the loadings indicate serious problems with the measures for 'Computer Fallibility' (COMPFAL).

'Computer Fallibility' (COMPFAL): First, E4 and E7 loaded negatively while the other three questions load positively. E4 and E7 were negatively worded, while E9, E19, and E22 were positively worded. This may have confused respondents. E7, for example, said "Computers make mistakes a human being would never make." Agreeing with this question would imply a sense that computers were more fallible than humans. However, question E9 said, "Computers make better decisions than people." Agreeing with this statement would suggest that computers were less fallible. In fact, it is likely that this mix of positive and negative connotations for each questions made it difficult for respondents to give consistent responses to the items.

Second, the remaining items did not load highly on the construct. This was also the case when E4 and E7 were removed. This suggests that the remaining items did not tap a unidimensional construct or were not reliable.

COMPFAL was defined as the perceived accuracy of computers. Its role in the model was to demonstrate the importance of computer credibility, determined by accuracy and appropriateness (COMPAPP), in acceptance of monitor measures.

	LOADING	ITEM RELIABILITY	COMPOSITE RELIABILITY	AVERAGE VARIANCE EXTRACTED
'Frequency of Quantitative Measurement'				
QFREQ			0.84	0.72
D6	0.88	0.77		
D7	0.82	0.67		
'Recipient of Quantitative Measures'				
QRECIP			0.85	0.74
D2	0.91	0.83		
D15	0.81	0.65		

Exhibit 33. Convergent Validity: QFREQ, QRECIP

Rather than drop COMPFAL altogether, the decision was made to use the single item best expressing the intended construct. Thus, only question 19 from Section E of the survey ("Computers are accurate and precise") remained in the model after this first review of the measures.

Exhibit 33 shows the item reliabilities and composite reliability, as well as the average variance extracted, for QFREQ and QRECIP. By definition, item reliabilities, composite reliability and average variance extracted for constructs measured by a summative or single indicator are equal to 1.00. This includes QTASK, QOBJ, COMPAPP, and the revised COMPFAL.

Discriminant Validity

Discriminant validity is the degree to which manifest variables differentiate between constructs. Cook and Campbell (1979) described this as "divergence between measures and manipulations of related but conceptually distinct 'things.'" The test for discriminant validity consists of examining the correlations between constructs and comparing them to the average variance extracted for each construct. The squared correlations between constructs (their shared variance) should be less than the average variance extracted by the measures of those constructs. That is, items should correlate more highly with the construct they measure than that construct correlates with other constructs in the model (Fornell and Larcker, 1981).

Exhibit 34 presents the data used to evaluate discriminant validity. The off-diagonal elements in Exhibit 34 indicate the squared correlations (or shared variance) between latent constructs. The diagonal elements are the average variance extracted for each construct. The two underlined figures in this table cause concern.

	QTASK	QFREQ	QRECIP	QOBJ	COMPFAL	COMPAPP
QTASK	1.00					
QFREQ	0.24	0.72				
QRECIP	0.20	0.22	0.74			
QOBJ	0.18	0.22	0.79	1.00		
COMPFAL	0.42	0.13	0.07	0.07	1.00	
COMPAPP	0.41	0.10	0.07	0.06	0.59	1.00
JOBQTY	0.00	0.00	0.00	0.01	0.00	0.05
RELQUAL	0.02	0.02	0.01	0.02	0.01	0.01
ACCQUAL	0.00	0.00	0.00	0.00	0.01	0.00
RELQTY	0.17	0.26	0.18	0.18	0.06	0.07
ACCQTY	0.00	0.02	0.01	0.02	0.00	0.02
PRODMSG	0.01	0.00	0.03	0.03	0.01	0.01
INTMSG	0.00	0.00	0.00	0.00	0.00	0.00
PERSPROD	0.00	0.00	0.00	0.00	0.00	0.00
PERSINT	0.00	0.00	0.00	0.00	0.00	0.00

	JOBQTY	RELQUAL	ACCQUAL	RELQTY	ACCQTY	PRODMSG
JOBQTY	0.60					
RELQUAL	0.01	0.55				
ACCQUAL	0.08	0.03	0.76			
RELQTY	0.02	0.05	0.00	0.67		
ACCQTY	0.10	0.01	0.58	0.03	0.70	
PRODMSG	0.03	0.00	0.06	0.02	0.12	0.62
INTMSG	0.07	0.02	0.23	0.00	0.19	0.52
PERSPROD	0.10	0.01	0.14	0.00	0.11	0.30
PERSINT	0.02	0.01	0.06	0.00	0.04	0.41

	INTMSG	PERSPROD	PERSINT
INTMSG	0.61		
PERSPROD	0.44	0.58	
PERSINT	0.45	0.58	0.61

(N.B. Diagonal elements = average variance extracted
Off-diagonal elements = shared variance between constructs)

Exhibit 34. Shared Variance Between and Within Latent Constructs

In the first case, the shared variance between 'Recipient of Quantitative Measures' (QRECIP) and 'Object of Quantitative Measures' (QOBJ) is extremely high (.79). It actually exceeds the average variance extracted for QRECIP (.74). This resulted from the way in which the manifest variables on these constructs were scaled. QOBJ was an arithmetic combination of the responses to questions D1 and D3, such that:

If D1=	and D3=	then QOBJ=
N or X	N or X	0
N or X	Y	1
Y	N or X	2
Y	Y	3

If D1 ('Company tracks individual performance') were 'N' or 'X,' there would have been no response to D2 ('Recipient of individual data'). Similarly, if D3 ('Company tracks group performance') were 'N' or 'X,' there would have been no response to D4 ('Recipient of group measures'). To keep non-quantitatively measured employees in the study, D2 and D4 were recoded. If D1 were 'N' or 'X,' D2 became '0'; if D3 were 'N' or 'X,' D4 became '0'. Thus, a low value for QOBJ would by definition result in a low value for QRECIP, while a high value for QOBJ might be accompanied by a low or a high value for QRECIP.

Discriminant validity is primarily a concern when examining proposed causal relationships. Poor discriminant validity reduces the ability to say whether two latent constructs are causes and effects of one another or are actually the same construct. In the case of QOBJ and QRECIP, no causal link has been hypothesized. The high correlation between these two constructs (r=.89), however, does suggest that one or the other could be dropped from the model without reducing its predictive power.

The effects of multicollinearity could also show up as instability in paths leading from these highly correlated constructs. As Asher (1983) explained,

> "This means that if we were to draw another sample from the same population and reestimate the [regression] equation, our new estimates might be substantially different - even though in both cases they had the desirable properties of regression estimates discussed previously."

Thus, one could not put a great deal of faith in the path coefficients per se. The results discussed in Section 6.1.2, therefore, must be considered in light of the multicollinearity identified here.

Problems could also arise from the high correlation between 'Personal Importance of Production' (PERSPROD) and 'Personal Importance of Interaction' (PERSINT). In this case, the average variance extracted for PERSPROD equals the shared variance between PERSPROD and PERSINT. Again, there is no causal relationship proposed between these two constructs, so the multicollinearity does not threaten causal inference directly.

These two personal importance constructs may be closely related because of (1) a methods effect, since all items were interspersed on the first two pages of the questionnaire, (2) an inability on the part of employees to distinguish between job factors in assessing their importance, or (3) the fact that attitudes toward production and interaction importance are actually closely related. Interview comments and observations made during the case study suggested that the third explanation is most likely. Employees seemed to take a holistic view of their work: if they thought one aspect of their job was important, they also thought others were. Interviews indicated that personal conflict between interaction and production goals arose precisely because employees thought both dimensions were important.

The discussion of convergent validity cited the weak loading of A5 on 'Personal Importance of Interaction' (PERSINT). This measure might not have belonged with the PERSINT construct and thus confounded discriminant validity. However, the loading of 0.68 suggested that removing it would not have a noticeable effect on discrimination. This was the case. The correlation between 'Personal Importance of Production' (PERSPROD) and PERSINT dropped only slightly when the item was temporarily removed and the average variance extracted did not improve enough to make a difference in the ability to discriminate between constructs.

This section examined the measurement model and described revisions made to JOBQTY and COMPFAL to improve it. While the majority of the measures were reliable and validity was reasonable, the possible threats to discriminant validity noted above must be kept in mind when analyzing the structural model.

6.1.2 The Structural Model

Chapter 5 described the two-sample approach used in this dissertation to test the causal model. The first sample consisted of the surveys with even identification numbers. Testing the research model with that sample produced the results shown in Exhibit 35. The exhibit indicates the estimated path coefficient for each hypothesis. This section briefly indicates the results related to each hypothesis contained in the model. Section 6.1.3 interprets those results.

Based on jackknifing with 30 subsamples, all but two of the path coefficients were significantly different from zero at alpha < 0.005 (one-tailed). The two exceptions were the coefficients associated with the paths from 'Computer Fallibility' (COMPFAL) and 'Computer Appropriateness' (COMPAPP) to 'Acceptance of Quantitative Measures' (ACCQTY) (hypotheses H9 and H10).

Results for Each Hypothesis

H1: The more extensive the quantitative measurement of performance, the greater the acceptance of quantitative performance measures.

The data produced a negative path from 'Tasks Quantitatively Measured' (QTASK) to 'Acceptance of Quantitative Measures' (ACCQTY). The more pervasive the monitoring, the less acceptable respondents considered the quantitative information. This result provides statistical evidence refuting the hypothesis and suggests a small, but noticeable, effect opposite to that proposed.

H2: The more extensive the quantitative measurement of performance, the more employees will believe employers rely on the quantitative data.

The path coefficent from QTASK to 'Reliance on Quantitative Measures' (RELQTY) was positive and statistically significant. The path coefficient of .16 indicates a relatively small effect.

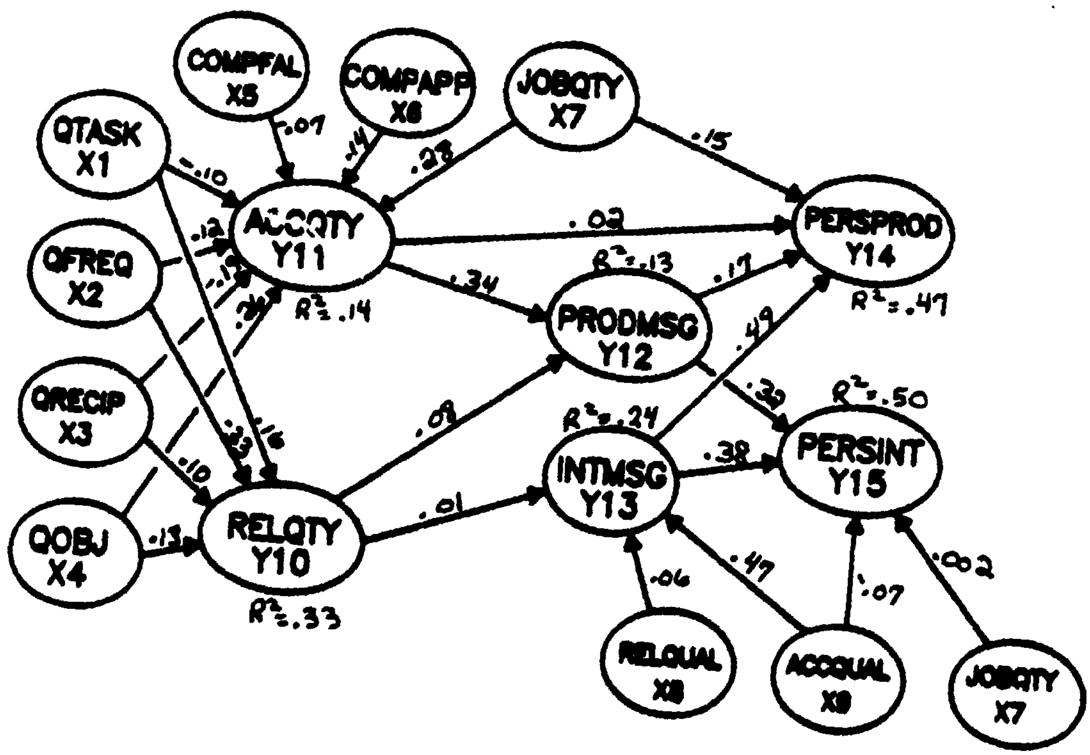


Exhibit 35. Path Coefficients and Significance in Original Model:
Based on First Sample of Surveys

H3: The shorter the measurement period, the greater the acceptance of quantitative performance measures.

The coefficient of the path from 'Frequency of Quantitative Measurement' (QFREQ) to 'Acceptance of Quantitative Measures' (ACCQTY) was .12, supporting the hypothesis that measuring performance more frequently increases acceptance of the information. The coefficient suggests that this is only a small effect.

H4: The shorter the measurement period, the more employees will believe employers rely on the quantitative data.

The coefficient from QFREQ to RELQTY was high compared to paths from the other dimensions of design. At .32, it supports the hypothesis that the frequency of measurement has a positive effect on the perceived reliance on quantitative data.

H5: The broader the audience for the evaluation data, the lower the acceptance of quantitative performance measures.

The moderate, negative path coefficient (-.19) from 'Recipient of Quantitative Measures' (QRECIP) to ACCQTY supports the hypothesis that increasing the audience for data decreases its acceptability to the employee. However, these results must be interpreted with caution since QRECIP and 'Object of Quantitative Measures' (QOBJ) were highly correlated (r=.89). Section 6.1.3 discusses this issue in greater detail.

H6: The broader the audience for the evaluation data, the more employees will believe employers rely on the quantitative data.

QRECIP appears to have a small (.10), but statistically significant, effect on RELQTY. This supports the hypothesis drawn from the literature.

H7: The more specific the object of the evaluation, the greater the acceptance of the quantitative measures.

The moderate, positive coefficient of .26 supports the hypothesis that linking performance measurement to the individual or group specifically responsible for the performance increases acceptance of the quantitative measures.

H8: The more specific the object of the evaluation, the more employees will believe employers rely on the quantitative data.

Once again, the path coefficient estimated from the data suggests some support for the hypothesis. While only a small effect (.13) and subject to cautions about multicollinearity, the model and the data agree that making the object of measurement more specific will make it seem that the employer relies on the measures more heavily.

H9: The more accurate monitored employees believe computers to be, the greater their acceptance of monitor data.

The path coefficient from 'Computer Fallibility' (COMPFAL) to ACCQTY was negative and significant at alpha < .025 (one-tailed). While the coefficient suggests that the relationship is opposite to that proposed, it is not conclusive (Asher, 1983). A negative path coefficient says that monitored employees who consider computers to be accurate and precise will be <u>less</u> accepting of the data they produce. This seems like a particularly unusual result. It suggests that there is an alternative explanation for the sign of this estimated path coefficient.

As an interaction term, COMPFAL is highly correlated (r=.65) with 'Tasks Quantitatively Measured' (QTASK). QTASK has a negative effect on ACCQTY. Thus, it is possible that the negative path from COMPFAL to ACCQTY is an artifact of this correlation. It may also be a function of poor measurement. Section 6.1.3 discusses these alternatives in greater detail.

H10: The more appropriate monitored employees believe computer measurement to be, the greater their acceptance of monitor data.

The analysis showed that 'Computer Appropriateness' ('COMPAPP') had a small effect (.14) on the acceptance of monitor data. The positive coefficient indicates that increasing the perceived appropriateness of computer measures among monitored employees increases acceptance of monitor data.

Despite agreeing with the proposed direction of the relationship between COMPAPP and ACCQTY, the path coefficient was not statistically significant at alpha < .05 (one-tailed test). However, this result should be considered inconclusive because of COMPAPP's correlation with the problematic COMPFAL (r=.77).

Direct Effects

	QTASK	QFREQ	QRECIP	QOBJ	COMP-FAL	COMP-APP	JOB-QTY	REL-QUAL	ACC-QUAL	REL-QTY	ACC-QTY	PROD-MSG	INT-MSG
RELQTY	16	33	10	13	0	0	0	0	0	0	0	0	0
ACCQTY	-10	12	-19	26	-7	14	28	0	0	0	0	0	0
PRODMSG	0	0	0	0	0	0	0	0	0	8	34	0	0
INTMSG	0	0	0	0	0	0	0	6	47	1	0	0	0
PERSPROD	0	0	0	0	0	0	15	0	0	0	2	17	49
PERSINT	0	0	0	0	0	0	0	0	-7	0	0	32	48

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Indirect Effects

	QTASK	QFREQ	QRECIP	QOBJ	COMP-FAL	COMP-APP	JOB-QTY	REL-QUAL	ACC-QUAL	REL-QTY	ACC-QTY	PROD-MSG	INT-MSG
RELQTY	0	0	0	0	0	0	0	0	0	0	0	0	0
ACCQTY	0	0	0	0	0	0	0	0	0	0	0	0	0
PRODMSG	-2	7	-6	10	-2	5	9	0	0	0	0	0	0
INTMSG	0	0	0	0	0	0	0	0	0	0	0	0	0
PERSPROD	0	2	-1	2	-1	1	2	3	23	2	5	0	0
PERSINT	0	2	-2	3	-1	1	3	3	23	3	11	0	0

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Total Effects

	QTASK	QFREQ	QRECIP	QOBJ	COMP-FAL	COMP-APP	JOB-QTY	REL-QUAL	ACC-QUAL	REL-QTY	ACC-QTY	PROD-MSG	INT-MSG
RELQTY	16	33	10	13	0	0	0	0	0	0	0	0	0
ACCQTY	-10	12	-19	26	-7	14	28	0	0	0	0	0	0
PRODMSG	-2	7	-6	10	-2	5	9	0	0	8	34	0	0
INTMSG	0	0	0	0	0	0	0	6	47	1	0	0	0
PERSPROD	0	2	-1	2	-1	1	17	3	23	2	7	17	49
PERSINT	0	2	-2	3	-1	1	3	3	16	3	11	32	48

Exhibit 36. Effects of Latent Constructs - Original Model:
Based on Even-Numbered Surveys

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H11: Employees who perceive their jobs to be quantitative or routine in nature will demonstrate greater acceptance of quantitative measures than will those who do not.

The positive path coefficient of .28 supports the hypothesis as modeled. Furthermore, 'Quantitative Nature of Work' (JOBQTY) had the largest direct effect of any construct on 'Acceptance of Quantitative Measures' (ACCQTY) (see Exhibit 36). This shows that a key factor in the acceptance of quantitative measures is the perceived 'fit' between the job and the measures. That is, the more quantitative the employee believes the job to be, the more acceptable quantitative measurement becomes.

H12: Greater acceptance of quantitative measures will result in stronger personal production importance.

The data do not support this hypothesis. Despite a statistically significant result, the direct effect of ACCQTY (.02) on 'Personal Importance of Production' (PERSPROD) is too small to be considered meaningful.

H13: Greater acceptance of quantitative measures will result in a stronger perceived production message.

'Acceptance of Quantitative Measures' (ACCQTY) has a direct effect of .34 on the 'Employer's Production Message' (PRODMSG). This supports the assertion that credible measures are a critical element in determining perceptions of the employer's message.

H14: Greater perceived reliance on quantitative measures will result in a stronger perceived production message.

The data indicated only weak effects (.08) of 'Reliance on Quantitative Measures' (RELQTY) on 'Employer Production Message' (PRODMSG). The data support the hypothesis, but demonstrate that mere reliance on quantitative measures has little <u>direct</u> effect on the perception that production is important to the employer.

H15: Greater perceived reliance on quantitative measures will result in a weaker perceived interaction message.

The case study indicated that employees often interpreted reliance on quantitative systems as evidence that interaction wasn't important. They said, "it can't be very important if they don't count it." Control system literature (Lawler, 1976; Lawler and Rhode, 1976) also argued that relying on systems which failed to measure aspects of the job would divert attention from the unmeasured elements. The survey data, however, did not support these assertions. While the path coefficient was statistically significant, it was too small (.01) for 'Reliance on Quantitative Measures' (RELQTY) to be considered a factor contributing to 'Employer's Interaction Message' (INTMSG).

H16: The perception that a job is quantitative or routine in nature will result in stronger personal production importance.

The path coefficient of .15 indicates statistically significant support for this hypothesis. In addition to the direct effect of 'Quantitative Nature of Work' (JOBQTY) on 'Personal Importance of Production' (PERSPROD), the construct has a slight indirect effect on PERSPROD via its indirect effect on 'Employer's Production Message' (PRODMSG).

H17: Greater perceived reliance on qualitative measures will result in a stronger perceived interaction message.

As discussed in hypothesis H14 above, the literature suggested that relying on certain measures would increase the perceived importance of a job dimension. Interaction evaluation depends on qualitative measures. Relying on those measures were thought to increase the 'Employer's Interaction Message' (INTMSG).

The test demonstrated results similar to those of RELQTY on PRODMSG. While statistically significant, the direct effect of 'Reliance on Qualitative Measures' (RELQUAL) on INTMSG was small.

H18: Greater acceptance of qualitative measures will result in a stronger perceived interaction message.

This hypothesis parallels hypothesis H13. Here again, the test demonstrated strong support for the assertion that acceptance of measures plays an important role in the perceptions of factors important to the employer. In this case, the data showed that increasing the 'Acceptance of Qualitative Measures' (ACCQUAL) would increase the perceived importance of interaction to the employer more than would either 'Reliance on Qualitative Measures' (RELQUAL) or 'Reliance on Quantitative Measures' (RELQTY).

H19: Greater acceptance of qualitative measures will result in stronger personal interaction importance.

The negative path coefficient suggests that 'Acceptance of Qualitative Measures' (ACCQUAL) actually has a contradictory effect on 'Personal Importance of Interaction' (PERSINT). In other words, it suggests that increasing acceptance of qualitative measures would make interaction less important to the employee. However, the coefficient is small enough (-.07) to suggest that this may not be a meaningful result.

H20: The perception that a job is quantitative or routine in nature will result in weaker personal interaction importance.

This coefficient (.002) is another example of a statistically significant, but meaningless, path. The effect of 'Quantitative Nature of Work' (JOBQTY) on 'Personal Importance of Interaction' (PERSINT) is entirely indirect and results from its effect on 'Acceptance of Quantitative Measures' (ACCQTY). It may also affect PERSINT indirectly by contributing to 'Acceptance of Qualitative Measures' (ACCQUAL) or 'Reliance on Qualitative Measures' (RELQUAL), but this dissertation did not study those relationships.

Within the context of this model, therefore, the direct effect is neglible.

H21: A stronger perceived production message will result in stronger personal production importance.

The results supported this hypothesis. The path coefficient from 'Employer's Production Message' (PRODMSG) to 'Personal Importance of Production' (PERSPROD) was .17.

'Employer's Production Message' (PRODMSG) and 'Employer's Interaction Message' (INTMSG) were highly correlated (r=.72), and the path coefficients from these two constructs could be very unstable. Thus, the path coefficient of .17 should not be considered an indicator of the absolute importance of PRODMSG in isolation. Instead, it should be recognized as a meaningful indicator of a positive relationship between PRODMSG and PERSPROD. The model supports the assertion that increasing the perceived importance of production to the employer will, to some degree, increase its importance to the employee as well.

H22: A stronger perceived interaction message will result in a stronger personal interaction importance.

As hypothesized, increasing 'Employer's Interaction Message' (INTMSG) resulted in greater 'Personal Importance of Interaction' (PERSINT). The path coefficient is large, relative to other paths leading to PERSINT. This suggests that INTMSG is an important factor in how employees perceive the importance of interaction.

H23: A stronger perceived production message will result in weaker personal interaction importance.

The test results decisively refute this hypothesis. The literature and the case study provided anecdotal evidence that monitored employees downplayed quality in the face of production-oriented employers. Despite such evidence, the national survey results demonstrated precisely the opposite.

H24: A stronger perceived interaction message will result in a weaker personal production importance.

The strong, positive path coefficient (.32) also refutes this hypothesis. PRODMSG emerges as a significant <u>positive</u> influence on PERSINT.

6.1.3 Discussion

Paths in a complex causal model cannot be effectively analyzed in isolation from one another for two major reasons. First, the constructs take meaning from the entire network of the inner and outer relationships. All measurement variables and latent constructs in overlapping causal chains are interconnected. These interconnected relationships produce interdependent meanings. Second, when exogenous constructs are highly correlated, the magnitude of the path coefficients from those constructs may be distorted by multicollinearity. In recognition of these factors, this section is organized to discuss selected results in terms of the endogenous constructs and the paths leading to them. (Exhibit 37 reproduces the estimates from the first sample test for reference.)

'Reliance on Quantitative Measures' (RELQTY): Each of the four design dimensions (task, frequency, recipient, and object showed a significant, positive effect on 'Reliance on Quantitative Measures' (RELQTY). Of these design dimensions, 'Frequency of Quantitative Measures' has the largest effect.

These results support the assertion of this research that choices made in designing a CPMCS affect the employee's per-

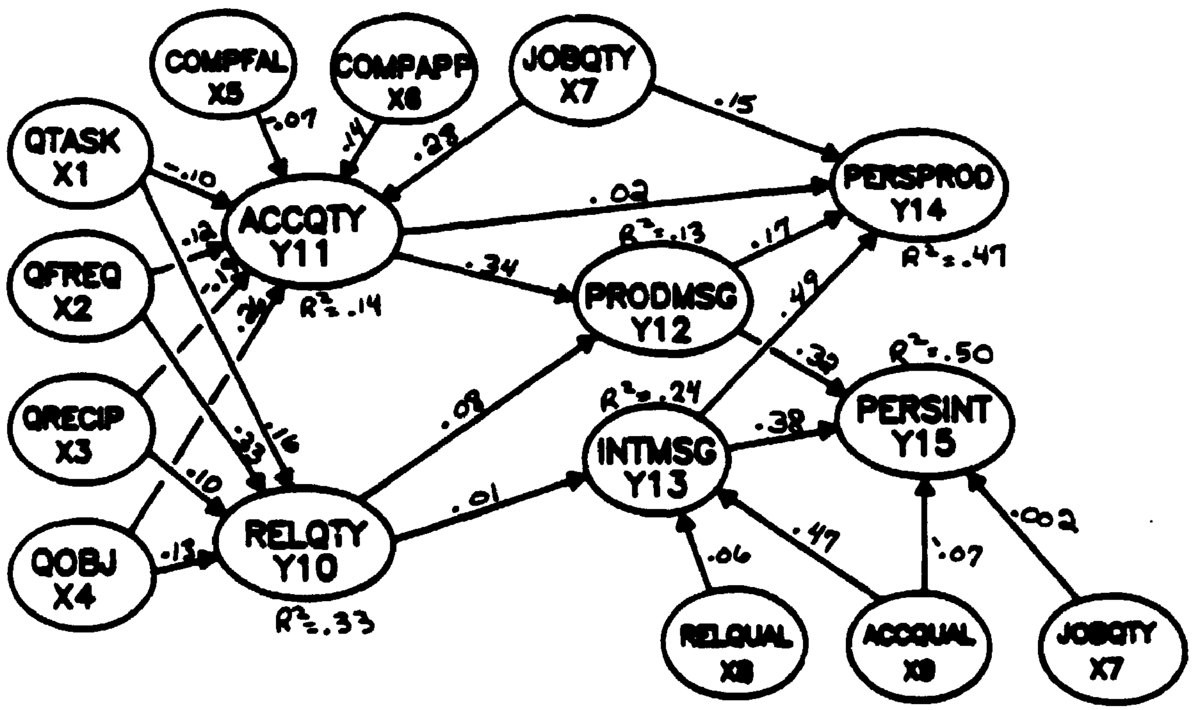

Exhibit 37. Path Coefficients and Significance in Original Model: Based on First Sample of Surveys

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ception of management reliance on quantitative measures. Particularly, the more frequently data are collected, the more importance employees will attach to the data.

'Acceptance of Quantitative Measures' (ACCQTY): The research model proposed seven causal paths contributing to 'Acceptance of Quantitative Measures' (ACCQTY). Results demonstrated that changing system design dimensions alters measurement acceptability. Increasing frequency increases acceptance. More directly attributing performance to its source seems to have a positive effect on acceptance, while making results more public seems to reduce it.

The path from 'Tasks Quantitatively Measured' (QTASK) to 'Acceptance of Quantitative Measures' (ACCQTY) contradicts conclusions drawn from the literature. While studies (Irving et al., 1986; Walton and Vittori, 1983) suggested that the process of monitoring led to dissatisfaction with the control system, they concluded that incomplete measurement or inappropriate standards caused the problems. Eisenman (1986), however, said,

> "...a key factor in the development of the current concerns of VDT workers may well be that their threshold for optimum supervisory structuring has been exceeded."

These test results may reflect such an effect.

The most common use of CPMCS among respondents was to count completed transactions (Exhibit 38). Increasing pervasiveness extends monitoring to activities with less direct quantitative content, such as task assignment and work process. This could decrease the perceived appropriateness of quantitative measurement, reducing acceptance.

Furthermore, human supervisors can recognize mitigating factors when measuring. CPMCS are less able to do so. The case study revealed this as the 'yeah but' syndrome discussed in Chapter 3. The monitor's inability to incorporate mitigating factors may also reduce perceived accuracy and completeness of information, as pervasiveness increases.

The results demonstrated that design dimensions play a more important role by influencing 'Acceptance of Quantitative Measures' (ACCQTY). Their indirect effect on perceived employer messages via ACCQTY was actually stronger than the indirect effect via 'Reliance on Quantitative Measures' (RELQTY). For example, increasing the audience for quanti-

	Percent of Respondents Subject to Method
Keystrokes counted by computer	15.8%
Completed transactions counted by computer	34.8%
Mistakes counted by computer	12.4%
Idle time recorded by computer	19.4%
Time to complete transaction counted by computer	16.8%
The way work is done checked by computer	5.3%
Work directed to the workstation by	10.1%

Exhibit 38. Methods of Quantitative Evaluation

tative data (QRECIP) increases RELQTY and has a positive indirect effect on 'Employer's Production Message' (PRODMSG). However, increasing QRECIP has a larger negative effect on ACCQTY. The net result is a negative indirect effect: increasing QRECIP ultimately decreases PRODMSG slightly.

Measurement problems rendered the effects of 'Computer Fallibility' (COMPFAL) and 'Computer Appropriateness' (COMPAPP) inconclusive. This was disappointing, since the role of computer beliefs is a controversial issue (Kammire, 1984; Morrison, 1983; Whisler, 1960; Zuboff, 1982). Model revision reduced the problems somewhat, but only at the cost of the fallibility construct (discussed below). The longer term solution must rest on better measures of these constructs.

'Employer's Production Message' (PRODMSG): The proposed paths from 'Acceptance of Quantitative Measures' (ACCQTY) to 'Employer's Production Message' (PRODMSG) and from 'Reliance on Quantitative Measures' (RELQTY) to PRODMSG were both significant. These paths reflected feedback models (Ilgen et al., 1979; Smith et al., 1986; Taylor et al., 1984) which assert that message interpretation depends on the acceptance of the message and its perceived importance to the employer. Increasing the acceptance of the quantitative data increases the perceived importance of production to the employer. Increasing perceived reliance on the measures has a similar, but weak, effect.

These results suggest that employees draw fewer inferences from measures they consider unacceptable. In other words, if the data collected seem inappropriate, incomplete or inaccurate, they will be ineffective in demonstrating management concern for production.

'Employer's Interaction Message' (INTMSG): The paths from 'Acceptance of Qualitative Measures' (ACCQUAL) to 'Employer's Interaction Message' (INTMSG) and from 'Reliance on Qualitative Measures' (RELQUAL) to 'Employer's Interaction Message' (INTMSG) were both significant.

These results demonstrate that reliance and acceptance play a role in developing a perception of interaction importance to the employer. They show that the acceptance of the qualitative information is far more important than the extent to which the employer seems to rely on it. The stronger change in message will result from changing the acceptance of measures, rather than from relying on them more heavily.

The literature (Cammann and Nadler, 1977; Irving et al., 1987; Kerr, 1975) suggested that relying heavily on quantitative information would reduce the perceived importance of qualitative performance. The tests in this research produced a positive coefficient for the path from 'Reliance on Quantitative Measures' (RELQTY) to 'Employer's Interaction Message' (INTMSG). However, although statistically significant, it is so small (.01) as to be virtually meaningless.

This small coefficient is surprising, given the evidence in the literature to support a significant effect. The discrepancy between the literature and the results may reflect differences in the operationalizing the construct. This model examined absolute (rather than relative) importance, while the literature tends not to distinguish between the two.

'Personal Importance of Production' (PERSPROD): 'Quantitative Nature of Work' (JOBQTY) and 'Employer's Production Message' (PRODMSG) both have significant effects on the personal importance of production.

The path coefficient from 'Acceptance of Quantitative Measures' (ACCQTY) to 'Personal Importance of Production' (PERSPROD) was also small. The impact of ACCQTY on PERSPROD is primarily indirect. Using more acceptable quantitative measures produces a stronger employer production message. This production message then strongly influences personal production attitudes.

'Personal Importance of Interaction' (PERSINT): The perceived employer message is again the most influential of the constructs contributing to personal importance of the job dimension.

The path from 'Quantitative Nature of Work' (JOBQTY) to 'Personal Importance of Interaction' (PERSINT) is virtually nonexistent. Instead, the major contribution from JOBQTY arises from its indirect effect via other constructs.

'Acceptance of Qualitative Measures' (ACCQUAL) has a large indirect effect on the 'Personal Importance of Interaction' (PERSINT). This arises from the role of the 'Employer's Interaction Message' (INTMSG) in contributing to PERSINT. In fact, Exhibit 36 showed that the indirect effect of ACCQUAL on PERSINT was over three times as large as its direct effect. The case study and the literature suggested a direct link between these two constructs. The survey demonstrates that the relationship exists, but is more appropriately modeled as an indirect one.

The case study survey pretest suggested that there was a positive, rather than a negative, correlation between PRODMSG and PERSINT. At that point, the evidence was not strong enough to justify contradicting the literature. The national survey's large sample, however, provided additional evidence that a positive relationship may be correct.

The literature (Cammann and Nadler, 1977; Lawler, 1976; Walton and Vittori, 1983) asserted that a strong employer performance message would decrease the personal importance of interaction. Their work also led to the conclusion that a strong interaction message would decrease the personal importance of production. These relationships form the crux of arguments that monitoring is counterproductive in the service sector.

The two employer message and the two employee attitude constructs were positively correlated to one another. The correlation (r=.72) between 'Employer's Production Message' (PRODMSG) and 'Employer's Interaction Message' (INTMSG) may show that employees believe employers are consistent in the importance attached to all aspects of performance. Similarly, the correlation (r=.77) between 'Personal Importance of Production' (PERSPROD) and 'Personal Importance of Interaction' (PERSINT) may indicate that employees hold consistent personal beliefs about the absolute importance of the major performance dimensions. Thus, the results demonstrate <u>increased</u> importance of complementary performance dimensions accompanying stronger employer messages. They indicate significant differences in the predictions one would make about the impact of monitor use.

The correlation between PRODMSG and INTMSG could reflect a methods effect from the survey design. These items were interspersed in survey Section A. Respondents might have simply circled the same number for each item without much thought. However, the scales do discriminate between 'Employer's Production Message' (PRODMSG) and 'Employer's Interaction Message' (INTMSG). The case study interviews also gave evidence that employees believed their employers were consistent in the absolute importance of all job factors. Thus, it seems unlikely that a methods effect was largely responsible for these results.

Absolute versus Relative Importance: The national survey did include questions about the relative importance of production and interaction. Questions 15 and 30 of Section A in the national survey asked, "What is the most important part of your job?" as seen by the employer and by the employee. Analyzing the responses to these questions helped to clarify a number of issues raised in this section (see Exhibit 39).

The responses revealed that greater monitoring is associated with 'production' as the most important dimension to the em-

MOST IMPORTANT ASPECT TO EMPLOYER

Number of Tasks Monitored
(C8 to C14 = 'C')

	0	1	2	3	4	5	6/7	Total
Production	349 49.4%	105 45.7%	97 59.5%	57 53.3%	27 55.1%	35 60.3%	24 75.0%	694 51.6%
Interaction	358 50.6%	125 54.3%	66 40.5%	50 46.7%	22 44.9%	23 39.7%	8 25.0%	652 48.4%

Chi-Square	D.F.	Significance
17.90720	6	0.0065

MOST IMPORTANT ASPECT TO EMPLOYEE

Number of Tasks Monitored
(C8 to C14 = 'C')

	0	1	2	3	4	5	6/7	Total
Production	261 37.6%	79 35.0%	59 36.0%	38 36.5%	12 24.0%	17 29.3%	6 19.4%	472 35.6%
Interaction	433 62.4%	147 65.0%	105 64.0%	50 63.5%	22 76.0%	23 70.7%	8 80.6%	855 64.4%

Chi-Square	D.F.	Significance
18.81827	6	0.1841

Exhibit 39. Production Versus Interaction Importance: Degree of Monitoring Based on All Surveys

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ployer. But it is also associated with 'interaction' as the most important dimension to the employee. This provides extra support for an argument that the paths from employer messages to personal importance constructs are actually positive, rather than reflecting a methods effect.

At the same time, these results suggest that the employee's personal view of relative importance is not strongly influenced by the use of monitoring. Thus, actual production and customer service may depend on the relative influence of the employer's criteria versus those of the employee in resolving conflicting demands.

This test using the first sample confirmed the majority of hypotheses in the the original research model, although many of the path coefficients were small.

There were three important exceptions: (1) the path from 'Tasks Quantitatively Measured' (QTASK) to 'Acceptance of Quantitative Measures' (ACCQTY); (2) the path from 'Employer's Interaction Message' (INTMSG) to 'Personal Importance of Production' (PERSPROD); and (3) the path from 'Employer's Production Message' (PRODMSG) to 'Personal Importance of Interaction' (PERSINT). These exceptions strongly contradicted expectations based on the literature. They also suggested that the hypothesized theoretical relationships should be reconsidered before testing the holdout sample.

Finally, they highlighted areas for future research, discussed in Chapter 8.

6.2 BUILDING THEORY

Zaltman et al. (1982) described research as an iterative process of observing, theorizing and testing. This dissertation proposed a causal model of a phenomenon which had not been widely studied. The model relied on theory about other control systems and used new scales to measure constructs. Some measures failed to capture information reliably, making interpretation difficult in those cases. Research improving these measures would contribute to more conclusive results.

The analysis also demonstrated areas where revisions would produce a more parsimonious model. This study is one of the first to test a causal model of CPMCS impact. It still contains a large element of theory exploration, in that it tests the applicability of theories from related fields.

It was not surprising to find that factors unique to CPMCS design and use made revisions necessary. The next step in the research, therefore, consisted of reviewing the theory and the data to revise the model. The revisions took two forms: (1) rethinking poorly measured constructs and (2) re-evaluating paths.

Poorly Measured Constructs

One should not alter a causal model strictly on the basis of data (Asher, 1983). A single test of any model can produce results which contradict a hypothesis. This does not mean that the theory underlying the model is at fault -- particularly when a clear problem with the measurement model is identified. Two such measurement problems emerged from the original model. These problems became clear only after data collection and initial scrutiny of results.

Object and Recipient (QOBJ/QRECIP): The survey did not reliably capture 'Object of Quantitative Measures' (QOBJ) separate from 'Recipient of Quantitative Measures' (QRECIP). The model had to be redefined to reflect the constructs being captured more accurately. There is no doubt that the approach most consistent with the theory is to keep these dimensions separate. Nothing dictates that they be integrated in making design decisions, and so it is more appropriate to treat them separately in research as well. However, the design of the survey made that difficult.

The original model included four hypotheses related to 'Recipient of Quantitative Measures' (QRECIP) and 'Object of Quantitative Measures' (QOBJ). They were:

H7: The broader the audience for the evaluation data, the lower the acceptance of quantitative performance measures.

H8: The broader the audience for the evaluation data, the more employees will believe employers rely on the quantitative data.

H9: The more individual the object of the evaluation, the greater the acceptance of the quantitative measures.

- and -

H10: The more pervasive the object of the evaluation, the more employees will believe employers rely on the quantitative data.

The data appeared to support these hypotheses. However, the correlation (r=.89) between QOBJ and QRECIP meant one could not interpret the results reliably. Dropping 'Recipient of Quantitative Measures' and 'Object of Quantitative Measures' entirely would remove the problems resulting from their multicollinearity. But it would also eliminate the information captured in the data collected for these two constructs.

One alternative when dealing with such highly correlated constructs is to merge them into one new construct (Asher, 1983). In this research, that new construct was 'Object and Recipient of Quantitative Measures' (QCOMB). It was formatively measured by questions 1 to 4 of survey section D. The more specific the target of measurement and the more public the results, the greater the value of QCOMB.

The literature (Lawler, 1976; Lawler and Rhode, 1979; Walton and Vittori, 1983) indicated that 'Recipient of Quantitative Measures' (QRECIP) and 'Object of Quantitative Measures' (QOBJ) would have opposite effects on 'Acceptance of Quantitative Measures' (ACCQTY). Therefore, the combination of the two would not have a predetermined effect. Instead, the combined effect would depend on the relative strength of QRECIP and QOBJ (which the original model failed to determine). As a result, the revised model did not propose a path from QCOMB to ACCQTY.

Both QRECIP and QOBJ were expected to increase 'Reliance on Quantitative Measures' (RELQTY) (Lawler, 1976). Therefore, the revised model included a positive path from QCOMB to RELQTY, represented by the hypothesis:

H7a: The more specific the object of measurement and the more public its audience, the more employees will believe employers rely on the quantitative data.

COMPFAL: Section 6.1.1 described problems with measures designed to capture 'Computer Fallibility' (COMPFAL). Even after reducing measurement to a single item, the negative path coefficient suggested that the research had not captured the concept of fallibility well.

The path from 'Computer Appropriateness' (COMPAPP) to 'Acceptance of Quantitative Measures' (ACCQTY) was not statistically significant. However, COMPFAL and COMPAPP were correlated at r=.77. The poorly measured COMPFAL could have contaminated the model and confounded the effect of constructs on ACCQTY. Due to these problems, the decision was made to drop COMPFAL completely. The effect of fallibility remains an area for further research.

Reevaluating Paths

PLS and jackknifing provided statistical evidence of relationships between pairs of constructs in the research model. However, one should distinguish between meaningful results and those which are simply statistically significant. Mere statistical significance does not say anything about the size or importance of an effect (Sawyer and Ball, 1981). One must examine both aspects of the paths to understand the degree to which they are meaningful.

With more than 650 surveys per sample, this research can detect very small, but statistically significant, effects. The path from 'Quantitative Nature of Work' (JOBQTY) to 'Personal Importance of Interaction' (PERSINT) demonstrates this point. The coefficient of 0.002 was statistically significant. Nonetheless, it added nothing to prediction or explanation of 'Personal Importance of Interaction.'

Similarly, the paths from 'Reliance on Quantitative Measures' (RELQTY) to 'Employer's Interaction Message' (INTMSG) and from 'Acceptance of Quantitative Measures' (ACCQTY) to 'Personal Importance of Production' (PERSPROD) were statistically significant. However, indirect effects captured virtually all of the contribution of RELQTY on INTMSG and of ACCQTY on PERSPROD. The two paths could be droppped without ill effect.

There is no specific threshold at which a path coefficient becomes meaningful. Many researchers use a coefficient of

0.05 as the threshold point (Pedhazur, 1982). Others suggest that the proportion of variance directly accounted for by the path can be crudely determined from the path coefficients and this figure used to determine meaningfulness. Asher (1983) argued that this approach is inappropriate in the face of multicollinearity:

> "The most useful statements to be made in interpreting coeffficents involve a comparison of the relative magnitudes of the coefficients within the same model..."

Pedhazur (1982) cautioned against arbitrarily dropping paths based simply on statistical significance of their coefficents. He made two specific points to support his position. First, causal models represent complex regression networks. One particular path may be statistically insignificant, yet produce changes in the significance of the remaining paths when dropped. Second, such modifications suffer from the disadvantage of being applied post hoc. They are data-driven, rather than theory-driven.

This research droppped only truly marginal paths. There were two reasons for this. First, the model represented a first test of the theory, subject to further improvement in measures of the exogenous constructs. Second, multicollinearity may have reduced path coefficients. The relative size of the effect is of interest in such cases.

Section 6.1.3 discussed unexpected signs on three paths: (1) from 'Tasks Quantitatively Measured' (QTASK) to 'Acceptance of Quantitative Measures' (ACCQTY); (2) from 'Employer's Production Message' (PRODMSG) to 'Personal Importance of Interaction' (PERSINT); and (3) from 'Employer's Interaction Message' (INTMSG) to 'Personal Importance of Production' (PERSPROD). Evidence provided by the case study and a fresh look at the theory supported these results. They made a strong case for hypotheses incorporating the sign of the paths indicated by the test of the first sample of surveys.

These revisions produced the model shown in Exhibit 40. To summarize the changes:

1) 'Computer Fallibility' (COMPFAL) and its path into 'Acceptance of Quantitative Measures' (ACCQTY) were dropped.

2) 'Recipient of Quantitative Measures' (QRECIP) and 'Object of Measures' (QOBJ) were combined 'Object and Recipient of Quantitative Measures' (QCOMB). A positive path into 'Reliance on Quantitative Measures' (RELQTY) was hypothesized.

3) The paths from 'Employer's Production Message' (PRODMSG) to 'Personal Importance of Interaction' (PERSINT) and from 'Employer's Interaction Message' (INTMSG) to 'Personal Im-

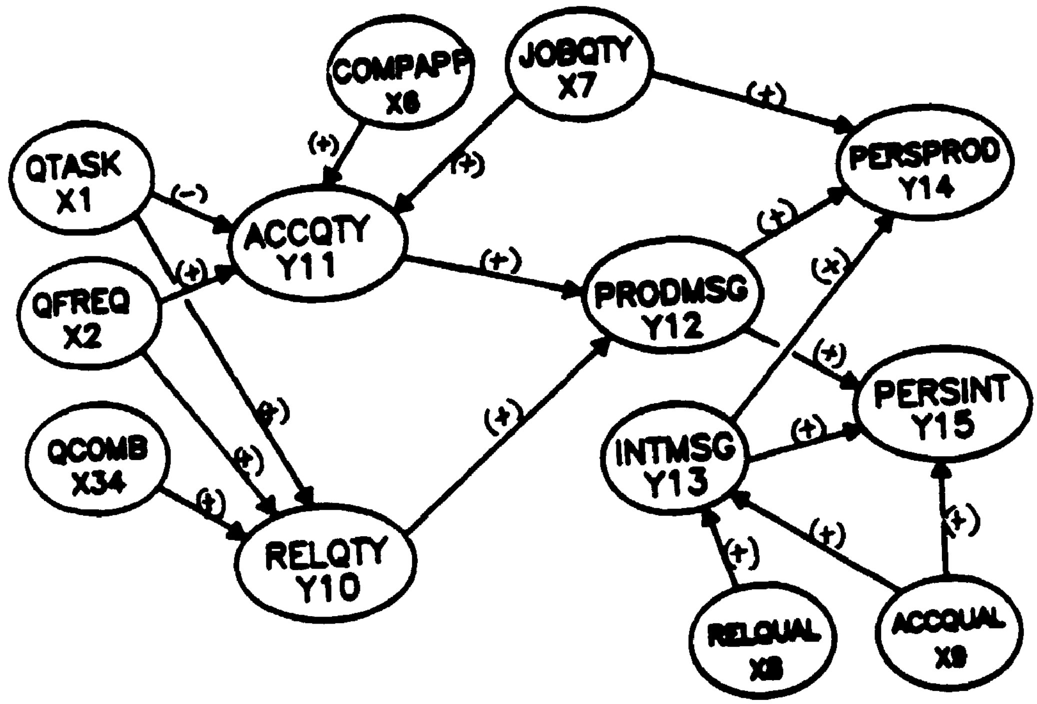

Exhibit 40. Revised Model

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portance of Production' (PERSPROD) were hypothesized to be positive, rather than negative.

4) The path from 'Tasks Quantitatively Measured' (QTASK) to 'Acceptance of Quantitative Measures' (ACCQTY) was hypothesized to be negative, rather than positive.

5) Three meaningless paths were removed. They were 'Reliance on Quantitative Measures' (RELQTY) to 'Employer's Interaction Message' (INTMSG); 'Quantitative Nature of Work' (JOBQTY) to 'Personal Importance of Interaction' (PERSINT); and 'Acceptance of Quantitative Measures' (ACCQTY) to 'Personal Importance of Production' (PERSPROD).

6.3 TESTING THE REVISED MODEL

The holdout sample provided the data to test the revised model shown in Exhibit 40. This section discusses the results of testing this revised model.

6.3.1 The Measurement Model

Dropping paths and constructs changes the measurement model as well as the structural model (Fornell, 1984). This section describes the differences between the original and revised measurement model.

Convergent Validity

Exhibit 41, Exhibit 42, and Exhibit 43 present the reliabilities and extracted variances of the revised model. While

	LOADING	ITEM RELIABILITY	COMPOSITE RELIABILITY	AVERAGE VARIANCE EXTRACTED
'Frequency of Quantitative Measurement'				
QFREQ			0.81	0.69
D6	0.93	0.87		
D7	0.71	0.50		
'Object and Recipient of Quantitative Measures'				
QCOMB			0.92	0.79
D2	0.90	0.80		
D4	0.80	0.44		
QOBJS	0.95	0.91		
'Quantitative Nature of Work'				
JOBQTY			0.80	0.58
F5	0.86	0.74		
F16	0.55	0.30		
F25	0.84	0.70		

Exhibit 41. Convergent Validity: QFREQ - JOBQTY (Revised Model)

the new model generally demonstrated good convergent validity and consistent item reliability, there were two areas of concern.

First, the loading of D10 ("Amount of direct supervision") on RELQUAL dropped to .01. 'Reliance on Qualitative Measures' (RELQUAL) was entirely captured by D15 ("Importance of supervisor's judgement"). This demonstrated the effect that eliminating paths had on empirical and conceptual definitions. RELQUAL and 'Reliance on Quantitative Measures' (RELQTY) were correlated at .23 in the original model, sug-

	LOADING	ITEM RELIABILITY	COMPOSITE RELIABILITY	AVERAGE VARIANCE EXTRACTED
'Reliance on Qualitative Measures'				
RELQUAL			0.50	0.50
D10	0.01	0.00		
D15	0.99	0.99		
'Acceptance of Qualitative Measures'				
ACCQUAL			0.96	0.78
B3	0.87	0.76		
B4	0.88	0.77		
B7	0.90	0.81		
B8	0.89	0.80		
B11	0.88	0.78		
B12	0.87	0.76		
'Reliance on Quantitative Measures'				
RELQTY			0.82	0.70
D12	0.80	0.64		
D14	0.87	0.75		
'Acceptance of Quantitative Measures'				
ACCQTY			0.93	0.70
B1	0.85	0.73		
B2	0.82	0.67		
B5	0.88	0.71		
B6	0.84	0.70		
B9	0.83	0.70		
B10	0.81	0.65		

Exhibit 42. Convergent Validity: RELQUAL - ACCQTY (Revised Model)

gesting that they shared a common dimension. Both were modeled as causes of 'Employer's Interaction Message' (INTMSG). Removing RELQTY as a cause of INTMSG subtly changed the definition of INTMSG and RELQUAL. Hence, the change in the loadings on RELQUAL.

	LOADING	ITEM RELIABILITY	COMPOSITE RELIABILITY	AVERAGE VARIANCE EXTRACTED
'Employer's Production Message'				
PRODMSG			0.90	0.61
A18	0.79	0.62		
A19	0.72	0.52		
A21	0.84	0.70		
A22	0.83	0.69		
A25	0.75	0.57		
A27	0.74	0.55		
'Employer's Interaction Message'				
INTMSG			0.92	0.58
A16	0.73	0.54		
A17	0.75	0.56		
A20	0.70	0.49		
A23	0.70	0.48		
A24	0.83	0.69		
A26	0.83	0.68		
A28	0.77	0.60		
A29	0.77	0.59		
'Personal Importance of Production'				
PERSPROD			0.88	0.56
A3	0.75	0.56		
A4	0.64	0.41		
A6	0.80	0.64		
A7	0.79	0.62		
A10	0.72	0.51		
A12	0.78	0.61		
'Personal Importance of Interaction'				
PERSINT			0.93	0.62
A1	0.82	0.67		
A2	0.82	0.66		
A5	0.69	0.47		
A8	0.73	0.53		
A9	0.82	0.66		
A11	0.77	0.60		
A13	0.84	0.71		
A14	0.83	0.69		

Exhibit 43. Convergent Validity: ACCQTY - PERSINT (Revised Model)

Second, the loading of F16 ("The amount of correct work I do is a good measure of my performance") on 'Quantitative Nature of Work' (JOBQTY) dropped to .55. Removing the paths from JOBQTY to 'Personal Importance of Interaction' (PERSINT) and from 'Acceptance of Quantitative Measures' (ACCQTY) to 'Personal Importance of Production' (PERSPROD) altered the empirical definition of JOBQTY slightly. This in turn reduced the internal consistency of its measures.

Discriminant Validity

The discriminant validity of the revised model improved slightly (see Exhibit 44). The shared variance between 'Personal Importance of Production' (PERSPROD) and 'Personal Importance of Interaction' (PERSINT) was high (.44), as was the shared variance of 'Employer's Production Message' (PRODMSG) and 'Employer's Interaction Message' (INTMSG) (.50). However, they were lower than in the original, causing a marginal increase in discriminant validity. Despite reductions in variance extracted for 'Quantitative Nature of Work' (JOBQTY) and 'Reliance on Quantitative Measures' (RELQTY), the model showed acceptable discriminant validity on all constructs.

	QTASK	QFREQ	QCOMB	COMPAPP	JOBQTY	RELQUAL
QTASK	1.00					
QFREQ	0.17	0.69				
QCOMB	0.21	0.15	0.79			
COMPAPP	0.45	0.08	0.08	1.00		
JOBQTY	0.12	0.00	0.00	0.06	0.58	
RELQUAL	0.12	0.01	0.00	0.00	0.01	0.50
ACCQUAL	0.01	0.00	0.00	0.00	0.06	0.01
RELQTY	0.14	0.21	0.17	0.08	0.02	0.00
ACCQTY	0.01	0.04	0.01	0.03	0.09	0.00
PRODMSG	0.00	0.01	0.01	0.01	0.00	0.00
INTMSG	0.01	0.00	0.00	0.01	0.01	0.02
PERSPROD	0.00	0.00	0.00	0.01	0.05	0.02
PERSINT	0.00	0.01	0.00	0.01	0.01	0.02

	ACCQUAL	RELQTY	ACCQTY	PRODMSG	INTMSG	PERSPROD
ACCQUAL	0.78					
RELQTY	0.01	0.70				
ACCQTY	0.52	0.06	0.70			
PRODMSG	0.03	0.02	0.07	0.61		
INTMSG	0.15	0.00	0.12	0.50	0.58	
PERSPROD	0.07	0.00	0.07	0.31	0.34	0.56
PERSINT	0.05	0.00	0.03	0.42	0.42	0.44

	PERSINT
PERSINT	0.62

(N.B. Diagonal elements = average variance extracted
Off-diagonal elements = shared variance between constructs)

Exhibit 44. Shared Variance Between and Within Latent Constructs

6.3.2 The Structural Model

This section highlights the differences between the original and revised structural model. The estimation and jackknifing procedures produced the results shown in Exhibit 45 and

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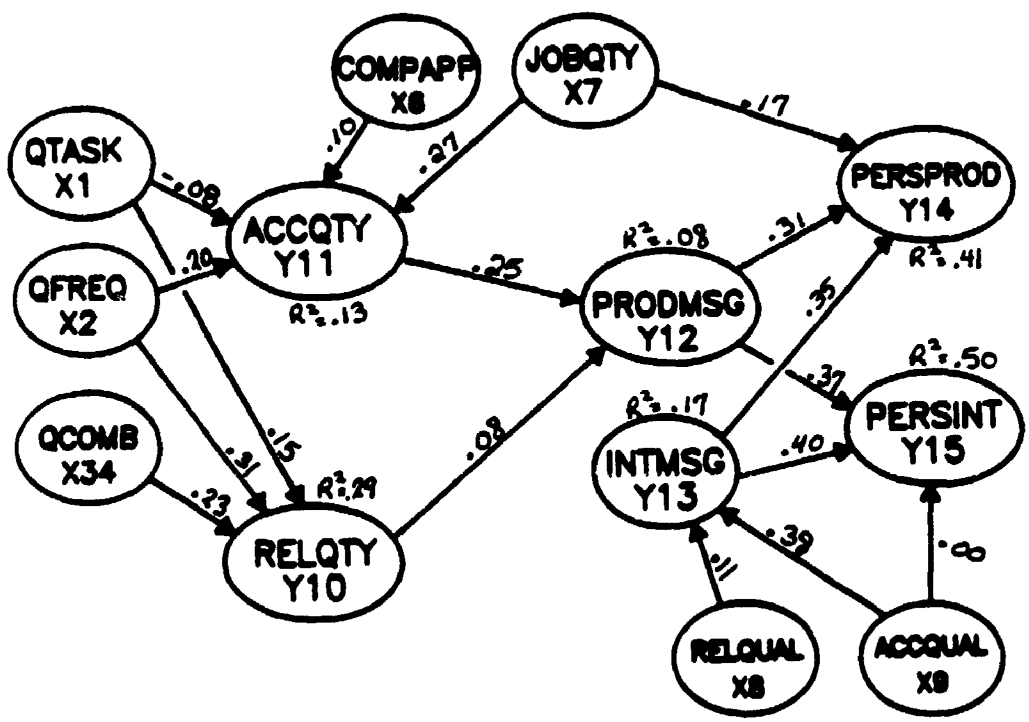

Exhibit 45. Path Coefficients and Significance in Revised Model: Based on Holdout Sample of Odd-Numbered Surveys

Exhibit 46. All path coefficients were statistically significant at alpha < 0.005 (one-tailed test).

H7a: The more specific the object of measurement and the more public its audience, the more employees will believe employers rely on the quantitative data.

This hypothesis was confirmed. The path coefficient (.23) indicated a moderate effect, slightly larger than that of 'Tasks Quantitatively Measured' (QTASKS).

H10: The more appropriate monitored employees believe computer measurement to be, the greater their acceptance of monitor data.

While the coefficient of this path dropped slightly, its standard error also dropped. As the result, the path coefficient was significant. This result suggests that 'Computer Appropriateness' (COMPAPP) does influence acceptance of quantitative measures. Repeated testing and multiple measures, as well as an enhanced model, could strengthen this finding. However, this research used a large sample, and the literature supported the role of credible evaluators. These factors make it reasonable to conclude that the choice between a manual and an automated measurement system can make a difference in acceptance.

These results demonstrate that it is not enough for employees to believe that (1) their jobs are quantitative in nature and (2) the measures themselves are accurate and complete. Consider two groups of employees, the first believing a computer is capable of measuring their performance and the second not. Even if the second group accepted manual quantitative measures, they may be less accepting of the monitored version of those measures than the first group.

While their path coefficients varied slightly in the revised model, the effects of 'Tasks Quantitatively Measured' (QTASK) and 'Frequency of Quantitative Measures'(QFREQ) were consistent in both models.

Finally, the path coefficient from 'Acceptance of Qualitative Measures' (ACCQUAL) to 'Personal Importance of Interaction' (PERSINT) was 0.00 in the revised model. The original model demonstrated a positive indirect effect of ACCQUAL on PERSINT, despite an apparent negative direct effect. The indirect effect persisted in the revised model, while the direct effect disappeared. This suggests that revisions to the model altered the definition of PERSINT and 'Employer's Interaction Message' (INTMSG) enough to eliminate the direct effect of 'Acceptance of Qualitative Measures' (ACCQUAL) on 'Personal Importance of Interaction' (PERSINT).

6.3.3 Discussion

The path coefficients from 'Employer's Production Message' (PRODMSG) and 'Employer's Interaction Message' (INTMSG) to 'Personal Importance of Production' (PERSPROD) and 'Personal Importance of Interaction' (PERSINT) differ considerably from the original model. This is largely an artifact of the correlation between PRODMSG and INTMSG. They remain highly significant and positive, however.

Path coefficients cannot be taken as absolute measures of the degree to which modifying one construct would change another. This is always the case when examining variables in a multiple regression. One cannot conclude that a one-unit change in 'Employer's Production Message' would, all things being equal, increase 'Personal Importance of Interaction' by .37 units. These constructs are perceptions, captured by many measures: a one-unit change or a .37-unit change has no meaning in such a construct. In addition, 'all things being equal' is impossible in situations of multicollinearity.

The relationship among such constructs guarantees that one construct cannot remain fixed while the other varies.

Direct Effects

	QTASK	QFREQ	QCOMB	COMP-APP	JOB-QTY	REL-QUAL	ACC-QUAL	REL-QTY	ACC-QTY	PROD-MSG	INT-MSG
RELQTY	15	31	23	0	0	0	0	0	0	0	0
ACCQTY	-8	20	0	10	27	0	0	0	0	0	0
PRODMSG	0	0	0	0	0	0	0	8	25	0	0
INTMSG	0	0	0	0	0	11	38	0	0	0	0
PERSPROD	0	0	0	0	17	0	0	0	0	31	35
PERSINT	0	0	0	0	0	0	0	0	-7	37	40

Indirect Effects

	QTASK	QFREQ	QCOMB	COMP-APP	JOB-QTY	REL-QUAL	ACC-QUAL	REL-QTY	ACC-QTY	PROD-MSG	INT-MSG
RELQTY	0	0	0	0	0	0	0	0	0	0	0
ACCQTY	0	0	0	0	0	0	0	0	0	0	0
PRODMSG	-1	8	2	3	7	0	0	0	0	0	0
INTMSG	0	0	0	0	0	0	0	0	0	0	0
PERSPROD	0	2	1	1	2	4	13	3	8	0	0
PERSINT	0	3	1	1	3	4	15	3	9	0	0

Total Effects

	QTASK	QFREQ	QCOMB	COMP-APP	JOB-QTY	REL-QUAL	ACC-QUAL	REL-QTY	ACC-QTY	PROD-MSG	INT-MSG
RELQTY	15	31	23	0	0	0	0	0	0	0	0
ACCQTY	-8	20	0	10	27	0	0	0	0	0	0
PRODMSG	-1	8	2	3	7	0	0	8	25	0	0
INTMSG	0	0	0	0	0	11	38	0	0	0	0
PERSPROD	0	2	1	1	19	4	13	3	8	31	35
PERSINT	0	3	1	1	3	4	15	3	9	37	40

Exhibit 46. Effects of Latent Constructs - Revised Model:
Based on Odd-Numbered Surveys

Nonetheless, both models demonstrated significant, positive paths from 'Employer's Production Message' (PRODMSG) and 'Employer's Interaction Message' (INTMSG) and high explained variance of 'Personal Importance of Production' (PERSPROD) and 'Personal Importance of Interaction' (PERSINT). This strongly suggests that the causal relationships represented exist, even if they cannot be converted into a metric predicting degree of change.

As expected, removing COMPFAL and combining QRECIP with QOBJ had little effect on the overall variance explained in 'Acceptance of Quantitative Measures' (ACCQTY). However, the variance explained in other constructs did drop. The paths from 'Object of Quantitative Measures' (QOBJ) and 'Recipient of Quantitative Measures' (QRECIP) were eliminated. As a result, the indirect effects of those constructs on 'Employer's Production Message' (PRODMSG) and 'Employer's Interaction Message' (INTMSG) also disappeared. This reduced variance explained. In addition, using few measures for each construct made the entire model more sensitive to the removal of exogenous constructs. Finally, instability in the measures of 'Reliance on Qualitative Measures' (RELQUAL) appears to have reduced variance explained in INTMSG and (via its indirect effects) in PERSPROD and PERSINT. More research is clearly needed to improve the stability of this model and to include other important explanatory constructs.

6.4 EXPLANATORY POWER

The research questions guiding this research focused on how monitor design dimensions affect personal importance of two job dimensions. This is an explanatory objective. The primary objective of PLS estimation procedures is prediction (Wold, 1985). It is not appropriate to evaluate a model estimated by such a technique in terms of its 'fit' with a comprehensive theory. However, while PLS does not have explanation as its principal objective, R-squared statistics indicating the portion of variance explained for each construct are of interest.

The conceptual model presented a complex network of constructs. The models tested in this research represented one segment of that network. The research design deliberately eliminated many constructs and paths, to look at the role of CPMCS in control system impact. These actions guaranteed that the models would not explain a large part of the variance in the endogenous constructs. This section evaluates the success with which the models tested do explain the effects of CPMCS on job perceptions.

As originally hypothesized, the model would do a poor job of explaining impact. The coefficient from 'Employer's Production Message' (PRODMSG) to 'Personal Importance of Inter-

Original Model
R-SQUARED OF LATENT CONSTRUCTS

RELQTY	ACCQTY	PRODMSG	INTMSG	PERSPROD	PERSINT
.33	.14	.13	.24	.47	.50

Revised Model
R-SQUARED OF LATENT CONSTRUCTS

RELQTY	ACCQTY	PRODMSG	INTMSG	PERSPROD	PERSINT
.29	.13	.08	.17	.41	.50

Exhibit 47. Variance Explained In Latent Constructs

action' (PERSINT) indicates that 'Employer's Production Message' influences 'Personal Importance of Interaction' positively. The original model proposed a negative effect. However, the proposed constructs themselves were important in explaining impact. Each version of the model explained 50% of the variance in 'Personal Importance of Interaction' (PERSINT) and at least 40% of of the variance in 'Personal Importance of Production' (PERSPROD).

Both models suggested that elements of the monitor (tasks, frequency and perceived appropriateness of computers) would affect acceptance of quantitative measures and perceived reliance on those measures. This is important, as acceptance and reliance do affect perceptions of employer messages. However, the model demonstrates that acceptance and reliance explain less than 25% of the variance in employer production and interaction messages.

The low explained variance in the mediating constructs is not necessarily bad. Perceived employer messages are complex constructs, as demonstrated by the work examining factors in feedback effects (Ilgen et al., 1979). There are undoubtedly a number of elements to be included in a model explaining them fully. This model simply suggests that monitor design dimensions are only one set of factors influencing those perceptions. Conclusive evidence depends on improving measures of 'Recipient of Quantitative Measures' (QRECIP) and 'Object of Quantitative Measures' (QOBJ), as well as filling in constructs which may mediate the effects of 'Acceptance of Quantitative Measures' (ACCQTY) and 'Reliance on Quantitative Measures' (RELQTY) on perceived messages.

The model tested with data from the first sample of surveys appeared to explain more of the variance in the two dependent constructs, as well as the mediating constructs. However, some of that explanation was misleading as a result of two poorly defined constructs and weak discriminant validity. The revised model explains slightly less variance, but its results can be interpreted more reliably.

Despite difficulties in using the first model to explain CPMCS impact, it was a better predictor of personal importance attitudes. Cook and Campbell (1979) emphasized the difference between 'prediction' and 'explanation' in terms of forecasting versus causal inference. Predictive models tolerate specification errors more readily than models meant to explain events. Misspecification and multicollinearity are secondary concerns in prediction:

> "Predictive validity is determined by, and only by, the degree of correspondence between the two measures involved. If the correlation is high, no other standards are necessary." (Nunnally, 1978)

An inability to distinguish between symptoms and causes does not create problems in prediction. Furthermore, dropping constructs may reduce the precision of the forecast, but does not undermine the predictive ability of the constructs which remain. Exhibit 48 summarizes the correlations among constructs in the two versions of the model. The higher correlations in the original version mean that it would do a better job of predicting levels for the intervening and dependent constructs than would the revised model.

Original Model

	QTASK	QFREQ	QRECIP	QOBJ	COMP-FAL	COMP-APP	JOB-QTY	REL-QUAL	ACC-QUAL	REL-QTY	ACC-QTY	PROD-MSG	INT-MSG	PERS-PROD
QFREQ	.49													
QRECIP	.45	.47												
QOBJ	.43	.48	.89											
COMFAL	.64	.36	.27	.25										
COMPAPP	.64	.36	.27	.26	.77									
JOBQTY	.08	.05	.05	.09	.08	.21								
RELQUAL	-.14	-.14	-.11	-.14	-.06	-.11	-.11							
ACCQUAL	.07	.02	-.05	.04	-.03	.05	.29	-.16						
RELQTY	-.41	-.51	-.43	-.43	-.24	-.27	-.14	.23	-.01					
ACCQTY	.05	.15	.09	.15	.05	.14	.31	-.11	.72	-.17				
PRODMSG	.10	.07	.16	.16	.12	.11	.16	-.08	.25	-.14	.35			
INTMSG	-.07	-.03	.01	.05	.00	.04	.26	-.14	.49	-.03	.44	.72		
PERSPROD	-.06	-.10	-.03	-.01	.04	.08	.31	-.08	.37	.03	.34	.55	.66	
PERSINT	-.03	-.07	.00	.01	.04	.04	.15	-.10	.24	.02	.21	.64	.67	.76

Revised Model

	QTASK	QFREQ	QCOMB	COMP-APP	JOB-QTY	REL-QUAL	ACC-QUAL	REL-QTY	ACC-QTY	PROD-MSG	INT-MSG	PERS-PROD
QFREQ	.41											
QCOMB	.46	.39										
COMPAPP	.67	.29	.29									
JOBQTY	.13	.04	.04	.23								
RELQUAL	.13	.10	.05	.06	-.07							
ACCQUAL	-.09	.03	-.06	.01	.25	-.11						
RELQTY	-.38	-.46	-.41	-.29	-.13	.02	-.10					
ACCQTY	.11	.21	.09	.17	.29	-.08	.72	-.25				
PRODMSG	.07	.08	.11	.09	.07	-.04	.19	.15	.27			
INTMSG	-.10	-.03	.00	.01	.10	-.15	.39	-.03	.34	.71		
PERSPROD	-.07	-.07	-.01	.00	.23	-.13	.28	.00	.26	.57	.58	
PERSINT	-.07	-.08	.02	-.03	.02	-.14	.22	.00	.16	.65	.66	.77

Exhibit 48. Correlations Among Latent Constructs

This chapter discussed the tests of the hypothesized causal models of CPMCS impact. Among the most important findings of the tests were:

1. The perceived importance of production to the employer has a positive effect on personal production _and_ interaction importance.

2. The perceived importance of interaction to the employer has a positive effect on personal interaction _and_ production importance.

3. Increasing the number of tasks monitored reduces the acceptability of the CPMCS measures.

4. The credibility of the computer as an appropriate measurement device has a positive effect on acceptance of CPMCS measures, among monitored employees.

5. While design dimensions have a stronger effect on the perceived reliance on quantitative measures, they also affect the acceptance of those measures. This acceptance, in turn, has the stronger effect on perceived production messages.

The first test of the research model revealed problems in the measurement model which made interpretation difficult. It also demonstrated insignificant and contradictory paths. The second stage of model testing revised the model in a 'theory building' (Zaltman _et al_., 1982) process. The third stage then used the 'holdout' sample of odd-numbered surveys to test the revised model. This stage produced the path coefficients and t-statistics for the revised model. Further research on factors affecting the intervening constructs would add to the explanation provided by the models tested here.

These results have implications for management and research, as well as suggesting other important issues which deserve attention. Chapter 7 summarizes the implications from the analysis in this dissertation and discusses the new questions it has raised for future study.

CHAPTER 7 - CONCLUSIONS AND FUTURE DIRECTIONS

Computerized performance monitoring and control systems (CPMCSs) have captured the attention of labor unions, managers, governments and journalists. Young (1980) claimed that, with the help of such systems, "the Office of the Future can reverse the skidding productivity of the non-manufacturing sector." Garson (1988) issued dire warnings that electronic monitoring is "transforming the Office of the Future into the Factory of the Past." In between, the issue of monitoring in the service sector has triggered all manner of controversy.

This chapter begins by summarizing the research conducted on the effects of CPMCS on job perceptions in the service sector. It then discusses the contributions of this work and its implications for business and academe. It concludes by examining unanswered questions which point to areas for future CPMCS research.

7.1 SUMMARY OF RESEARCH EXECUTION

This research explored the complex interaction of factors in monitor design, qualitative evaluation systems, and service sector jobs to explain CPMCS impact. Its objectives were to:

1) clarify the key elements contributing to CPMCS impact;

2) qualitatively examine CPMCS in a controlled environment;

3) develop and test a causal model of CPMCS impact on the importance of production and interaction; and

4) provide a large base of qualitative and quantitative data for future CPMCS research.

The research began with an intensive case study. This case revealed significant differences between monitored and unmonitored processors in the perceived importance of production and interaction to their employer. It also provided evidence of effects from even low-level monitoring.

In the second stage of this research, over 1400 workers in Canadian service firms responded to a national survey. The national survey used a judgement sample. The respondents represented a diverse group in terms of age, language, work experience, unionization, and types of monitoring experienced. They worked in 50 firms in 14 industries, and could be considered representative of Canadian service workers in jobs likely to be monitored.

The survey studied how the design and use of CPMCSs affect the importance service workers attach to production and interaction. 'Common wisdom' treats production and interaction importance as components in a zero-sum game. By examining them as independent elements, this research sought to demonstrate how CPMCSs affected their absolute and relative importance.

The survey responses provided data for two large-sample tests of causal models of CPMCS impact. The data strongly refuted the 'common wisdom' that monitoring necessarily reduces the perceived importance of interaction. They also revealed that monitor design is only one element explaining the differences in attitudes observed.

The findings of the case study and the national survey have significant implications for businesses and for researchers. The next sections examine these implications.

7.2 LESSONS FOR BUSINESS

Businesses considering or using CPMCSs must decide how to design the monitor and integrate it into a complete control system. This research contributed new information to assist in these decisions.

Firms which monitor often take their traditional quantitative control systems and automate the data collection. Such an approach does not guarantee smooth implementation or acceptable systems. This research suggested that **monitors are not simply automated versions of manual, quantitative control systems**. Employees seem to judge the computer and decide whether it is an appropriate device for measuring their performance. Those who believe the computer is the wrong tool may not accept monitor measures -- even if they had accepted manual versions of the same measures.

Companies strive to ensure that employees consider supervisors and managers to be credible evaluators. They must do the same for the credibility of their monitors. This will require an ongoing dialogue among system designers, managers, supervisors, and employees to ensure that the measures are considered accurate, complete, and appropriate.

A common argument against monitoring is that it undermines customer service. This study, however, demonstrated that **monitors do not automatically reduce the importance employees attach to interaction or customer service roles**. The more tasks a company monitors, the more the employees believe the company values production over interaction. But employees form their own attitudes about the absolute importance of various job dimensions. The nature of the work, the absolute importance of other job dimensions, and the employer's criteria all contribute to these attitudes.

Companies which see monitors as a way of motivating increased production may be disappointed. **Using monitors does not automatically increase the importance employees attach to production.** Instead, two features of quantitative measures actually influence the importance which employees attach to production. The first is the acceptance of the data. Making quantitative measures more acceptable makes employees think production is more important to their employer. This in turn increases the importance which the employee attaches to production.

The second feature influencing importance is reliance on the measures. However, merely relying more heavily on a monitor does not have a large effect. Both the case study and the national survey demonstrated that it is not enough to install a monitor and tell employees that it is a key element in the control system. Such a move may have a small effect, but using more acceptable measures has a much stronger effect.

One processor in the case study said,

> "Everything you do is recorded on the machine, so they don't need people to supervise you."

In fact, **monitors do not replace or improve upon human supervisors, except in a very narrow sense.** Using a monitor to count consistently and accurately can improve a control system. This only holds, however, when employees believe the computer can detect and measure the activity properly. There is still a major role for qualitative control mechanisms. Inappropriate measurement led to bureaucratic behavior in the case study. Teamwork broke down, difficult claims became scrapwork, and processors worried about meeting quotas before taking time to give extra service.

The fact that monitors measure performance objectively does not mean that they do so fairly. Fair measurement depends on information that is complete, accurate and appropriate. This does not necessarily mean quantitative information. The supervisor seems to be even more important in satisfying employees that their appraisal is fair when a monitor is involved than when it is not.

Supervisors in the case study played a critical role in determining whether monitoring would be stressful and whether feedback would promote or undermine intrinsic satisfaction. As a monitored processor explained,

> "Our unit head deals with problems immediately. Other units feel pressure about their count all the time. Our unit head keeps everybody relaxed and still keeps average productivity up."

One conclusion is that monitor data can be a valuable tool in the hands of a competent manager. They can be a dangerous weapon in the hands of an incompetent one.

More monitoring isn't necessarily better control. Employers must capture the important quantitative tasks. A shotgun approach to monitoring tasks does not improve the message. Employees react negatively to simply increasing the number of tasks measured, even if it is done in an attempt to get at all the aspects of the job. Employers should select the most appropriate and important tasks to monitor, rather than sifting through data which comes from an all-purpose monitor.

Finally, **management must look at a CPMCS as a component system.** The different dimensions of monitors do have different effects. Each dimension should be designed to meet the objectives of the particular system. There is no specific design requirement which says that the monitor must exhibit the same degree of pervasiveness on every dimension. "Off the shelf" monitor systems carry hidden costs in terms of dysfunctional effects, if such systems reduce acceptance of quantitative measures.

In summary, the case study and the survey demonstrated that monitoring is important as a component of an integrated control system. Monitor design has a direct effect on employer messages and employee attitudes. But the research also showed that good management and competent supervision lie at the heart of effective monitoring.

7.3 LESSONS FOR RESEARCHERS

This study produced information for researchers interested in various monitoring issues. It was the first work to develop and test a causal model of impact which used CPMCS as an independent variable. It also explored the role of the computer as a control device. Its results demonstrate areas where other researchers could benefit from this work.

CPMCS researchers should recognize that a monitor is not a unidimensional system. This work demonstrated different effects of task pervasiveness and frequency; it suggested that recipient and object would also have direct effects. The four dimensions used in this research (task, frequency, recipient, and object) proved to be a useful way of discriminating among monitor designs. Message content would be a valuable fifth dimension.

Schemes which categorize monitors only as 'low level,' 'moderate,' and 'high level' should specify the dimension on which the design is low, moderate or high. They should also differentiate the systems being studied along more than one dimension. Furthermore, Westin (1986) suggested multidimensional criteria for studies of privacy and stress issues in monitoring. The four dimensions of this work capture many of the criteria he proposed and could be applied to research dealing with other aspects of CPMCS.

This research also showed that **the data collection device seems to make a difference.** General control system models which do not differentiate between human and automated measurement may have limited applicability in monitoring environments. Within the limitations discussed below, this work demonstrated that the perceived appropriateness of the computer makes a difference in measure acceptance. It may also figure in other elements of monitoring impact.

This study did not adequately measure computer fallibility and other attitudes toward general computer characteristics.

These elements may or may not have important effects in acceptance, as well as other aspects of CPMCS impact. The scales for these items should be improved and the issues studied in greater detail to determine if they do explain variance in outcomes.

The boundaries of the model should be expanded to study the impact of monitors on other constructs. Job perceptions, for example, may differ on the basis of monitor designs. The same may be true for reliance and acceptance of qualitative measures. This study did not examine those relationships. Future work should do so before concluding that monitoring only affects reliance and acceptance of quantitative messages.

Prior work classified respondents or systems according to the researcher's analysis of the system in use. This work relied on employee perceptions of the system. It showed that **research can use employee perceptions of the control system as independent variables.** Opportunities remain to study how employees form beliefs about the features of their control systems. However, examining attitudes based on perceived system features produced consistent results. Employees who believed they were monitored in a certain way held attitudes similar to those who knew they were monitored that way.

This consistency of perceptions increases opportunities for large-sample research. It can take a long time and many interviews to classify CPMCSs in different companies. The more dimensions involved, the greater the effort required to accurately code the monitor. Furthermore, a company may use many systems, thereby increasing the difficulty. Using employee perceptions is a much quicker and less expensive method.

Finally, the case study showed that **case and survey research can be combined to explore and model a complex MIS issue.** Rapid changes in technology and system application will always exist. Case research is an effective way to explore new problems and study complex issues in their natural environment (Benbasat et al., 1987). It supports efforts to learn from practitioners and develop grounded theories (Zaltman et al., 1982). However, broad-based tests of those theories require extensive data from multiple sites. Case research does not provide such data easily. This research demonstrated how a case study clarified issues and constructs, identified possible relationships, and pinpointed shortcomings in research instruments. The model development and national survey then built upon the case findings to test a causal model applied to a variety of systems and companies.

7.4 LIMITATIONS

Discussion throughout this dissertation mentioned areas in which the research design or the instrument limited the interpretation of findings. This section discusses these limitations and ways they could be handled to improve future research.

Multicollinearity: A number of constructs in this model demonstrate multicollinearity. The problems with 'Recipient of Quantitative Measures' (QRECIP) and 'Object of Quantitative Measures' (QOBJ) in particular argue for further, deliberately controlled tests.

There is no theoretical reason for the multicollinearity. However, it may indicate that certain combinations of design options are more common in service firms or easier to acquire than others. If that is the case, it could be difficult to locate firms using each of the possible combinations of the four design dimensions.

A series of experiments could further test the model studied in this dissertation. Field, rather than lab, experiments seem appropriate for two reasons. First, monitors are only one part of a complex control system network. The tests in this dissertation and other recent research (Eisenman, 1986; Smith et al., 1986; Tamuz, 1987; Westin, 1986) demonstrate that other factors probably play a major role in monitor impact. Isolating the system in a lab environment could distort results. Second, employees work day in and day out under monitoring. Feedback models suggest that time and performance levels will act nonrecursively to alter impact of control system messages. Field research can capture such longitudinal impacts more effectively than lab experiments can.

Possible Misspecification: Other points of multicollinearity suggest that one or more causal factors are missing from the model. For example, the high correlations between 'Acceptance of Quantitative Measures ' (ACCQTY) and 'Acceptance of Qualitative Measures' (ACCQUAL), as well as between 'Employer's Production Message' (PRODMSG) and 'Employer's Interaction Message' (INTMSG), strongly suggest that a common causal factor is missing.

Refining the conceptual model to produce a testable research model meant dropping a number of constructs and causal paths. These included the content of the message and key elements of the qualitative control system. This was a deliberate decision to accommodate the primary focus of this research on CPMCS impact. Asher (1983) wrote,

> "One hopes that our theories will be sufficiently developed to enable us to identify the most important variables that merit investigation, thereby minimizing the consequences of our specification errors."

Unfortunately, this is not the case in monitor research. Control system work to date has largely bypassed the issue of how manual versus automated measurement systems affect intentions. Research directed at CPMCS per se has concentrated on issues of quality of work life, stress and privacy. This makes it difficult to determine <u>ex ante</u> the most important constructs. Instead, one must begin by studying manageable subsets of the complete model.

Identifying the missing factor(s) could improve the explanatory power of the model. For example, the case study demonstrated that interaction with the supervisor and his/her interpretation of monitor data could modify monitor effects. Feedback research (Ilgen <u>et al</u>., 1979; Smith <u>et al</u>., 1986; Lawler, 1976) has concluded that the content of the message is an important factor with other control systems. Extending the model to include message content as an exogeneous construct may improve the explanation of acceptance of quantitative measures and the perceived employer messages.

Analysis Techniques: Two technical characteristics of second-generation techniques also contributed to the results observed here. First, PLS cannot handle nonrecursive relationships. This eliminates paths such as from 'Personal Importance of Production' (PERSPROD) to 'Acceptance of Quantitative Measures' (ACCQTY) or from 'Personal Importance of Interaction' (PERSINT) to 'Acceptance of Quantitative Measures' (ACCQTY). Yet the feedback literature suggests that performance priorities do influence acceptance of control system data. Second, PLS does not accommodate moderating constructs naturally. They must be introduced as interaction terms. In the present study, that aggravated conditions of multicollinearity.

7.5 FUTURE RESEARCH

Any research of broad and unexplored issues is bound to expose more questions than it answers. Four specific areas of CPMCS impact appear promising as future topics of study:

1) the role of 'recipient' and 'object' in determining system impact;

2) the effective interaction of supervisor and monitor;

3) designing effective monitor messages; and

4) modeling the relative importance of job dimensions.

7.5.1 The Role of 'Recipient' and 'Object'

The initial research model included 'recipient' and 'object' as significant features of system design. It proposed that increasing the audience for monitor data would (1) make measures less acceptable, and (2) make it seem that the employer relied on those measures more heavily. The model also proposed that linking performance to the responsible party would make data more acceptable and make it seem that reliance was greater.

The initial results suggested that these hypotheses were correct. However, the design of survey responses produced high correlations between the two dimensions. This multicollinearity prevented the results from being generally interpretable. Attempts to refine the model to capitalize on some of the data gathered were equally ineffective.

Task and frequency had significant effects. Theory strongly supports the notion that recipient and object would also have such effects. It would enhance these findings if future research provided more reliable tests of these two dimensions.

One way to approach this problem may be to review the empirical definition of 'Recipient of Quantitative Measures' (QRECIP). This research used 'recipient of individual data' (question D2) and 'recipient of group data' (question D4) to measure QRECIP, resulting in high correlations with QOBJ. However, D2 and D4 were also highly correlated with each other (r=.49). This suggests that companies may not distribute individual and group data differently. In future studies, multiple questions asking "Who receives performance data?," rather than "Who receives individual data?" and "Who receives group data?," might be effective.

7.5.2 Supervisory Use of Monitors

The parties using monitor data play an important role in determining its impact. Yet Eisenman (1986) pointed out that the supervisors in her study did not fully use the data or facilities available to them.

This raises many questions. First, do supervisors have preconceptions about the impact of monitors on their jobs and on their employees? Second, how can monitors be designed to suit different supervisory styles? Third, anecdotal evidence from the literature and the case study indicates that employees believe supervisors with monitors use those systems heavily. The case study and Eisenman's (1986) work suggest that this does not happen. How, then, does the perception arise? This research demonstrated that factors of the monitor design can increase this perceived reliance. Do elements of the message or supervisor's use of particular data also contribute to the perceived reliance?

These are complex questions. Answering them means observing supervisors and employees in action and measuring their perceptions. More field research (both cases and experiments) could contribute new and important insights into these issues.

7.5.3 Effective Monitor Messages

The content of a monitor message can vary as widely as any other dimension of its design. Ilgen *et al*. (1979) discussed the importance of the message content in determining response to feedback.

Many aspects of the content contribute to the perceived message. For example, employees more readily accept messages

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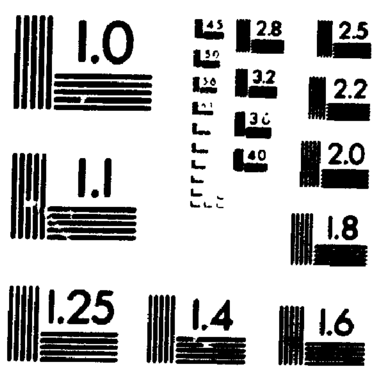

which reinforce their own assessment of performance. Survey responses in this study indicated that employees generally rated themselves higher than average on performance. How effective will messages be, then, which report when employees fall below standards or behind the group average?

Other researchers (Smith et al., 1986) have suggested that evaluative messages are accepted more readily from a machine than from another human. Yet the case study indicated that supervisors and colleagues can play a significant role in interpreting messages. Such interpretation can change content dramatically, particularly if the system is not designed to provide information directly to the employee.

A field experiment could be a particularly effective way to study the effect of message content. The expense of designing and implementing monitors varying along all four dimensions prohibited using such methods in this research. However, programmed CPMCS messages could be varied cheaply and quickly. Modifications could be implemented in firms using monitors to compare the impact of different messages and of the same message in different environments. Lab and field experiments have been used successfully with a variety of MIS problems (e.g., Dickson et al., 1977; Gallupe and McKeen, 1988; Jarvenpaa et al., 1985; Lin et al., 1988).

These controlled methods could be useful in building on the current research.

7.5.4 Relative Versus Absolute Importance

A common complaint among monitored workers is that monitoring forces them to reduce the quality of direct service to the customer (Oreskovich, 1985; Garson, 1988). This research showed that monitoring need not reduce the absolute importance of customer service. However, service workers often make trade-off decisions to cope with conflicting demands in day-to-day operations. They may still reduce service quality to meet production standards. Case study claims processors, for example, met turnaround service targets and rated customer service as very important. Nonetheless, the scrapwork indicated that at least one group of customers received markedly different service.

This study concentrated on causally explaining absolute importance of production and interaction. At the same time, survey data demonstrated that the degree of monitoring affects the perception of relative importance. A causal analysis of relative importance would be a meaningful extension of this work.

Monitors which improve productivity contribute to greater efficiency. But what impact do they have, if any, on effectiveness? Businesses would be very interested in research which studied how customers viewed monitored versus unmonitored service.

7.6 CONCLUSION

This research studied the impact of CPMCS design on the importance service workers attach to production and interaction in performing their jobs. It demonstrated areas in which design choices affected the acceptance of quantitative measures and the perceived reliance on them. These factors in turn affected the employee's interpretation of management performance criteria. Acceptance and reliance had little direct effect on the employee's own criteria. The degree of monitoring also affected perceptions of how employers view the relative importance of production and interaction.

Many important questions remain unanswered. The case study provided a wealth of qualitative data about monitor impact. The causal model produced a framework within which to explore other relationships. It also suggested areas to expand and improve the framework. Continued research in these areas will greatly enhance our understanding and effective use of computerized performance monitoring and control systems.

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UNIVERSITY OF WESTERN ONTARIO

RESEARCH SURVEY

- NON-SUPERVISORY STAFF -

Section I.

To begin, please think about how you judge your own work. For each item listed below, please indicate (by circling the appropriate rating) how important you think it should be in judging your overall performance.

	EXTREMELY UNIMPORTANT						EXTREMELY IMPORTANT
Q.-1. The quality of your work.	1	2	3	4	5	6	7
Q.-2. The amount of effort you put into your work.	1	2	3	4	5	6	7
Q.-3. The quantity of work you do.	1	2	3	4	5	6	7
Q.- . The accuracy of your work.	1	2	3	4	5	6	7
Q.-5. How well you get along with your unit head.	1	2	3	4	5	6	7
Q.-6. How well you get along with your coworkers.	1	2	3	4	5	6	7
Q.-7. The overall productivity of your unit.	1	2	3	4	5	6	7
Q.-8. The overall productivity of your department.	1	2	3	4	5	6	7
Q.-9. Your attendance.	1	2	3	4	5	6	7
Q.-10. How well you handle customers.	1	2	3	4	5	6	7

Now, please think about how <u>your company</u> judges your work. For each item listed below, please indicate (by circling the appropriate rating) how important you think <u>your company</u> considers it in judging your overall performance.

	EXTREMELY UNIMPORTANT						EXTREMELY IMPORTANT
Q.-11. The quality of your work.	1	2	3	4	5	6	7
Q.-12. The amount of effort you put into your work.	1	2	3	4	5	6	7
Q.-13. The quantity of work you do.	1	2	3	4	5	6	7
Q.-14. The accuracy of your work.	1	2	3	4	5	6	7
Q.-15. How well you get along with your unit head.	1	2	3	4	5	6	7
Q.-16. How well you get along with your coworkers.	1	2	3	4	5	6	7
Q.-17. The overall productivity of your unit.	1	2	3	4	5	6	7
Q.-18. The overall productivity of your department.	1	2	3	4	5	6	7
Q.-19. Your attendance.	1	2	3	4	5	6	7
Q.-20. How well you handle customers.	1	2	3	4	5	6	7

Section II.

In this section, we would like your opinion about various aspects of the performance measurement and appraisal process at your company.

Q.-21. When you are doing a good job, how often does your unit head comment on it? (Please circle appropriate number)

NEVER ... ALWAYS

1 2 3 4 5 6 7

Q.-22. When you are doing a poor job, how often does your unit head comment on it? (Please circle appropriate number)

NEVER ... ALWAYS

1 2 3 4 5 6 7

Q.-23. How often does your unit head discuss your job or your performance with you? (Please circle appropriate number)

TOO SELDOM ... TOO OFTEN

1 2 3 4 5 6 7

Q.-24. How useful are those discussions with your unit head? (Please circle appropriate number)

NOT USEFUL AT ALL ... EXTREMELY USEFUL

1 2 3 4 5 6 7

Q.-25. 'Direct supervision' occurs when a unit head or supervisor personally observes an employee performing a job. How much direct supervision do you receive? (Please circle appropriate number)

NONE ... ALMOST CONSTANT

1 2 3 4 5 6 7

Q.-26. How effective is direct supervision in judging your performance? (Please circle appropriate number)

EXTREMELY INEFFECTIVE						EXTREMELY EFFECTIVE
1	2	3	4	5	6	7

Q.-27. 'Indirect supervision' occurs when a unit head or supervisor reviews the results of an employee's work, such as production counts, accuracy statistics or client files. How much indirect supervision do you receive? (Please circle appropriate number)

NONE						ALMOST CONSTANT
1	2	3	4	5	6	7

Q.-28. How effective is indirect supervision in judging your performance? (Please circle appropriate number)

EXTREMELY INEFFECTIVE						EXTREMELY EFFECTIVE
1	2	3	4	5	6	7

Q.-29. How **complete** is the information your unit head uses to evaluate the quantity of work you do? (Please circle appropriate number)

EXTREMELY INCOMPLETE						EXTREMELY COMPLETE
1	2	3	4	5	6	7

Q.-30. How **accurate** is the information your unit head uses to evaluate the quantity of work you do? (Please circle appropriate number)

EXTREMELY INACCURATE						EXTREMELY ACCURATE
1	2	3	4	5	6	7

Q.-31. How **appropriate** is the information used to evaluate the quantity of work you do? (Please circle appropriate number)

EXTREMELY INAPPROPRIATE						EXTREMELY APPROPRIATE
1	2	3	4	5	6	7

Q.-32. How **complete** is the information your unit head uses to evaluate the accuracy of your work? (Please circle appropriate number)

EXTREMELY INCOMPLETE						EXTREMELY COMPLETE
1	2	3	4	5	6	7

Q.-33. How **accurate** is the information your unit head uses to evaluate the accuracy of your work? (Please circle appropriate number)

EXTREMELY INACCURATE						EXTREMELY ACCURATE
1	2	3	4	5	6	7

Q.-34. How **appropriate** is the information your unit head uses to evaluate the accuracy of your work? (Please circle appropriate number)

EXTREMELY INAPPROPRIATE						EXTREMELY APPROPRIATE
1	2	3	4	5	6	7

Q.-35. How **complete** is the information your unit head uses to evaluate the way you handle customers? (Please circle appropriate number)

EXTREMELY INCOMPLETE						EXTREMELY COMPLETE
1	2	3	4	5	6	7

Q.-36. How **accurate** is the information your unit head uses to evaluate the way you handle customers? (Please circle appropriate number

EXTREMELY INACCURATE						EXTREMELY ACCURATE
1	2	3	4	5	6	7

Q.-37. How **appropriate** is the information your unit head uses to evaluate the way you handle customers? (Please circle appropriate number)

EXTREMELY INAPPROPRIATE						EXTREMELY APPROPRIATE
1	2	3	4	5	6	7

Q.-38. How **complete** is the information your unit head uses to evaluate your interpersonal skills? (Please circle appropriate number)

EXTREMELY INCOMPLETE						EXTREMELY COMPLETE
1	2	3	4	5	6	7

Q.-39. How **accurate** is the information your unit head uses to evaluate your interpersonal skills? (Please circle appropriate number)

EXTREMELY INACCURATE						EXTREMELY ACCURATE
1	2	3	4	5	6	7

Q.-40. How **appropriate** is the information your unit head uses to evaluate your interpersonal skills? (Please circle appropriate number)

EXTREMELY INAPPROPRIATE						EXTREMELY APPROPRIATE
1	2	3	4	5	6	7

Q.-41. Overall, how **complete** is the information your unit head uses to evaluate your performance? (Please circle appropriate number)

EXTREMELY INCOMPLETE						EXTREMELY COMPLETE
1	2	3	4	5	6	7

Q.-42. Overall, how **accurate** is the information your unit head uses to evaluate your performance? (Please circle appropriate number)

EXTREMELY INACCURATE						EXTREMELY ACCURATE
1	2	3	4	5	6	7

Q.-43. Overall, how **appropriate** is the information your unit head uses to evaluate your performance? (Please circle appropriate number)

EXTREMELY INAPPROPRIATE						EXTREMELY APPROPRIATE
1	2	3	4	5	6	7

Q.-44. How fair is the process of evaluating your performance? (Please circle appropriate number)

EXTREMELY UNFAIR						EXTREMELY FAIR
1	2	3	4	5	6	7

Q.-45. How often do you think your coworkers cheat to achieve high production counts? (Please circle appropriate number)

NEVER						ALWAYS
1	2	3	4	5	6	7

Q.-46. How often do you discuss your production counts with your coworkers? (Please circle appropriate number)

NEVER						ALWAYS
1	2	3	4	5	6	7

Q.-47. Overall, how satisfied are you with the company's system for evaluating your performance? (Please circle appropriate number)

EXTREMELY DISSATISFIED						EXTREMELY SATISFIED
1	2	3	4	5	6	7

Section III.

For each of the following questions, please circle the number of your answer to the question.

Q.-48. On most days on your job, how often does time drag for you?
(Please circle the appropriate number)

1 ABOUT HALF THE DAY OR MORE

2 ABOUT ONE-THIRD OF THE DAY

3 ABOUT ONE-QUARTER OF THE DAY

4 ABOUT ONE-EIGHTH OF THE DAY

5 TIME NEVER SEEMS TO DRAG

Q.-49. Some people are completely involved in their job -- they are absorbed in it night and day. For other people, their job is simply one of several interests. How involved do you feel in your job?
(Please circle appropriate number)

1 VERY LITTLE INVOLVED; MY OTHER INTERESTS ARE MORE ABSORBING

2 SLIGHTLY INVOLVED

3 MODERATELY INVOLVED; MY JOB AND OTHER INTERESTS ARE EQUALLY ABSORBING TO ME

4 STRONGLY INVOLVED

5 VERY STRONGLY INVOLVED; MY WORK IS THE MOST ABSORBING INTEREST IN MY LIFE

Q.-50. How often do you do some extra work for your job which isn't really required? (Please circle the appropriate number)

1 ALMOST EVERY DAY

2 SEVERAL TIMES A WEEK

3 ABOUT ONCE A WEEK

4 ONCE EVERY FEW WEEKS

5 ABOUT ONCE A MONTH OR LESS

Q.-51. Would you say you work harder, less hard, or about the same as other people doing your type of work in your company? (Please circle appropriate number)

1 MUCH HARDER THAN MOST OTHERS

2 A LITTLE HARDER THAN MOST OTHERS

3 ABOUT THE SAME AS MOST OTHERS

4 A LITTLE LESS HARD THAN MOST OTHERS

5 MUCH LESS HARD THAN MOST OTHERS

Section IV.

People make many comments about computers in work and everyday life. For each of the following comments, please tell us whether you agree or disagree with the statement, by circling the appropriate number on the scale beside the question.

	STRONGLY DISAGREE						STRONGLY AGREE
Q.-52. Computers make work more interesting.	1	2	3	4	5	6	7
Q.-53. People lose their jobs to computers.	1	2	3	4	5	6	7
Q.-54. Computers make mistakes no human would ever make.	1	2	3	4	5	6	7
Q.-55. People who use computers are more productive.	1	2	3	4	5	6	7
Q.-56. You can't prove a computer is wrong.	1	2	3	4	5	6	7
Q.-57. Working with computers is fun.	1	2	3	4	5	6	7
Q.-58. If I had a choice, I would have a job where I didn't use a computer.	1	2	3	4	5	6	7
Q.-59. People who use computers produce higher quality work.	1	2	3	4	5	6	7
Q.-60. Computers encourage managers to supervise employees more closely.	1	2	3	4	5	6	7

Section V.

Now we would like to ask a few more questions about your job. For each question, please indicate whether you agree or disagree with the statement by circling the appropriate number on the scale next to it.

	STRONGLY DISAGREE						STRONGLY AGREE
Q.-61. I have a lot of control over how I do my work.	1	2	3	4	5	6	7
Q.-62. My unit is very productive.	1	2	3	4	5	6	7
Q.-63. My department is very productive.	1	2	3	4	5	6	7
Q.-64. I am satisfied with my overall work situation.	1	2	3	4	5	6	7
Q.-65. The support of people in the clerical area helps me do a better job.	1	2	3	4	5	6	7
Q.-66. It is easy for me to know when I do a good job.	1	2	3	4	5	6	7
Q.-67. Sometimes I have to do sloppy work just to keep up.	1	2	3	4	5	6	7
Q.-68. The quantity of work I do gives a fair picture of of my performance.	1	2	3	4	5	6	7
Q.-69. My company has a lot of control over how I do my work.	1	2	3	4	5	6	7

	STRONGLY DISAGREE						STRONGLY AGREE
Q.-70. The support of people responsible for the claims system helps me do a better job.	1	2	3	4	5	6	7
Q.-71. A computer could measure my performance fairly.	1	2	3	4	5	6	7
Q.-72. My job involves handling lots of special cases.	1	2	3	4	5	6	7
Q.-73. I have a very stressful job.	1	2	3	4	5	6	7
Q.-74. I have a very interesting job.	1	2	3	4	5	6	7
Q.-75. Only a human being could measure my performance fairly.	1	2	3	4	5	6	7
Q.-76. My performance depends upon how well other people do their jobs.	1	2	3	4	5	6	7
Q.-77. My performance depends upon job-related factors outside my control.	1	2	3	4	5	6	7
Q.-78. My role in dealing with customers is very important to my company.	1	2	3	4	5	6	7

Section VI.

In this section, we would like you to think about how you would rate your own performance at the present time.

For each of the following items, please circle the appropriate number to indicate how you would rate your performance on that item.

	POOR						OUTSTANDING
Q.-79. The quality of your work.	1	2	3	4	5	6	7
Q.-80. The amount of effort you put into your work.	1	2	3	4	5	6	7
Q.-81. The quantity of work you do.	1	2	3	4	5	6	7
Q.-82. The accuracy of your work.	1	2	3	4	5	6	7
Q.-83. How well you get along with your unit head.	1	2	3	4	5	6	7
Q.-84. How well you get along with your coworkers.	1	2	3	4	5	6	7
Q.-85. Your attendance.	1	2	3	4	5	6	7
Q.-86. How well you handle customers.	1	2	3	4	5	6	7
Q.-87. Your overall performance.	1	2	3	4	5	6	7

Section VII.

Your cooperation in completing this questionnaire has been most helpful. All of the answers you have given us will be kept strictly confidential. However, we would appreciate it if you would now provide some basic information about yourself. This information will also be kept confidential, and will be used only in summary form to help us interpret the results of this questionnaire.

Q.-88. How long have you worked for this company? (Please fill in number of months or years on the appropriate line)

______ years -or- _______ months (if less than one year)

Q.-89. How long have you worked in this department? (Please fill in number of months or years on the appropriate line)

______ years -or- _______ months (if less than one year)

Q.-90. How long have you worked at your present job? (Please fill in number of months or years on the appropriate line)

______ years -or- _______ months (if less than one year)

Q.-91. How long do you expect to continue working in the group claims department? (Please circle appropriate number)

1 3 MONTHS OR LESS

2 BETWEEN 4 AND 6 MONTHS

3 BETWEEN 7 MONTHS AND 1 YEAR

4 BETWEEN 1 YEAR AND 18 MONTHS

5 BETWEEN 18 MONTHS AND 2 YEARS

6 2 YEARS OR MORE

Q.-92. Approximately what percent of your work day do you spend working on a computer terminal? (Please circle the appropriate number)

0%			50%			100%
1	2	3	4	5	6	7

Q.-93. How long have you been working on a computer terminal at this company? (Please circle the appropriate number)

1 I DO NOT WORK ON A COMPUTER TERMINAL

2 LESS THAN 6 MONTHS

3 BETWEEN 6 MONTHS AND 1 YEAR

4 BETWEEN 1 AND 2 YEARS

5 MORE THAN 2 YEARS

Q.-94. How long had you worked on a computer terminal before taking your present job? (Please circle the appropriate number)

1 I HAD NEVER WORKED ON A COMPUTER TERMINAL BEFORE TAKING MY PRESENT JOB

2 LESS THAN 6 MONTHS

3 BETWEEN 6 MONTHS AND 1 YEAR

4 BETWEEN 1 AND 2 YEARS

5 MORE THAN 2 YEARS

Q.-95. What is your age? (Please circle the appropriate number)

1 LESS THAN 25

2 25 - 34

3 35 - 44

4 45 - 54

5 55 - 64

6 OVER 64

Q.-96. What is your first language? (Please circle the appropriate number)

1 ENGLISH

2 FRENCH

3 OTHER

Q.-97. What is your sex? (Please circle the appropriate number)

1 FEMALE

2 MALE

INTERVIEW GUIDE - NON-SUPERVISORY STAFF

ID Number____________

1. What skills do you think makes a person good at doing your job?

2. What do you enjoy most about your job? Least? Why?

3. How would you describe the atmosphere in your office?

4. Why do you think management here is interested in your productivity?

5. Is there anything you think could be done to make your work more interesting without reducing your productivity? What?

6. Is there anything you think could be done to improve your productivity? What?

7. Do you think your performance evaluation is a fair representation of what you do? Why or why not?

.8. How do you think your performance affects the overall results of the company (new business, profit...)?

9. Have your ever worked in a job where your performance was monitored by a computer? What was the job? Where? What kind of monitoring?

10. "Direct supervision" is when a supervisor or unit head personally observes you as you work, while "indirect supervision" occurs when a supervisor or unit head reviews the results of your work (client files, production counts, or accuracy statistics). Which type of supervision (or what mix of the two types) do you think provide the information on which your performance evaluation is based?

100% INDIRECT			50% DIRECT 50% INDIRECT			100% DIRECT
1	2	3	4	5	6	7

11. How important do you think quantitative information (production counts, accuracy rates, etc) is to your unit head in evaluating your performance?

OF NO IMPORTANCE AT ALL			MODERATELY IMPORTANT			IT IS THE ONLY IMPORTANT FACTOR
1	2	3	4	5	6	7

12. What is your unit head's role in reviewing and evaluating your work?

13. What role does the CPMCS play?

14. Overall, what do you think of the CPMCS? Would you like to see more extensive use of it? Less use?

15. Are there any other comments you would like to make about the topics discussed here or in the questionnaire?

APPENDIX B - NATIONAL SURVEY

ATTITUDES TOWARD CONTROL AND EVALUATION SYSTEMS

UNIVERSITY OF WESTERN ONTARIO

INSTRUCTIONS

This survey is being conducted by researchers at the University of Western Ontario to determine how you feel about the way your work is evaluated and the effect it has on how you do your job.

Please answer each question frankly. There are no "right" or "wrong" answers, or trick questions. We are interested in how you feel about the topics discussed here.

Your answers to this survey will be completely confidential. No one in your company will ever see your answers.

When you have finished this survey, please mail it back to us in the envelope we have provided. You do not need to put a stamp on it -- we will pay the return postage.

Thank you very much for your help with this project.

Rebecca Grant
Project Coordinator

SECTION A. JUDGING YOUR WORK

In this section, we would like you to think about the things you do in your work and how important each one is to doing a good job.

First, think about how you would judge your own work. For each item listed below, please tell us how important you think it is in doing your job well. (Please circle the appropriate number for each item.)

	VERY UNIMPORTANT TO YOU						VERY IMPORTANT TO YOU
1. The service you give customers.	1	2	3	4	5	6	7
2. The amount of effort you make.	1	2	3	4	5	6	7
3. The quantity of work you do.	1	2	3	4	5	6	7
4. The accuracy of the work you do.	1	2	3	4	5	6	7
5. Getting along with your supervisor.	1	2	3	4	5	6	7
6. Your work group's productivity.	1	2	3	4	5	6	7
7. Your department's productivity.	1	2	3	4	5	6	7
8. Getting along with your coworkers.	1	2	3	4	5	6	7
9. How well you solve customer problems.	1	2	3	4	5	6	7
10. How quickly you work.	1	2	3	4	5	6	7
11. How well you answer customer questions.	1	2	3	4	5	6	7
12. Your attendance.	1	2	3	4	5	6	7
13. Cooperating with others.	1	2	3	4	5	6	7
14. Your overall performance.	1	2	3	4	5	6	7

Often jobs have many parts, and people must choose which one to do first or best.

15. Which of the following items do you think is the most important part of your job? (Please circle the number next to your choice.)

1 Productivity

2 Customer Service

3 Getting along with others at work

4 Effort

5 Accuracy

Now, please think about how your company judges your work. For each item listed below, please tell us how important your company thinks it is in doing your job well. (Please circle the appropriate number for each item.)

	VERY UNIMPORTANT TO COMPANY						VERY IMPORTANT TO COMPANY
16. The service you give customers.	1	2	3	4	5	6	7
17. The amount of effort you make.	1	2	3	4	5	6	7
18. The quantity of work you do.	1	2	3	4	5	6	7
19. The accuracy of the work you do.	1	2	3	4	5	6	7
20. Getting along with your supervisor.	1	2	3	4	5	6	7
21. Your work group's productivity.	1	2	3	4	5	6	7
22. Your department's productivity.	1	2	3	4	5	6	7
23. Getting along with your coworkers.	1	2	3	4	5	6	7
24. How well you solve customer problems.	1	2	3	4	5	6	7
25. How quickly you work.	1	2	3	4	5	6	7
26. How well you answer customer questions.	1	2	3	4	5	6	7
27. Your attendance.	1	2	3	4	5	6	7
28. Cooperating with others.	1	2	3	4	5	6	7
29. Your overall performance.	1	2	3	4	5	6	7

30. Which of the following items does your company think is the most important part of your job? (Please circle the number next to your choice.)

1 Productivity

2 Customer Service

3 Getting along with others at work

4 Effort

5 Accuracy

SECTION B. JOB MEASUREMENT METHODS

In this section, we would like your opinion about the information used to evaluate your work and the way it is used.

*A. To begin, how **COMPLETE** is the information your supervisor uses to evaluate each of these items? (Please circle the appropriate number for each item.)*

	EXTREMELY INCOMPLETE						EXTREMELY COMPLETE
1. The quantity of work you do.	1	2	3	4	5	6	7
2. The accuracy of your work	1	2	3	4	5	6	7
3. The customer service you provide.	1	2	3	4	5	6	7
4. Your interpersonal skills.	1	2	3	4	5	6	7

*B. Next, how **ACCURATE** is the information your supervisor uses to evaluate each of these items? (Please circle the appropriate number for each item.)*

	EXTREMELY INACCURATE						EXTREMELY ACCURATE
5. The quantity of work you do.	1	2	3	4	5	6	7
6. The accuracy of your work.	1	2	3	4	5	6	7
7. The customer service you provide.	1	2	3	4	5	6	7
8. Your interpersonal skills.	1	2	3	4	5	6	7

*C. Finally, how **APPROPRIATE** is the information your supervisor uses to evaluate each of these items? (Please circle the appropriate number for each item.)*

	EXTREMELY INAPPROPRIATE						EXTREMELY APPROPRIATE
9. The quantity of work you do.	1	2	3	4	5	6	7
10. The accuracy of your work.	1	2	3	4	5	6	7
11. The customer service you provide.	1	2	3	4	5	6	7
12. Your interpersonal skills.	1	2	3	4	5	6	7

13. Overall, how **complete** is the information your supervisor uses to evaluate your work? (Please circle appropriate number.)

EXTREMELY INCOMPLETE						EXTREMELY COMPLETE
1	2	3	4	5	6	7

14. Overall, how **accurate** is the information your supervisor uses to evaluate your work? (Please circle appropriate number.)

EXTREMELY INACCURATE						EXTREMELY ACCURATE
1	2	3	4	5	6	7

15. Overall, how **appropriate** is the information your supervisor uses to evaluate your work? (Please circle appropriate number.)

EXTREMELY INAPPROPRIATE						EXTREMELY APPROPRIATE
1	2	3	4	5	6	7

16. How satisfied are you with your company's system for evaluating your work? (Please circle appropriate number.)

EXTREMELY DISSATISFIED						EXTREMELY SATISFIED
1	2	3	4	5	6	7

SECTION C. WORK FEATURES

Now we would like to ask some basic questions about your job and the way you are supervised. For each question, please circle the answer which best describes your job.

		Yes	No	Not Sure
1.	Do you deal directly with customers?	Y	N	X
2.	Is your job covered by a union contract or a collective agreement?	Y	N	X
3.	Are you watched on closed circuit television while you work?	Y	N	X
4.	Can your supervisor listen in on your phone conversations?	Y	N	X
5.	Can your supervisor view your work from another terminal?	Y	N	X
6.	If your terminal is idle too long, does the computer tell your supervisor?	Y	N	X
7.	Do you have a production quota?	Y	N	X

Some companies use computers to observe, measure or direct work. Other companies rely on a human supervisor or the worker to carry out these tasks. For each item below, please circle the answer which best describes how it is handled for your job.

		Usually Done By Computer	Usually Done By Supervisor	I Do This Myself	Rarely or Never Done
8.	Counting your keystrokes	C	S	M	N
9.	Counting your completed transactions	C	S	M	N
10.	Counting your mistakes	C	S	M	N
11.	Recording how long a terminal is idle	C	S	M	N
12.	Counting how long it takes you to complete a transaction	C	S	M	N
13.	Checking the way your work is done	C	S	M	N
14.	Directing work to your work station	C	S	M	N

SECTION D. MEASUREMENT SYSTEM CHARACTERISTICS

In this section, we would like to know how your company measures and reviews the work you do.

1. Does your company keep track of <u>your performance</u> (such as speed, accuracy, productivity, etc.) separate from that of the rest of your work group? (Please circle circle the appropriate letter.)

Yes	No	Not Sure
Y	N	X

2. If you answered 'yes' to question 1, please tell us who has access to the information about your individual performance. (Please circle the appropriate number.)

1 I am the only person who can see my results

2 My immediate supervisor can see my results

3 My supervisor and my supervisor's boss can see my results

4 Any supervisor can see my results

5 My results are not posted, but they are available for anyone to check

6 My results are posted for everyone to see

7 I do not know or am not sure

3. Does your company keep track of <u>group performance</u> (such as speed, accuracy, productivity, etc.) separate from that of individuals in the group? (Please circle the appropriate letter).

Yes	No	Not Sure
Y	N	X

4. If you answered 'yes' to question 3, please tell us who has access to the information about your group performance. (Please circle the appropriate number.)

1 Only people in the group can see that group's results

2 The group's immediate supervisor can see the results

3 The supervisor and the supervisor's boss can see the results

4 Any supervisor can see the results

5 The results are not posted, but they are available for anyone to check

6 The results are posted for everyone to see

7 I do not know or am not sure

Now we would like you to think about the way your supervisor collects the information used to evaluate your performance.

5. How often does your supervisor look at the way you do your job? (Please circle the appropriate number.)

NEVER	YEARLY	MONTHLY	WEEKLY	DAILY
1	2	3	4	5

6. How often does your supervisor look at the work you've completed or the amount of work you've done? (Please circle the appropriate number)

NEVER	YEARLY	MONTHLY	WEEKLY	DAILY
1	2	3	4	5

7. How often does your supervisor get a computer printout telling how much work you've done? (Please circle the appropriate number.)

NEVER	YEARLY	MONTHLY	WEEKLY	DAILY
1	2	3	4	5

8. When your performance is evaluated, how important is the amount of work you do? (Please circle the appropriate number.)

VERY UNIMPORTANT						VERY IMPORTANT
1	2	3	4	5	6	7

9. When your performance is evaluated, how important is the way you do your work? (Please circle the appropriate number.)

VERY UNIMPORTANT						VERY IMPORTANT
1	2	3	4	5	6	7

10. "Direct supervision" occurs when your supervisor actually watches or listens to you while you do your job. How much direct supervision do you receive? (Please circl the appropriate number.)

NONE						ALMOST CONSTANT
1	2	3	4	5	6	7

11. How effective is direct supervision in judging how you do your job? (Please circle the appropriate number.)

EXTREMELY INEFFECTIVE						EXTREMELY EFFECTIVE
1	2	3	4	5	6	7

12. "Indirect supervision" occurs when your supervisor looks at the results of your work (such as production counts, completed documents, or customer files) to judge how well you do your job. How much indirect supervision do you receive? (Please circle the appropriate number.)

NONE						ALMOST CONSTANT
1	2	3	4	5	6	7

13. How effective is indirect supervision in judging how you do your job? (Please circle the appropriate number.)

EXTREMELY INEFFECTIVE						EXTREMELY EFFECTIVE
1	2	3	4	5	6	7

14. The number of tasks completed, the number of customers served, or the time required to complete a task are examples of **performance counts**. Some supervisors consider counts like this important measures of job performance. How important are performance counts to your supervisor in evaluating your work? (Please circle the appropriate number.)

EXTREMELY UNIMPORTANT						EXTREMELY IMPORTANT
1	2	3	4	5	6	7

15. Some supervisors depend on personal judgement or their own opinions about the way employees do their job. How important does your supervisor consider his or her own judgement in evaluating your work? (Please circle the appropriate number.)

EXTREMELY UNIMPORTANT						EXTREMELY IMPORTANT
1	2	3	4	5	6	7

16. If you had to place your job on a scale from 100% production to 100% customer service, where would you place it? (Please circle the appropriate number.)

100% PRODUCTION						100% CUSTOMER SERVICE
1	2	3	4	5	6	7

17. How fair is your company's system for evaluating your work? (Please circle the appropriate number.)

EXTREMELY UNFAIR						EXTREMELY FAIR
1	2	3	4	5	6	7

SECTION E. COMPUTERS AND WORK

People make many comments about computers in work and everyday life. For each of the following comments, please tell us how much you agree or disagree with it. (Please circle the appropriate number for each comment.)

	STRONGLY DISAGREE						STRONGLY AGREE
1. Computers make work more interesting.	1	2	3	4	5	6	7
2. Jobs using computers are more desirable.	1	2	3	4	5	6	7
3. People who use computers produce higher quality work.	1	2	3	4.			7
4. You can't prove a computer is wrong.	1	2	3	4	5		7
5. Working with computers is fun.	1	2	3	4	5	6	7
6. People who use computers are more productive.	1	2	3	4	5	6	7
7. Computers make mistakes a human being would never make.	1	2	3	4	5	6	7
8. People lose their jobs to computers.	1	2	3	4	5	6	7
9. Computers can make better decisions than people.	1	2	3	4	5	6	7
10. When businesses start using computers, they stop caring about people.	1	2	3	4	5	6	7
11. Computers make work more challenging.	1	2	3	4	5	6	7
12. People who can use computers get promoted faster.	1	2	3	4	5	6	7
13. It's easy to use a computer.	1	2	3	4	5	6	7
14. Mistakes made by computers are easy to correct.	1	2	3	4	5	6	7
15. Computers can think like human beings.	1	2	3	4	5	6	7
16. Computers cause unemployment.	1	2	3	4	5	6	7
17. Companies with computers care more about efficiency than service.	1	2	3	4	5	6	7
18. Working with computers is tiring.	1	2	3	4	5	6	7
19. Computers are accurate and precise.	1	2	3	4	5	6	7
20. Computers make work more enjoyable.	1	2	3	4	5	6	7
21. Computers help businesses operate more efficiently.	1	2	3	4	5	6	7
22. People assume computer answers are always correct.	1	2	3	4	5	6	7
23. Working on a computer is boring.	1	2	3	4	5	6	7

SECTION F. TASK ENVIRONMENT

In this section, we would like to ask a few questions about your work situation. For each statement below, please tell us how much you agree or disagree that it describes your job. (Please circle the appropriate number for each statement.)

	STRONGLY DISAGREE						STRONGLY AGREE
1. I have a lot of control over how I do my work.	1	2	3	4	5	6	7
2. It's easy for me to know when I do a good job.	1	2	3	4	5	6	7
3. A computer could measure my performance fairly.	1	2	3	4	5	6	7
4. My job involves lots of special cases.	1	2	3	4	5	6	7
5. The quantity of work I do is a fair picture of my performance.	1	2	3	4	5	6	7
6. I have a very interesting job.	1	2	3	4	5	6	7
7. Sometimes I have to do sloppy work just to keep up.	1	2	3	4	5	6	7
8. I have a very stressful job.	1	2	3	4	5	6	7
9. My role in dealing with customers is very important to my company.	1	2	3	4	5	6	7
10. My performance could be measured against standard production quotas.	1	2	3	4	5	6	7
11. I have lots of freedom in how I do my job.	1	2	3	4	5	6	7
12. My job requires me to use a number of complex or high-level skills.	1	2	3	4	5	6	7

	STRONGLY DISAGREE						STRONGLY AGREE
13. Just doing my job gives me many chances to figure out how well I'm doing.	1	2	3	4	5	6	7
14. Once you learn my job, it's pretty straight-forward.	1	2	3	4	5	6	7
15. My performance could only be judged by someone who knew the job well.	1	2	3	4	5	6	7
16. The amount of correct work I do is a good measure of my performance.	1	2	3	4	5	6	7
17. My job has a lot of variety.	1	2	3	4	5	6	7
18. I have many chances to use my own judgement in carrying out my work.	1	2	3	4	5	6	7
19. It's easy to judge the accuracy of my work	1	2	3	4	5	6	7
20. My job is simple and repetitive.	1	2	3	4	5	6	7
21. Solving new or different problems is an important part of my job.	1	2	3	4	5	6	7
22. The higher my productivity, the better I'm doing my job.	1	2	3	4	5	6	7
23. If time is a problem, I can decide which tasks to do first.	1	2	3	4	5	6	7
24. I have a "piece-work" kind of job	1	2	3	4	5	6	7
25. The speed at which I work is a good measure of my performance.	1	2	3	4	5	6	7

SECTION G. SELF-RATED PERFORMANCE

In this section, we would like you to think about how you would rate your performance. For each of these items, please circle the number which best describes how you would rate your performance on that item.

YOUR PERFORMANCE ON:	WELL BELOW AVERAGE			AVERAGE			WELL ABOVE AVERAGE
1. The service you give customers.	1	2	3	4	5	6	7
2. The amount of effort you make.	1	2	3	4	5	6	7
3. The quantity of work you do.	1	2	3	4	5	6	7
4. The accuracy of the work you do.	1	2	3	4	5	6	7
5. Getting along with your supervisor.	1	2	3	4	5	6	7
6. Your work group's productivity.	1	2	3	4	5	6	7
7. Your department's productivity.	1	2	3	4	5	6	7
8. Getting along with your coworkers.	1	2	3	4	5	6	7
9. How well you solve customer problems.	1	2	3	4	5	6	7
10. How quickly you work.	1	2	3	4	5	6	7
11. How well you answer customer questions.	1	2	3	4	5	6	7
12. Your attendance.	1	2	3	4	5	6	7
13. Cooperating with others.	1	2	3	4	5	6	7
14. Your overall performance.	1	2	3	4	5	6	7

SECTION E. LEGAL ISSUES

At the present time, there are few laws dealing with computer systems which monitor, observe, or measure performance.
For each of the following statements, please tell us how much you agree or disagree with it. (Please circle the appropriate number for each statement.)

	STRONGLY DISAGREE						STRONGLY AGREE
1. All computer monitor systems should be illegal.	1	2	3	4	5	6	7
2. All electronic surveillance of workers (cameras, tape recorders, etc.) should be illegal.	1	2	3	4	5	6	7
3. It is acceptable to measure or monitor individual workers with computers.	1	2	3	4	5	6	7
4. It is acceptable to measure or monitor group work with computers.	1	2	3	4	5	6	7
5. The design and use of computer monitors should be part of contract negotiations.	1	2	3	4	5	6	7
6. Management has the right to use computer monitors as they see fit.	1	2	3	4	5	6	7
7. Workers should be able to refuse to be monitored.	1	2	3	4	5	6	7
8. Workers should be able to see and correct any information gathered about them.	1	2	3	4	5	6	7
9. Employers should be forced to tell workers exactly what systems are being used and what the information is used for.	1	2	3	4	5	6	7

10. Who do you think should be responsible for enforcing any rules, laws or restrictions dealing with work monitoring systems? You may think that more than one of the groups listed below should be involved. Please put an 'X' next to each one you think should be responsible.

____ Federal Government
____ Management
____ Employees
____ Provincial Government
____ Labour Unions

SECTION I. EXPERIENCE, ETC.

Your cooperation in completing this survey has been very helpful. All of the answers you have given us will be kept strictly confidential. We would also appreciate it if you would provide some basic information about yourself. This information will be kept confidential, and will only be used in summary form to help us interpret the results of this survey.

1. How long have you worked for this company? (Please circle appropriate number.)

    1 **3 months or less**

    2 **Between 4 and 6 months**

    3 **Between 7 months and 2 years**

    4 **Between 2 and 5 years**

    5 **5 years or more**

2. How long have you worked in this department? (Please circle appropriate number.)

    1 **3 months or less**

    2 **Between 4 and 6 months**

    3 **Between 7 months and 2 years**

    4 **Between 2 and 5 years**

    5 **5 years or more**

3. How long have you been doing your present job? (Please circle appropriate number.)

    1 **3 months or less**

    2 **Between 4 and 6 months**

    3 **Between 7 months and 2 years**

    4 **Between 2 and 5 years**

    5 **5 years or more**

4. About how much of your work day do you spend working on a computer terminal? (Please circle appropriate number.)

    1 **None - I do not use a computer in my work.**

    2 **Some, but no more than 25%**

    3 **Between 25 and 50%**

    4 **Between 50 and 75%**

    5 **Between 75 and 99%**

    6 **100%**

5. How long have you been working on a computer terminal at this company? (Please circle the appropriate number.)

    1 I do not work on a computer terminal

    2 Less than 6 months

    3 Between 6 months and 1 year

    4 Between 1 and 2 years

    5 More than 2 years

6. How long had you worked on a computer terminal before taking your present job? (Please circle the appropriate number.)

    1 I had never worked on a computer terminal before taking my present job.

    2 Less than 6 months

    3 Between 6 months and 1 year

    4 Between 1 and 2 years

    5 More than 2 years

7. What is your age? (Please circle the appropriate number.)

    1 Less than 25

    2 25 - 34

    3 35 - 44

    4 45 - 54

    5 55 - 64

    6 Over 64

8. What is your first language? (Please circle the appropriate number.)

    1 English

    2 French

    3 Other

9. What is your sex? (Please circle the appropriate number.)

    1 Female

    2 Male

APPENDIX C - MAILING TO CHIEF EXECUTIVE OFFICERS

National Centre for Management Research and Development

Centre national de recherche et développement en administration

October 9, 1987

[redacted]
President & Chief Executive Officer
[redacted]

Dear [redacted]:

The University of Western Ontario's School of Business Administration and the National Centre for Management Research and Development (NCMRD) are committed to studying the challenges facing Canadian managers. As part of its mission, the NCMRD in particular is charged with fostering research into productivity problems and their solutions.

We are conducting a national survey of clerical and service workers who regularly use computer terminals on the job. This study examines the methods used to evaluate performance and their impact on employee productivity, including quantity and quality. We expect many aspects of our final research report to interest service sector managers. In particular, it will address such questions as:

- What are the most effective ways to motivate increased productivity among office workers?
- Does increased productivity undermine the quality of customer service? How can this be avoided?
- How can remote or indirect supervision be used effectively to measure and evaluate service employees' performance?

The report will include a discussion of our findings, as well as the conclusions and recommendations pertaining to these questions. Each company which participates in this study will receive a copy of this report.

....2

We are anxious to include [redacted] in our research. We would work with the liaison person you designate (on the attached form) to identify appropriate participating employees. We would then mail a confidential survey and explanatory letter to each participant. The survey itself takes about 20 minutes to complete and will be returned prepaid to our research group at U.W.O.

Thank you for considering this request. The School of B Administration and NCMRD appreciate the active support of Car businesses in our managerial research programs.

Sincerely,

Rebecca A. Grant
Project Coordinator
School of Business Administration
The University of Western Ontario
(519) 679-2111 Ext. 5183

RAG:jf

National Centre for Management Research and Development

Centre national de recherche et développement en administration

PRODUCTIVITY EVALUATION RESEARCH PROJECT

[redacted]

Is your company willing to participate in this study?

Yes ___________ No ___________

Do you have a group of employees who engage in both production and customer service work and regularly use computer terminals? (Such as claims processors, customer account representatives, reservation agents or directory assistance operators).

Yes ___________ No ___________

Whom should we contact to arrange details of this project?

Name: ______________________________

Title: ______________________________

Address: ______________________________

____

____

____

Phone: ______________________________

SCHOOL OF BUSINESS ADMINISTRATION / THE UNIVERSITY OF WESTERN ONTARIO
LONDON / CANADA / N6A 3K7 / (519) 661-3233

APPENDIX D - NATIONAL SURVEY COVER LETTER

National Centre for Management Research and Development

Centre national de recherche et développement en administration

Dear [redacted],

The University of Western Ontario is currently studying how service companies measure employee productivity and customer service. Our study is designed to help us understand how evaluation systems affect your work and the way you feel about it. [redacted] has given us permission to ask you to take part in the project.

Your participation is extremely important to us. The information you provide will help businesses, governments and labour make sure that performance evaluation systems are used correctly and fairly.

All of your answers will be confidential. While [redacted] has generously allowed us to contact you, our purpose is to gather information valuable to many Canadian businesses. Your employer will never see your survey. In addition, the results will never be presented in such a way that answers could be traced back to an individual employee.

There are instructions on the front of the survey and in each section to help you complete it. But if you have any questions or concerns about this project, please feel free to discuss them with your manager or to contact me directly.

When you have completed the questionnaire, please mail it directly back to us in the envelope we have provided. Don't bother to put a stamp on it -- we will pay the return postage.

Thank you in advance for your valuable cooperation with this project. We look forward to receiving your survey soon.

Sincerely yours,

Rebecca Grant
Project Coordinator
(519) 679-2111 Ext. 5183

APPENDIX E - COMPARISON OF FIRST AND HOLDOUT SAMPLES

ITEM	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR
C8 Keystrokes Counted				
FIRST SAMPLE	733	0.3302	0.734	0.027
HOLDOUT SAMPLE	709	0.3399	0.743	0.028

		SEPARATE VARIANCE ESTIMATE		
F VALUE	2-TAIL PROB.	T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
1.03	0.731	-0.25	1436.94	0.802

ITEM	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR
C9 Completed Tx Counted				
FIRST SAMPLE	733	0.7967	0.933	0.034
HOLDOUT SAMPLE	709	0.7941	0.942	0.035

		* POOLED VARIANCE ESTIMATE *		
F VALUE	2-TAIL PROB.	T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
1.02	0.794	0.05	1440	0.957

ITEM	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR
C10 Mistakes Counted				
FIRST SAMPLE	733	0.5634	0.707	0.026
HOLDOUT SAMPLE	709	0.5726	0.707	0.027

		* POOLED VARIANCE ESTIMATE *		
F VALUE	2-TAIL PROB.	* T VALUE	DEGREES OF FREEDOM	2-TAIL PROB. *
1.00	0.977	* -0.25	1440	0.805 *

ITEM	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR
C11 Idle Time Counted				
FIRST SAMPLE	733	0.4461	0.811	0.030
HOLDOUT SAMPLE	709	0.4245	0.793	0.030

		* POOLED VARIANCE ESTIMATE *		
F VALUE	2-TAIL PROB.	* T VALUE	DEGREES OF FREEDOM	2-TAIL PROB. *
1.05	0.553	* 0.51	1440	0.610 *

ITEM	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR
C12 Tx Completion Time Counted				
FIRST SAMPLE	733	0.4352	0.779	0.029
HOLDOUT SAMPLE	709	0.3949	0.757	0.028

		* POOLED VARIANCE ESTIMATE *		
F VALUE	2-TAIL PROB.	* T VALUE	DEGREES OF FREEDOM	2-TAIL PROB. *
1.06	0.437	* 1.00	1440	0.320 *

ITEM	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR
C13 Work Methods Checked				
FIRST SAMPLE	733	0.5744	0.579	0.021
HOLDOUT SAMPLE	709	0.6093	0.602	0.023

		* POOLED VARIANCE ESTIMATE *		
F VALUE	2-TAIL PROB.	* T VALUE	DEGREES OF FREEDOM	2-TAIL PROB. *
1.08	0.286	* -1.12	1440	0.261 *

ITEM	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR
C14 Work Assigned By				
FIRST SAMPLE	733	0.6494	0.680	0.025
HOLDOUT SAMPLE	709	0.6079	0.648	0.024

		* POOLED VARIANCE ESTIMATE *		
F VALUE	2-TAIL PROB.	* T VALUE	DEGREES OF FREEDOM	2-TAIL PROB. *
1.10	0.186	* 1.19	1440	0.236 *

D1 Individual Performance Tracked

		FIRST	HOLDOUT	TOTAL
	N	129	138	267
No		48.3%	51.7%	18.6
		17.7%	19.6%	
	X	79	91	170
Not Sure		46.5%	53.5%	11.8
		10.8%	12.9%	
	Y	522	476	998
Yes		52.3%	47.7%	69.5
		71.5%	67.5%	
COLUMN TOTAL		730 50.9%	705 49.1%	1435 100.00%

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.
2.83598	2	0.2422	83.519

ITEM	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR
D2 Access to Individual Performance Stats				
FIRST SAMPLE	529	3.6371	1.227	0.053
HOLDOUT SAMPLE	482	?.6680	1.282	0.058

		* POOLED VARIANCE ESTIMATE *		
F VALUE	2-TAIL PROB.	T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
1.09	0.318	-0.39	1009	0.695

D3 Group Performance Tracked

		FIRST	HOLDOUT	TOTAL
N	No	172	163	335
		51.3%	48.7%	23.4%
		23.6%	23.3%	
X	Not Sure	145	130	275
		52.7%	47.3%	19.2%
		19.9%	18.6%	
Y	Yes	413	407	820
		50.4%	49.6%	57.3%
		56.6%	58.1%	
	COLUMN TOTAL	730	700	1430
		51.0%	49.0%	100.00%

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.
0.47472	2	0.7887	134.615

ITEM	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR
D4 Access to Group Performance Stats				
FIRST SAMPLE	420	4.1381	1.451	0.071
HOLDOUT SAMPLE	415	4.3446	1.492	0.073

		* POOLED VARIANCE ESTIMATE *		
F VALUE	2-TAIL PROB.	T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
1.06	0.567	-2.03	833	0.043

C2 Unionized

		FIRST	HOLDOUT	TOTAL
No	N	427	426	853
		50.1%	49.9%	59.3%
		58.4%	60.2%	
Not Sure	X	27	22	49
		55.1%	44.9%	3.4%
		1.9%	1.5%	
Yes	Y	277	260	537
		51.6%	48.4%	37.3%
		19.2%	18.1%	
	COLUMN TOTAL	731	708	1439
		50.8	49.2	100.00%

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.
0.68210	2	0.7110	24.108

I1 Time With Company

		FIRST	HOLDOUT	TOTAL
3 months or less	1	8	5	13
		61.5%	38.5%	.9%
		.6%	.3%	
4 - 6 months	2	22	18	40
		55.0%	45.0%	2.8%
		3.0%	2.5%	
7 months - 2 years	3	107	108	215
		49.8%	50.2%	14.9%
		14.6%	15.2%	
2 - 5 years	4	156	164	320
		48.8%	51.3%	22.2%
		21.3	23.1%	
5 years or more	5	440	414	854
		51.5%	48.5%	59.2%
		60.0%	58.4%	
COLUMN TOTAL		733	709	1442
		50.8%	49.2%	100.00%

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.
1.68955	4	0.7926	6.392

I2 Time in Department

		FIRST	HOLDOUT	TOTAL
3 months or less	1	18 56.3% 2.5%	14 43.8% 2.0%	32 2.2%
4 - 6 months	2	35 47.9% 4.8%	38 52.1% 5.4%	73 5.1%
7 months - 2 years	3	186 53.6% 25.4%	161 46.4% 22.8%	347 24.1%
2 - 5 years	4	197 48.2% 26.9%	212 51.8% 30.0%	409 28.4%
5 years or more	5	296 51.3% 40.4%	281 48.7% 39.8%	577 40.1%
COLUMN TOTAL		732 50.9%	706 49.1%	1438 100.00%

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.
2.89537	4	0.5755	15.711

I3 Time in Present Job

		FIRST	HOLDOUT	TOTAL
1	3 months or less	28	25	53
		52.8%	47.2%	3.7%
		3.8%	3.5%	
2	4 - 6 months	54	57	111
		48.6%	51.4%	7.7%
		7.4%	8.1%	
3	7 months - 2 years	206	182	388
		53.1%	46.9%	26.9%
		28.1%	25.7%	
4	2 - 5 years	196	200	396
		49.5%	50.5%	27.5%
		26.7%	28.2%	
5	5 years or more	249	244	493
		50.5%	49.5%	34.2%
		34.0%	34.5%	
	COLUMN TOTAL	733	708	1441
		50.9%	49.1%	100.00%

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.
1.39323	4	0.8454	26.040

I4 Percent of Day Spent Using Terminal

		FIRST	HOLDOUT	TOTAL
<25%	2	98	119	217
		45.2%	54.8%	15.0%
		13.4%	16.8%	
25% - 50%	3	105	109	214
		49.1%	50.9%	14.8%
		14.3%	15.4%	
50% - 75%	4	161	139	300
		53.7%	46.3%	20.8%
		22.0%	19.6%	
75% - 99%	5	258	245	503
		51.3%	48.7%	34.9%
		35.2%	34.6%	
100%	6	111	97	208%
		53.4%	46.6%	14.4
		15.1%	13.7%	
	COLUMN TOTAL	733	709	1442
		50.8%	49.2%	100.0%

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.
4.60048	4	0.3308	102.269

I5 Tenure of Computer Work in Company

		FIRST	HOLDOUT	TOTAL
< 6 months	2	43	43	86
		50.0%	50.0%	6.0%
		5.9%	6.1%	
6 months - 1 years	3	76	68	144
		52.8%	47.2%	10.0%
		10.4%	9.6%	
1 - 2 years	4	128	133	261
		49.0%	51.0%	18.1%
		17.5%	18.8%	
> 2 years	5	486	465	951
		51.1%	48.9%	66.0%
		66.3%	65.6%	
COLUMN TOTAL		733	709	1442
		50.8%	49.2%	100.00%

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.
0.60468	3	0.8954	42.284

I6 **Tenure of Computer Work Elsewhere**

		FIRST	HOLDOUT	TOTAL
No Prior Exp.	1	401 51.8% 54.9%	373 48.2% 52.6%	774 53.8%
< 6 months	2	52 46.8% 7.1%	59 53.2% 8.3%	111 7.7%
6 months - 1 years	3	50 64.9% 6.8%	27 35.1% 3.8%	77 5.4%
1 - 2 years	4	54 48.6% 7.4%	57 51.4% 8.0%	111 7.7%
> 2 years	5	173 47.3% 23.7%	193 52.7% 27.2%	366 25.4%
COLUMN TOTAL		730 50.7%	709 49.3%	1439 100.00%

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.
9.19397	4	0.0564	37.938

I7 **Age**

		FIRST	HOLDOUT	TOTAL
<25	1	135 51.5% 18.4%	127 48.5% 18.0%	262 18.2%
25 - 34	2	347 51.0% 47.4%	334 49.0% 47.2%	681 47.3%
35 - 44	3	161 49.8% 22.0%	162 50.2% 22.9%	323 22.4%
45 - 54	4	62 51.2% 8.5%	59 48.8% 8.3%	121 8.4%
55 - 64	5	26 52.0% 3.6%	24 48.0% 3.4%	50 3.5%
>64	6	1 50.0% .1%	1 50.0% .1%	2 .1%
	COLUMN TOTAL	732 50.9%	707 49.1%	1439 100.00%

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.
0.21565	5	0.9989	0.983

I8 First Language

		FIRST	HOLDOUT	TOTAL
English	1	600	587	1187
		50.5%	49.5%	82.9%
		82.3%	83.5%	
French	2	88	82	170
		51.8%	48.2%	11.9%
		12.1%	11.7%	
Other	3	41	34	75
		54.7%	45.3%	5.2%
		5.6%	4.8%	
	COLUMN TOTAL	729	703	1432
		50.9%	49.1%	100.00%

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.
0.53558	2	0.7651	36.819

I9 Gender

		FIRST	HOLDOUT	TOTAL
Female	1	654	611	1265
		51.7%	48.3%	87.7%
		89.2%	86.2%	
Male	2	79	98	177
		44.6%	55.4%	12.3%
		10.8%	13.8%	
	COLUMN TOTAL	733	709	1442
		50.8%	49.2%	100.00%

CHI-SQUARE	D.F.	SIGNIFICANCE	MIN E.F.
2.82631	1	0.0927	87.027