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A CAUSAL MODEL OF MANAGERIAL ELECTRONIC WORKSTATION USE

by

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A Causal Model of Managerial Electronic Workstation Use

Thesis directed by Professor Douglas E. Durand

This study explored an initial model of three causes of managerial EW use at the micro (individual) level of analysis. A literature review identified seven classes of variables related to computer use. The seven classes were dichotomized into factors varying within and between systems. In this within system study, the exogenous variables were: (1) system/work fit, (2) system/skill fit, and (3) user background. Data generated from an interview and a computer monitor were collected in the field. Covariance structure analysis resulted in the respecification of two modified models. Results suggest that system/work fit is an important factor in managerial EW use. User background was not a significant factor in EW use. Results concerning system/skill fit were inconclusive. A revised measurement model of system use is recommended for future research.

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CHAPTER I

INTRODUCTION

The Need for Research

Computer based information systems (CBISs) have been a common feature of organizations for twenty years or more. From early applications that focused on routine clerical tasks, CBISs have proliferated to address many kinds of organizational work.

The growth in CBISs has been driven by two primary forces. First, organizations have faced rapidly increasing information volume together with rapidly increasing payroll cost for the workers who process the information. One estimate put annual growth in information volume at twelve (12) percent and in knowledge worker (which includes managers, secretaries and professionals) payroll costs at eight (8) percent (Dunn, 1979). These facts have provided strong motivation to improve information processing productivity. CBISs are a part of this effort.

Secondly, rapid technological advances have lowered the costs of computing dramatically and made interaction with the machine more "user friendly." When a tool becomes easier to use and less costly, it is reasonable to expect more uses may be found for it.

Despite the wide variety of knowledge worker tasks that are now computer-aided, the expected productivity payoff has been illusive. Over the decade, 1969-1979, the total increase in productivity for managers, clericals and professionals was only four (4) percent (Stewart, 1979).

Information system failure is one reason for the lack of CBIS productivity impact. Two general sets of factors are cited as the cause of system failures.

First, technical factors may inhibit the functioning of the system. This group of potential causes of system failure have in common the fact that they are attributes of the electronic processing subsystem. Problems may result from inadequate performance of hardware or software. However, the technical aspects of a system may be in complete accord with the expectations of its designers and, yet, the system fails for lack of use (Lucas, 1975, 1981; LaFerrera in Kirchner, 1983; Turner, 1982).

Given that the system is technically successful, the reasons for nonuse may be found in the human or social component of the information processing system. Characteristics of individuals, groups, and tasks along with the structures and processes that interrelate them comprise this second major facet of information processing systems.

A CBIS is a person/machine system. The computer or machine part of the system is the typical focus of the research by computer scientists, programmers and electrical engineers. The technologies that have resulted from progress in our understanding of the machine-side of CBISs are astounding even to the casual observer. Besides the geometrical increase in the ability of computers to process data at ever lower costs, human interfaces have been made more "friendly" with the advent of high-level, vernacular-like languages and direct manipulation devices ("mouses" and "joysticks," for example) (Shneiderman, 1982). Voice recognition systems likely will permit man-machine communication that is nearly as natural as person to person conversation (Shneiderman, 1982). These developments together with the massive efforts in educational institutions to improve "computer literacy" mean that ease of use may soon disappear as a major issue in human-computer interaction.

The results of research into the human side of information processing systems are not nearly as dramatic. Studies range from basic research into human thinking (e.g. Simon, 1956) to the investigation of ergonomic system specifications. (See Bailey, 1983 for an excellent summary of this work.) There is relatively little empirical work involving the factors that influence CBIS use in field settings, however. (See the following Review of Relevant Literature.) Studies involving managers interacting directly with computers in work organizations are particularly rare.

Perhaps as a consequence of this lack of research effort, information systems designed to be used interactively by managers have not been widely accepted. In contrast to the rapid diffusion and acceptance of computers in the world of clerical and technical professionals, a 1981 survey of Fortune 500 company managers by International Data Corporation reported that attitudes toward electronic workstations (the managerial interface with the machine component of information processing systems) ranged from "hostile to enthusiastic" (Norris, 1981). J.L. LaFerrera, Jr., executive director of Bell Labs' Management Information and Administrative Systems Division, has commented that "...with all the recent hype in office systems...it is moving rather slowly at the managerial level" (Kirchner, 1983). Some observers have suggested that "the aggressive manager will leave the keyboard in the hands of his support people..." (Young, 1983).

Thus, in surveying the impediments to the successful application of CBISs to knowledge worker productivity, it appears that factors on the human side of information systems loom as large, or larger, than technical considerations. The potential productivity benefits of managerial use are estimated to be between nine and twenty-five percent in time savings alone (Shindler, 1983). Between 1970 and 1978 the total labor force grew only eighteen percent, while the number of administrators and managers grew fifty-eight percent (Naisbitt, 1982). Therefore, a theory of managerial use of electronic workstations could contribute significantly to the improvement of productivity in our society.

Purpose and Scope of the Study

The purpose of this research is to build and test a model of individual and organizational factors that influence the use of electronic workstations by managers.

The theory to be developed is not a general theory of computer use. The scope is defined in terms of the environment for the human-computer interaction under study: the work organization. Specifically, the focus is on managers using interactive electronic workstations (EWs). An EW is "a (computer) terminal that permits immediate access to the collection and communication of information within the organization" (Carlisle, 1981). A micro computer at a manager's desk is considered an electronic workstation also, even though it may or may not provide access to organizational communication networks. "Interactive" is a designation given to information systems that permit the user to manipulate the electronic system directly in real time. This description is in contrast to "batch" systems that require lag times between information input, processing and output (Keen, 1976).

Electronic workstations for managers are usually part of an office automation (OA) system. It is generally agreed that the components of an OA system include the following:

- data communications
- electronic filing and retrieval
- word/text processing
- electronic mail, voice record
- interactive graphics
- video conferencing
- data processing and manipulation
- dictation
- voice communications

(Adapted from Lieberman, Selig and Walsh, 1982)

(See Barcomb, 1981 and Olson and Lucas, 1982 for alternative classifications of OA system components.)

The term "automation" may not describe the purpose of this technology accurately. "Automation" was coined in 1936 by D.H. Harder at General Motors to describe work that had been taken over by machines (Barcomb, 1981). In this sense, it is a logical extension of the concept of mechanization that is defined as humans performing work aided by machines. "Augmentation," on the other hand, implies expansion of the work that can be performed by humans. It is not clear whether OA systems are designed to automate the managerial job in the original sense of the word. A certain mechanization (enhanced communication tools, for example) and augmentation (increased span of control, for example) may be intended.

As part of an OA system, electronic workstations are used by managers as a link to managerial information systems (MIS) and/or decision support systems (DSS). There is an on-going discussion among information systems academics and practitioners about the difference between MIS and DSS. Some consider DSS a mere "buzzword" and equate it with MIS. However, the distinction is usually made based on the following definitions:

1. An MIS is a system that provides structured reports intended to aid in the management and control of an organization.

2. A DSS is an information system for decision makers that is more flexible and responsive to the individual styles and requirements of higher level managers.

(See Sprague and Carlson, 1982 for an excellent description of such systems and a discussion of the differences between them.)

In the context of the present study, drawing such distinctions is less relevant than identifying the MIS/DSS functions that may be accessed by managers through an electronic workstation. These functions include on-line interaction with software that provides:

- Statistical data analysis
- Operations Research/Management Science modeling
- Spreadsheet analysis
- Data base queries

- Customized report formatting
- Read only access to reports produced by others

The functional characteristics of electronic workstations differ from one system to another. This is a study of managerial use in a particular organization, and it is not designed to address the effects of variation in system configuration on use. The degree to which conclusions reached in this study about managerial use of electronic workstations with a particular configuration can be generalized to EWs with different functional capabilities is a question that should be addressed empirically. Since this research is focused on the implementation and use of managerial workstations (not their design), technical features are outside the scope of the study.

CHAPTER II

THEORY

Review of Relevant Literature

Introduction

The computer has affected organizations in many ways. As an extremely efficient information processing tool, the computer's impact on individuals, organizations and society has been widespread since the mid-twentieth century. In the workplace, the computer has made changes to individual jobs, to how jobs are organized into work groups, and to organizations themselves in terms of both structure and process. Certainly, the managers of organizations have felt these changes for some time, but until recently, managers have had little direct experience with computing machinery. Computers have largely been devices that make the work of managers' subordinates more efficient--in the factory or in the office. Now, electronic workstations are being put on the desks of managers. Their purpose is to make the managerial task more efficient and effective.

The research question guiding this review is: "What are the factors that influence managerial use of electronic workstations (including terminals and micro computers)?" Electronic workstations on the desks of managers are part of a broader phenomenon called office automation (OA). OA can be defined in two parts. First, the office is understood as "any place where managerial, professional and clerical workers are engaged primarily in handling business information" (Barcomb, 1981). Secondly, "automation" of the office means support for the office worker with computer based information systems. Since the manager is a key participant in office work, widespread attempts have been made to provide such support to him/her. The specific functions provided vary among systems but include some combination of the following:

- data communications
- electronic filing and retrieval
- word/text processing
- electronic mail
- voice recording
- interactive graphics
- video conferencing
- data processing and manipulation
- dictation
- voice communications
- links to MIS and DSS systems

It is important to remember that this study focuses on the use of EWs by managers and business professionals--not clerical workers or technical professionals. (Note: "Business professionals" are professional staff persons serving in some advisory function, i.e. personnel, legal, financial, administration and planning. "Technical professionals" are persons with technical backgrounds serving in some line capacity, i.e. engineers, R&D scientists, and the like. Business professionals may also have managerial responsibilities or may have had managerial duties in the past. In what follows, both managers and business professionals will be referred to as "managers." Applications for clerks and secretaries using word processing equipment have gained widespread acceptance. Use of computer aided design and graphics functions by engineering professionals is now considered status quo. Use by managers is much more problematic (Norris, 1981; Kirchner, 1983; Young, 1983).

The potential impacts of managerial use of EWs are great. Olson and White (1979) have traced the impacts of OA on society in general. Among the important issues they cite are: (1) Will OA change the fundamental nature of the office? A primary source of change will come from the new work roles that may be defined. Consider the changes in the traditional role of the secretary when a manager creates his/her own text, has a voice storage and forwarding device to take telephone messages, schedules meetings and maintains a personal calendar electronically, and communicates with immediate subordinates either in meetings or through the medium of electronic mail. (2) What changes in decision making may occur when managers have direct access to information and analytical techniques? (3) What will be the impact on job satisfaction for managers or their subordinates? Will the manager find the experience enriching? Will subordinates find the manager's enhanced ability to monitor and control their activities intimidating? (4) What will leadership mean in an automated environment? If conferencing is accomplished electronically, physical appearance and personal attractiveness may become less important as leader attributes. (5) More generally, will the time saved by managers using EWs translate into an improved quality of work life? Will more productive organizations mean more leisure time? Will there be a reduction in the size of the office workforce so that workers are displaced permanently? These are questions that are important to everyone interested in organizations. To begin addressing some of these issues, the study begins with a review of the literature.

Organizing the Literature

For Marcus (1983), the literature can be fitted into a three by two matrix wherein task, social and time/place impacts are described at the individual and organizational levels of analysis. The issues implicit in each of the cells of the matrix define the literature. In the individual level/task cell, for example, impacts of OA on job characteristics are cited.

Olson and Lucas (1982) begin by describing the three technical components of OA as communications functions, personal applications and text processing and proceed to speculate about the separate and combined impacts of these parts on such variables as organizational communication, interdepartmental relations, employee attitudes, and so on.

The way to group ideas relevant to managerial EW use chosen for the present review posits seven clusters of characteristics: (1) characteristics of the electronic (technical) system, (2) characteristics of the user, (3) characteristics of the user's job, (4) characteristics of the user's interpersonal relationships, (5) characteristics of the organization as a whole, (6) characteristics of the Information Systems (IS) department, and (7) characteristics of the implementation process.

Literature related to the system implementation process (category 7, above) is the body of knowledge most focused on issues relevant to the present study. First, it often takes into account factors from the other six categories (above). Second, the fundamental concern of implementation theory is the integration of the electronic system, organization and user to achieve system success. Third, the dependent variable in implementation research is frequently system use. In short, the goal of implementation research is to identify the causes of system success. Since success is often measured as system use (Olson and Ives, 1981; Huber, 1982; Ginzberg, 1978c), this purpose is similar to the aim of the present study. Consequently, this emerging field plays an important role in guiding the theory developed below and gets considerable attention in the literature review.

There are many ideas from diverse sources that are important to understanding the context of managerial EW use, however. The seven categories above provide a broad framework to organize the relevant literature.

Characteristics of the Electronic System

Some theories of use emphasize the variables or factors in the hardware and software of the electronic system. System designers have identified a number of characteristics of the human-computer interface and labeled these "human factors." These factors concern primarily the user's relationship to software and hardware. Shneiderman lists (1) time to learn the system, (2) response time (speed of system performance), (3) rate of errors made by the user, (4) user satisfaction and (5) retention of operating commands over time as representative human factors issues

(Shneiderman, 1983). Other systems designers focus on ergonomic issues, such as: user fatigue, user eye strain, optimal matching of the workstation to human anatomy, etc. (See Bailey, 1982.)

The human factors and ergonomics of human-computer interaction are beyond the scope of this study. The neglect of these issues does not represent an evaluation of their importance. Sensible and user friendly design of software and terminals is a basic requirement for use by anyone. Because these groups of variables are common to use in all contexts, however, they are less relevant in developing a theory of managerial use. To put the point differently: this study addresses the causes of managerial use, while holding the technical definition of the system constant. This research focus derives from the orientation (revealed in the Introduction) that hurdles to successful systems may be found in the human and organizational side of information systems.

Characteristics of the Design and Implementation Process

Research focusing on the design and implementation process often takes into account many different kinds of factors. This body of theory draws from characteristics of the individual, group, organization, task and Information Systems department as predictors of system use or system success.

Implementation as Organizational Change

"The ultimate objective of implementation research is to provide guidelines for the management of implementation" (Ginzberg, 1984). Ideally, the implementation process should integrate factors in the system and its organizational environment such that use or success is achieved. There are some recent "guidebooks" to system development that attempt to prescribe the means for such integration (Lucas, 1981; Ginzberg, 1978b; Meister, 1976).

An important fact about OA systems that distinguishes them from other, noninteractive computer applications is the magnitude of organization change in their adoption. Ginzberg (1978a) noted that in transactions-based (e.g., airline reservations) and clerical replacement systems (e.g., general ledger accounting), the motivation for implementation is basically a response to changes occurring outside the organization. Existing systems are simply unable to cope with the required amounts of data. In decision support systems, however, as well as OA systems used by managers, the impetus is a belief that there could be "better ways of doing things." The motivation is to induce change, rather than to respond to it.

Ginzberg (1978a) defined four "levels of adoption" for different kinds of systems:

1. Management Action: The system may be used without extensive understanding. At this level, the user treats the system as a black box which gives him/her needed information or provides him/her with a solution. Examples include systems for travel and lodging reservations, systems for entering customer orders, and systems for tracking an individual's credit worthiness.

2. Management Change: Use of a system with an elementary understanding by the user of what the system does; at this level, the user treats the system as a tool which he/she can apply to help find answers to specific questions. Examples are inventory control systems, production scheduling systems, and sophisticated data-based inquiry systems of all kinds.

3. Recurring Use of the Management Science Approach: Use of the system involves an appreciation for the analytic approach to problem solving. Here the user attempts to apply the analytic framework provided by the system to a variety of problems which confront him/her during the course of performing the job. Systems that make use of operations research models (such as loan portfolio management systems, investment decision support systems, and strategic planning systems) illustrate this level of adoption.

4. Task Redefinition: At this level, use of the system acts as a catalyst for change in the definition of the user's role. The user actively attempts to change his/her view of the job, and uses the system to help redefine the tasks it was designed to support. A great deal of change may occur because the nature of the job itself is changed as a result of the adoption of system use. Automated office systems have had this kind of impact on secretarial jobs, for example. Secretarial work is now divided into new specialties: administrative assistance, word processing, message keeping, etc. The strong reaction by some office workers to this new division of work demonstrates the magnitude of change implicit in the adoption of such systems (Downing, 1981).

Each of these levels involves a different degree of change in the individual and the organization. Level Four, where the most change is induced, applies to the managerial use of OA systems. Because so much change is involved in the adoption and use of OA for managers, the approach to design and implementation of such systems should be grounded in organization change theory. While this may seem obvious, calls for finding some way to cope with "resistance to change" in OA implementation abound in the literature (Ness, 1980; Nussbaum, 1982). Too often the tendency among computer specialists is to "design the system, get it up and running, and then deal with the people problems, politics and other nontechnical issues" (Keen, 1975).

There have been explicit attempts to integrate concepts from organization development into the design and implementation of managerial information systems (Ginzberg, 1975, 1978; Keen, 1975; Alter and Ginzberg, 1978). As a change program, the design and implementation of OA systems is divided into three stages: diagnosis, planning and action (Keen, 1975).

Setting Goals for Implementation

In the diagnosis stage, goals are set and problems defined that the system is expected to address (Ginzberg, 1978b). It is vital that consensus be reached among the change agent and client group if commitment to implementation is to be assured (Keen, 1975). Goals and problems must be defined in some detail so that progress can be measured (Keen, 1975). It is often emphasized that OA implementation must be "need driven" not "technology driven" (Rockhold, 1982, Carlisle, 1979). This idea is consistent with social change theory: successful innovations start with a need felt in the potential adopters (Rogers and Shoemaker, 1971).

Part of the diagnostic phase, but also part of the planning and action steps, is a clarification of expectations among users and the Information Systems department. Unclear or unfulfilled expectations have been associated with implementation failure (Faeber and Ratliff, 1980; Ginzberg, 1981).

Expectations should be clarified about: (1) the reasons for developing the system, (2) the importance of the problem being addressed, (3) the way the system will be used, (4) the impacts the system is likely to have on the organization, and (5) the criteria which should be used to evaluate the system (Ginzberg, 1981).

Participation in Planning

When diagnosis of the problem is complete and goals and expectations for the system clarified, detailed planning can begin. A committee or task force to accomplish this is often recommended (Walshe, 1981, Maskovsky, 1981; Goldfield, 1982). Representatives from top management, data processing, administrative services, personnel, behavioral science and facilities planning should be blended into this group (Miller, 1981; Dickinson, 1981; Maskovsky, 1981). By involving the affected parties in the planning process, the resource allocation and system design decisions reached are less likely to meet resistance during implementation.

The involvement of the user in the design and implementation process is widely recommended by writers in the information system field (Olson and Ives, 1981; Wagner, 1982; Clapp, 1983; Connell, 1982; Maskovsky, 1982). Moreover, there is evidence to support the relationship between user involvement and system success (Kling, 1981; Steinbrecher, 1983; King and Rodriguez, 1981) even in the specific context of OA (Mankin, Bikson and Gutek, 1982). The proposition that user involvement facilitates system success is consistent with change theory; the degree of involvement should vary directly with the magnitude of the change involved (Lewin, 1951; Coch and French, 1948; Dickinson, 1981).

Implementation Elements

Writers have pointed out a number of key elements in the action phase of system implementation. For some, education of managers should precede even the diagnosis phase (Norton, 1982; Conroy and Bieber, 1981). An attitude survey may help to determine the degree to which OA is feared (Horrigan, 1981). Pilot groups may be singled out for the project, and once their success is demonstrated the program is more easily broadened to a wider context (Conroy and Bieber, 1981). Another popular idea is to allow managerial users to experiment with the new tools in a "toy store" environment--permitting equipment to be taken home, for example (Business Week, 1980; Conroy in Dwyer, 1983). The view that higher status employees will not want their early mistakes to be obvious to subordinates seems to apply especially well in the managerial case (Martorelli, 1982).

Comprehensive Theories of Implementation

Lucas (1981) differentiates between process and factor studies in the literature and produces a scheme whereby relevant "design activities" are identified at each stage of a six stage implementation process. The stages are: (1) scouting and entry, (2) diagnosis, (3) planning, (4) action, (5) evaluation and (6) termination. Factors are categorized in five ways: technical characteristics, client action, attitudes toward the system, decision style and personal/situational factors. The cells of this six by five matrix represent the prescribed design activity for each type of factor at each stage in system development.

Schultz, Ginzberg and Lucas (1984) reviewed the literature on implementation and found "relationships identified in replicated studies." Table 2.1 summarizes the variables related to system success and use in their theory of implementation. In this framework, implementation is defined in terms of management change and improvement. Because change and even improvement may occur without use, use is only one of the measures of implementation and implementation success. Acceptance of the system is the other key measure of implementation.

Based on this distinction, the authors develop a multiple level theory of implementation wherein manager acceptance is modeled for each level of intermediary between system designer and user. For example, the basic model anticipates that a system must first be accepted by the management responsible. Factors important to management acceptance are modeled at the first level of a two level theory. The second level of

Table 2.1: Variables Identified in A Structural Model of Implementation (working paper, Schultz, Ginzberg and Lucas, 1984)

Manager Model

- top management support
- manager-researcher involvement
- manager belief in system concept
- manager knowledge of system
- manager confidence in system and support
- manager decision style
- goal congruence
- manager job characteristics
- manager demographics
- organizational support
- manager acceptance

User Model

- user perception of management support
- user knowledge of system purpose/use
- organizational change caused by system
- problem urgency
- user's personal stake
- user decision style
- user knowledge of system
- user-researcher involvement
- user confidence in system and support
- goal congruence
- system characteristics
- user job characteristics
- user demographics
- organizational support
- satisfaction
- user acceptance
- use
- performance

this "structured model" depicts the relationships among variables that determine user acceptance and use. Interestingly, the determinants of acceptance and use are more or less the same for all levels and are based on the variables identified in Table 2.1.

While Schultz, Ginzberg and Lucas (1984) suggest a methodology for testing their model, the results presented are relevant only to a small subset of the variables contemplated in their model. The limitations of their findings are not surprising given the diverse nature of the independent variables and the measurement problems this presents.

Characteristics of the Individual

Theory and research relevant to the factors in the individual that influence managers to use OA comes from a variety of sources. There are rigorous empirical studies and rather well developed theories regarding individual differences and the acceptance of management information systems. There is a sizeable literature appearing in many different kinds of journals concerning fears that people may have about interacting with computers. There has been some research and more speculation about demographic factors in relation to computer usage. Theories of innovation communication and social change speak in a very straightforward way to the issue of individual differences. Finally, there is a good deal of stereotyping of users versus non-users in the popular and trade press. While this last category may not belong in a scientific discussion, the influence of these ideas is apparent, and they may provide the basis for theory-building research.

Individual Differences in MIS

Individual differences among managers may affect their use of OA. These differences are many and varied.

Zmud (1979) reviewed the literature of individual differences affecting the success of management information systems (MIS). He found that four kinds of individual differences have been found to affect MIS success: cognitive style, personality, attitudes, and demographic factors. Table 2.2 summarizes the most important associations that have been established.

For this body of theory, research results have shown that MIS usage and success are consistently positively associated; Zmud (1979) cited eight studies to support this proposition (p. 973). Research must be conducted in the OA environment to confirm the generalizability of these theories in a new context.

Whisler (1970) in a wide-ranging study conducted from an organization behaviorist's perspective confirmed some of the attitudinal and demographic findings but had an interesting, organizational interpretation of such results. He also found that younger managers had a more favorable attitude toward computers—except when compared to those older individuals at the top of the organization. These top managers felt "beyond the reach of the technology" and were consequently undisturbed by the change. One wonders whether this find holds for the contemporary environment. Whisler also found that line managers held negative attitudes toward computer systems because they felt uneasy about the influence conferred on DP staff specialists within the organization.

Table 2.2: Individual Differences Affecting the Success of MIS (Adapted from: Zmud, 1979.)

Source of Difference	Effect
Cognitive Style:	information requirements based on decision maker's world view;
	cognitively complex subjects found to search for and use more information;
	systematics observed to utilize MIS more than heuristics;
	subjects with greater risk-taking propensity utilized MIS less;
	subjects intolerant of ambiguity found to prefer concrete stimuli and to perceive more information as being valuable.
Personality:	greater information search activity observed for subjects possessing an internal locus of control, low degree of dogmatism and high risk-taking propensity;
	extroverted subjects found to retrieve information stored in their own minds more quickly and to retain information better over short intervals.
Attitudes:	preconceived attitudes associated with MIS success to a much greater extent than user satisfaction with MIS;
	usage positively associated with attitudes regarding the potential of an MIS, the urgency of MIS, the extent of top management support for an MIS and the quality of the MIS staff.
Demographic Factors:	males have less positive attitudes to MIS than females;
	older individuals have less positive attitudes than younger individuals;
	less educated individuals have less positive attitudes toward MIS but more educated individuals exhibit less usage (somewhat contradictory findings);
	subjects with longer tenure in the organization exhibit less usage;
	individuals with higher task knowledge and a professional status tend to use MIS more;
	findings regarding organizational level of subjects and MIS usage are mixed.

Fears of OA

The most pervasive of these fears is the fear of loss of jobs. The popular and business press both have given this issue attention in the specific context of threats to the jobs of middle managers (Bralove, 1983; Business Week, 1983). Such fears are not altogether ungrounded in fact. Studies of the effect of word processing on clerical jobs have found that a skilled word processor can replace 2.5 to 3.0 typist positions (Modern Office and Data Management, 1979). Journalists have reasoned that because electronic workstations provide top management with access to information and analytical reports previously provided by middle managers, there should be a reduction in the number of this segment of the work force. Studies of how computer systems affect middle management jobs are mixed regarding whether a real reduction occurs (Stone, 1975; Steward, 1971; Delaharty, 1967; Whisler, 1970). Whether it is grounded in fact, the threat to job security represented by OA for some managers would likely produce low utilization behavior.

Another fear rooted in OA usage by managers surrounds the possibilities that are opened up for supervision and control (Zuboff, 1982). The spectre of a top manager perusing the work of subordinates or requesting daily progress reports through an electronic workstation has negative implications for the autonomy present in managerial work. Since autonomy has been found to be an important motivating factor in managerial work (Hackman and Oldham, 1974), one can understand why its loss would be feared. There is no hard evidence to suggest that workstations have been used to monitor workers in this way.

The changes required of the individual in adopting OA are also the source of fear for some. Argyris (1971) pointed out long ago that management information systems portend threatening changes. He argues that an MIS tends to create conditions where an executive's space for free movement is reduced, where the executive faces psychological failure and where leadership is based more on competence than formal power. Any or all of these deviations from the status quo can be the basis for negative reactions on the part of managers. Apprehension is also based on a fear of the unknown in a more general way. This may include: (1) worries about new skills that are required (Tapscott, 1981), (2) feelings of a loss of control over the work environment (Galitz and Cirillo, 1983), (3) distaste for working in an abstract media (Zuboff, 1983); or basic feelings of inadequacy and fear of failure in the face of new performance expectations (Galitz and Cirillo, 1983; Scannel, 1982).

A final source of fear is the impact that OA may have on a manager's social environment. It is widely held in social psychology that changes that disturb existing social relationships will be resisted. Zuboff (1982), who has interviewed many managers, confirms that some see social interaction affected in a fundamental way when workstations are on everyone's desk. According to these resistors, the terminal becomes the focus of social interaction, and this has a negative effect on the quality of work life. Many have speculated that communication patterns will change with electronic networking. Generally, it is believed that the overall volume of communication transactions will increase and that electronic communications through the terminal will replace face-to-face and voice communications to some degree (Olson and Lucas, 1982). Empirical research supports this proposition but more studies are needed in a variety of contexts (The Yankee Group, 1979; Johansen and DeGrasse, 1979).

Fear is a very powerful emotion. It is felt deep within the psyche of individuals. Whatever factor becomes so labeled deserves special attention as a resisting force to OA implementation. More research is needed both into the existence of these fears in managers and their basis in fact.

Age and OA Use

One of the demographic variables recognized in MIS research has been taken up in the literature of OA and should be mentioned separately. It is widely believed that age is in itself a barrier to utilization. The stereotypical reluctant user of OA is over fifty-five. There is some evidence to support this description (Tisdall, 1982). Another widely cited study (Poppel, 1982) concludes that not age, but tenure with the organization is strongly associated with low usage levels in managers. The logic is that older managers have a vested interest in the status quo and basic fears of obsolescence in the face of this new technology (Barnes, 1983). Again, one must recognize that while there may be some validity to age as a predictor of utilization, too little empirical work has been done to determine the degree to which it is valid.

Innovation Adoption

The theory of social change produces a typology of adopters of innovation that has been widely discussed and broadly confirmed in research. It stands out as an individual difference measure that may have great utility in a theory of managerial utilization of electronic workstations. The five types are: innovators, early adopters, early majority, late majority and laggards. (Rogers and Schoemaker, 1971). There is a large body of research about the psychological differences present in this typology. Since early adopters are a key group to gaining acceptance of any innovation, their characteristics may apply to potential early managerial users of OA. Rogers and Shoemaker (1971) find confirmation for the following hypotheses: 91) early adopters are younger, (2) early adopters are more educated, (3) early adopters are of higher status, (4) early adopters are upwardly mobile, (5) early adopters are less dogmatic, (6) early adopters are more favorable toward change in general, (7) early adopters are more intelligent, (8) early adopters are more favorable toward risk-taking, (9) early adopters are less fatalistic and (10) early adopters are higher in N-Ach (achievement) motivation.

Stereotypes and Status

There is another adopter of innovation typology wherein only two stereotypes exist. On the one hand there is the "technitron" that believes technology can solve any problem, and on the other hand, there is the "luddite" who resists the use of new technology (Springer, 1983). In loose conversation it is often suggested that these types can be predicted based upon professional background, job experience, and the like.

Finally, there has been much made of the status of using an electronic workstation. On the one hand, "making it electronically" has been described as being as important as country club membership and executive dining rooms (Buss, 1982). Another camp sees any tool as something a laborer, not manager, uses and, further, that the higher one climbs the organizational hierarchy "the less you should really know." In short, using a terminal is "not something to be done in public" (Falvey, 1983). Both the stereotyping and contradictory status theories are sorely unresearched.

Characteristics of the Job

The aspects of a manager's job that are enhanced or facilitated by OA can be seen as factors contributing to use, and the aspects of a manager's job that are made more difficult or that are impacted negatively by OA can be seen as resistance factors. This presumes that managers are rational and will utilize a tool like OA to the degree it makes their job easier or more enjoyable. Of course, the benefit must also be perceived by a potential user before utilization can be expected.

If OA really performs useful work for managers, it may only be a matter of educating them to that benefit and waiting for them to take it up. Consequently, it is generally recognized "that these tools must suit managers' work habits, roles, and perceptions..." and "...they must also facilitate quick and efficient task accomplishment..." (Fancher, 1982).

Terminals must "fit the personality and work of the executive..." (Data Management, 1982). Many are of the opinion that OA for managers is somehow inevitable: that "managers in the 21st century will have to sharpen old skills and acquire new ones" (Mertes, 1981). With this inevitability will come fundamental changes in managerial work roles such that "jobs should be reformulated; methods of supervising should be rethought" (Adams, 1982).

Measuring Productivity

Overriding the attention paid to OA's impact on the manager's job is a concern that this impact should be positive. Ways to measure the impacts on the productivity of managers have consequently been much discussed. Some call for the standardization and counting of work done by professionals and secretaries (LeBoutillier, 1980), but it is doubtful that this approach could apply to managerial work, especially at higher levels in the hierarchy. Others describe the need to look "beyond the task to be performed and concentrate on the extent to which better performance of that function will improve overall organizational performance" (Mayman, 1980). Other approaches analyze the managerial job into task subcomponents and address OA's impact for each of these functions or components. Such approaches are divided into two groups: those based on a segmentation of managerial work into activities described at a low level of abstraction (e.g. meeting, creating documents, analyzing, reading and less productive—IBM Corporation, 1983), and those based on a division of managerial work described from the perspective of traditional management theory (e.g., planning, supervising, communicating, coordinating, etc.). The former typically focus on time savings in each of the categories as the measure of OA's productivity impact, while the latter are less explicit about productivity impacts but are directed at identifying benefits nonetheless.

Managerial Activities

There have been a variety of studies of how a manager spends his time. Table 2.3 summarizes several of these.

One can see from Table 2.3 that the measurement of managerial time is either a very situation-specific or highly unreliable process—or both. (The percentages represent the percent of time spent in each activity.) In fact, researchers following this methodology recognize that results are "highly variable from person to person" and "even comparisons between similar companies...can be misleading" (James H. Bair in Schindler, 1983). Measured productivity gains are similarly variable across studies from nine percent (IBM Corporation, 1983) to ten (Poppel, 1983), to nineteen, twenty or even twenty-five percent (Barcomb, 1981). Conservatively, one can conclude that OA improves managerial productivity in terms of time savings between ten and fifteen percent.

One way of putting these studies into perspective is to observe that their underlying idea is to measure the benefits of OA in terms of improved support for the manager's job. The greatest advantages seem to be in time savings derived mostly from the elimination of misdialing, redialing, getting a busy signal, etc., on the telephone, avoiding

Table 2.3: Summary of How Managerial Time Is Spent (Adapted from Shindler, 1983)

Bell Northern Research, Inc.

Meetings 59%
Unscheduled Meetings 10%
Phone 6%
Travel 3%
Desk work 22%

IBM/SRI International

Meetings 30%
Phone 14%
Travel 13%
Desk work 23%
Filing and Retrieval 6%
Clerical 10%
Other 3%

Bolt Beranek and Newman, Inc.

Meetings 40-70%

Document Generation 15-25%

Document Retrieval 10-20%

Activity Management 5-10%

Barcomb

Shadow function 30 minutes per day
Unscheduled interruptions 60 minutes
Instructions to typist 5 minutes
Transfer/retrieval of information 20 minutes

Booz Allen and Hamilton, Inc.

Meetings (including phone) 46%
Reading 8%
Document Creation 13%
Analysis 8%
Less Productive Activities 25%

IBM Study, 1983

Meetings 42%
Creating Documents 15%
Analyzing 14%
Reading 10%
Less Productive Activities 19%

unscheduled interruptions, avoiding travel made unnecessary by electronic communications, and reducing time spent writing, proofreading, copying and transferring text. In the IBM study (1983), for example, 44% of the projected nine percent time savings came in telephone and other waiting delays improvement. These activities have been called "less productive" (Poppel, 1983) or "the shadow functions of management" (Barcomb, 1981) in that they do not contribute directly to the management task but are "attendant to it" and frequently undelegable.

There are other ways to save managers' time with improved support besides OA. More and better secretarial support is an alternative. This raises the issue as to whether the OA alternative is most cost effective. Secondly, even given that the most effective way to provide this support is through OA, the magnitude of perceived benefit produced in the mind of the manager considering utilization may not be sufficient to outweigh the personal costs of learning the new technology. After all, while a ten to fifteen percent time savings is highly significant from an organizational perspective, to the individual manager such expectations may be too low to warrant the effort.

There is a third point about measuring OA's impact in this way. If the payoff is mostly in terms of providing more leisure to the individual, where is the organization's benefit? There may be a reduction on manager stress levels (as yet not established), but is this sufficient to tip the cost/benefit scale in favor of OA? In one of the above studies where this was investigated, managers indicated that they would like to redistribute

4.6 hours of their time, but 3.1 of these would go to increased leisure activity (IBM Corporation, 1983).

Managerial Functions

The two most popular formulations of the managerial task are the process approach (Steiner, Miner and Gray, 1982) and the working roles approach (Mintzberg, 1973). The process approach comes out of classical organization theory, but has recently received empirical attention (Miner, 1971; 1978). As empirically confirmed, this list of functions includes planning, organizing, supervising, coordinating, controlling, communicating, investigating, evaluating, and decision making. The working role's approach (Mintzberg, 1973; 1975; 1979) identifies three main types of roles each with sub-roles included: (1) interpersonal roles (figurehead, leader, liaison), (2) informational roles (monitor, disseminator, spokesman), and (3) decisional roles (entrepreneur, disturbance handler, resource allocator, negotiator). While the working roles typology would appear to hold more promise for analyzing OA's impact on the managerial task, the work that has been done is focused more on the variables as defined by the more traditional approach.

Whisler (1970) provides an exception to the narrowly focused studies of computers on managerial work. He created his own definition of managerial work consisting of four components: communication, goal setting, computation and pattern recognition. He found that computer systems could enhance communications and computations but that they had little effect on goal setting or pattern recognition. It is important to remember the age of this study and that it was done in a noninteractive environment. Despite these restrictions, some parallels exist between these results and the more recent time studies described earlier.

The research on this topic has examined only a subset of managerial processes or functions; it has disproportionately focused on the decision making and communications processes.

Decision Support Systems

Extensive work has been done within the management information systems literature. It becomes relevant because of the focus on decision support systems. These support systems have been defined by their principal characteristics as (1) a complement to electronic data processing transaction oriented systems, (2) users of external data as well as internal organization data, (3) capable of quick assembly in the form of ad-hoc models, and (4) making computer technology more applicable to the judgmental and proactive areas of management decision making (Interfaces, 1982; Keen, 1982).

A decision support system (DSS) fits certain decision making environments better than others. Morton (in Blakeney, 1982) has described the three possibilities as structured, semi-structured and unstructured problems. The nature of a DSS makes its use most effective for semi-structured problems. (Structured problems can be programmed and require litle decision activity, and unstructured problems are by definition not susceptible to the kind of analysis computers perform best.) Because OA puts the computer literally in the hands of managers, it provides apparent relief in this area of semi-structured problem solving (Wagner, 1980), and this may be its most important application for managers. In this context OA could have the benefit of "enhancing and amplifying the inherent mental powers of managers and stimulating their creativity" (Wagner, 1980).

However, there is some evidence that an effective decision support system does not imply electronic workstations on the desks of managers. Alter (1975) studied fifty-six systems and rarely found a decision maker sitting at a terminal; this behavior typically was observed where the subject was to produce a report for someone else. Andreoli and Steadman (1975) studied a bank trust department and found almost no interactive use of a portfolio management system by bank officers. Carter (1975) argued that the executive and terminal are not likely to meet face-to-face because (1) most executive decision making does not require much detail or immediate response, (2) usually lower level management is responsible to examine the raw data and present key facts, and (3) executive decision making is a more leisurely process where an immediate decision is rarely needed.

In fact, a very influential scholar in the field advocates the "chauffeur-driven" mode as appropriate for higher levels of management. This presupposes an intermediary who will learn system facility for the executive and respond to information and analytical demands that arise. Even though response time may not be sub-second, Keen (1976) insists that such a system may satisfy the "turnaround test," i.e. the time taken by the information search does not interrupt the problem solving process. In this sense, a system is interactive from a managerial perspective if the executive can (1) maintain the nonstructured approach, (2) get responses in terms and forms that he or she needs and (3) get the results in a reasonable amount of time. If this is true, a decision support system may not be one of the payoffs managers attribute to OA.

Essentially the decision to rely on an intermediary or provide an interactive system is based on a trade off between the following factors: (1) the degree of structure in the job, (2) the number of users of the DSS, (3) the difficulty (and thus cost) of training users, (4) the level in the organizational hierarchy that users occupy, and (5) the overhead inherent in the interactive software under consideration (Keen, 1976). This suggests that as a decision support system, workstations may be limited to the desks of junior and middle managers.

Decision making is a central aspect of management. The degree to which interactive use by managers enhances decision support is likely to be important in supporting use of OA by managers. For benefits to accrue to the communications process, however, it must be presumed that managers use a workstation interactively.

Managerial Communications

The communications functions of OA have broad organizational consequences. Olson and Lucas (1982) mention communications functions in nine of the seventeen propositions of OA's organizational impacts. Almost any accepted definition for OA systems emphasizes the communications function; communications is frequently cited as the area of most benefit to managers from OA (Bair, 1978; Hiltz and Turoff, 1979; Moody, 1983).

First, it has been shown that the communications functions (electronic mail, voice mail, teleconferencing) of OA have the effect of increasing the total volume of communications (The Yankee Group, 1979). This can probably be explained by the ease with which electronic communication is accomplished when it is available. (Recall that studies of managerial time usage have shown important efficiency improvements here.)

However, the fact that a manager can communicate more does not guarantee that the communications process or organization performance will be improved. Communication theory postulates that communication effectiveness is at least partly determined by the appropriate matching of message content with channel. If feelings are to be communicated, for example, an audio or face-to-face channel would be preferred. Thus, turning the OA communications function into a facilitator of the managerial task means that managers must discriminate wisely in channel selection—not overuse or misuse the electronic medium. Moreover, Ackoff (1967) questions whether improved communications by managers means improved organizational performance.

While there is no doubt that OA can enhance the communication process, it is apparent that substantial research and education is required in order to make effective use of the new medium. Otherwise, negative consequences (e.g. a reduction in the social reinforcement received at work by a decrease in face-to-face contact) will become reasons to resist OA.

To summarize, there is clear evidence and common sense to support the notion that a workstation can allow the manager to increase message volume; however, it is clear that not all messages are effectively transmitted over the electronic medium. More research into the kind of message content that can be effectively transmitted over terminals is needed. Moreover, this knowledge must be understood by practicing managers to avoid negative consequences and to encourage effective results.

Other management processes that are clearly affected by OA are planning, coordination and supervision. Of these, only the latter two have been examined in the OA context.

Planning

For planning, one must broaden the context to include all formal computer based planning systems, interactive or not. First, there is considerable debate as to how important formal planning is at higher management levels (Quinn, 1980; Lindblom, 1959). Nevertheless, many organizations have made a variety of attempts to implement formal planning models with computer systems. The computer's ability to manipulate large amounts of data quickly and to respond to "what if" queries (i.e. simulations) seem to apply directly to this managerial task. This is true whether the planning unit is a billion dollar corporation or an accounting department. Financial planning in the form of budget reports has been computerized in many organizations for some time. Should the budgeting process be implemented to give managers on-line access and simulation abilities, a natural enhancement to the planning function would result from the use of OA. Moreover, the simple revisability and confidentiality provided by a manager's creation of a written plan through OA text processing functions would argue for some effect on the planning process—whether this effect is positive or negative is as yet undetermined.

Coordination

The manager's coordination responsibilities may also be enhanced by OA. There is no empirical work to support this, but Reifschneider believes that "activity management" (i.e. a system designed to plan and monitor performance of tasks contributing to some overall activity) integrates well with the personal workstation approach to management. It seems reasonable to extend this concept to the coordination of subordinate activity in general. After all, information transfer alone achieves coordination in some contexts, and OA facilitates information transfer (Reifschneider, 1981). However, there has been some fear expressed on the part of those in the subordinate role that such "electronic coordination" produces a dehumanized organization in which the system becomes the task master (Zuboff, 1982).

Supervision

One of the more widely expected impacts of OA on managers is an increased span of control, i.e. the ability to supervise a larger number of subordinates (Olson and Lucas, 1982; Reifschneider, 1981; Olson and White, 1979). In the context of OA, no empirical work has been done to confirm this expectation. Whisler (1970) found the opposite in his study of the computer's impact on insurance companies. In this regard, it is unclear whether the communications functions of the terminal substitute adequately for the kind of face-to-face supervision to which managers and subordinates are accustomed.

If the span of control hypothesis proves accurate, managers will necessarily have less actual contact with their subordinates (Kirchner, 1980). Reducing personal contact may reduce supervision effectiveness. It has been a principle of supervision for some time that the number of individuals supervised increases with the degree of routinization, specialization and standardization in the task performed by subordinates (Fayol, 1949). It is also well accepted in the literature of leadership that subordinates vary in terms of the degree of structure needed or desired from management and the degree of interpersonal concern needed or desired (Fiedler, 1967; Vroom, 1964). Interpersonal concern is probably difficult to express over a terminal network; whereas, routine tasks can likely be monitored more efficiently through an electronic medium. These kind of propositions need to be tested and a theory of "electronic supervision" developed before improved supervision can be confidently labeled a benefit of OA.

Remote Office Work

There is one kind of office work that necessarily involves electronic supervision--remote office work. This term has been defined as "organizational work performed outside the normal confines of space and time" (Olson, 1981). In a survey of participants in remote work programs, Olson (1981) found that jobs performed successfully on a remote basis possessed the following six characteristics: (1) minimum physical requirements, (2) individual control over the work pace, (3) defined deliverables, (4) a need for concentration, (5) well defined milestones, and (6) relatively low communication needs. All but the first of these descriptors implies a low need for supervision of the work in general. These findings may thus have implications for the use of terminals in supervision more broadly. Another observation Olson (1981) made was that individuals that were successful in remote work contexts tended to be self-motivated and disciplined. This has implications for supervisory practices.

Thus the available evidence suggests that OA may indeed make it possible for managers to supervise a greater number of subordinates. However, such supervision may only be appropriate under limited circumstances.

Managerial Job Satisfaction

Empirical work on job satisfaction is in the exploratory stage. There have been no studies describing the impact of OA on job satisfaction of managers. In a broad investigation of the impact of information systems on user job satisfaction levels, Cheney and Dickson (1982) found that in about one-half of the projects studied satisfaction measures showed a post implementation increase.

In order to speculate on the impacts of OA on managerial satisfaction, it is necessary to understand the accepted dimensions of job satisfaction. One of the most widely accepted and researched models that relates the dimensions of work to job satisfaction has been developed by Hackman and Oldham (1974). Table 2.4 represents the variables and relationships of this concept. It is assumed that as OA increases the internal motivation and job satisfaction of managers OA utilization will be increased. Indeed, if OA fails to have a positive influence on the core job dimensions, organizations can expect negative outcomes such as lower quality work performance and higher absenteeism and turnover.

In other contexts, the notion that OA systems should be designed to have positive effects on such dimensions has been used to avoid negative consequences (Mumford and Weir, 1979). Known as the sociotechnical approach to work design, the process is to diagnose jobs prior to implementing OA along the dimensions suggested by Hackman and Oldham or other (e.g. Herzberg, 1968) "job enrichment" schemes and then use the new system to create more positive effects on satisfaction and motivation.

Job Dimensions

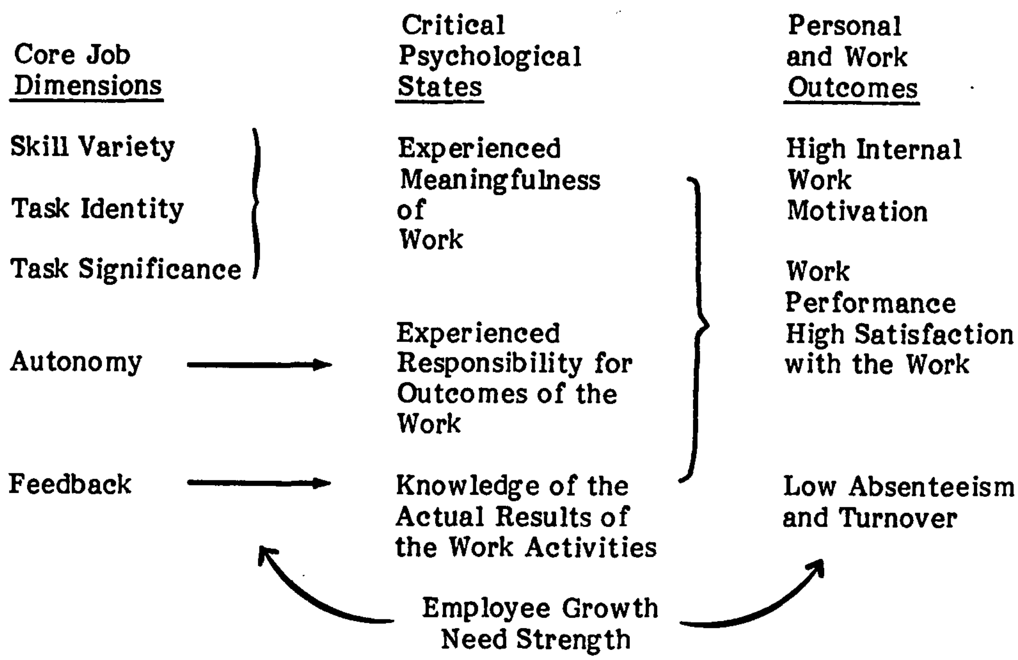
It is important to define the core job dimensions and examine the evidence as to the effect OA may have on each. Definitions for each of the five terms follow below (adapted from Hackman and Oldham, 1974).

1. Skill variety: To an extent, the more that different skills are involved, the greater the potential for a meaningful job.

2. Task identity: To the extent that the job allows for a whole piece of work which is identifiable to the worker, the job is more meaningful.

Table 2.4: Relationships Among Core Job Dimensions and On-the-Job Outcomes

Source: "The Job Diagnostic Survey: An Instrument for the Diagnosis of Jobs and the Evaluation of Job Reassign Projects," J. Richard Hackman and Greg R. Oldham, Technical Report No. 4, Dept. of Administrative Sciences, Yale University, May 1974.



3. Task significance: A significant task has a perceivable impact on others.

4. Autonomy: Autonomy is the degree to which the job gives the worker independence, freedom, and discretion in scheduling and carrying out the task.

5. Feedback from the job: Feedback is the extent to which a worker can obtain information about the effectiveness of his/her work. Feedback is most effective when it comes directly from the work itself, rather than from some other source.

There is no empirical evidence of OA impact on these dimensions for managerial jobs. However, for clerical applications Mumford and Weir (1979) argue that OA reduces task variety, task identity and task significance by increasing specialization and routinization of work. Harkness (1977) also finds an increase in specialization in clerical work. For production tasks, it has long been believed that automation reduces skill requirements (by increasing specialization) (Bright, 1958). In Zuboff's interviews (1982) she found that managers feared greater regimentation and an encroachment on their freedom as a result of the increased measurability of work provided in an OA environment. Although there has been no suggestion to this effect in the literature to date, it would appear that OA has positive impacts on the feedback dimension by virtue of the ability of such systems to keep track of task performance (e.g. document when a request coming over electronic mail has been answered).

There is more speculation than evidence on this issue, but it appears that unless OA is deliberately implemented in a way which avoids the kind of negative impacts cited above, such systems have the potential for negative consequences on job satisfaction and internal work motivation of managers. If this is so, these factors are powerful forces of resistance to OA utilization.

Characteristics of Interpersonal Relationships

Along with the tasks of management, the importance of interpersonal relationships for managers has been emphasized for decades. Exclusive focus on the task by management theorists marked the school of "Scientific Management." Since the Hawthorne studies conducted at Western Electric (Rothliesburger and Dickson, 1939), it has been understood that the sociology of the workplace is as important to management as the structure of the task. Accepted models for leadership consistently cite relationships with others as a crucial consideration in determining appropriate managerial behavior (Blake and Mouton, 1978). Thus, we conclude that any impact of OA that facilitates the interpersonal process will help support OA use by managers; inhibiting factors will create resistance.

That OA impacts relationships among co-workers is virtually unquestioned. The communications functions of OA are the primary source of these changes. Ideas abound on this topic but careful research is meager.

Leduc (1979) found in an empirical study that communicating personal opinions and feelings electronically is difficult and usually avoided. Thus, to the degree that electronic communications supplants channels that do carry feeling messages, OA is likely to reduce the emotional component of social interaction at work. This effect transforms the quality of work life (Zuboff, 1982). Moreover, it will likely be some time before computer communications become personalized (Morgan, 1981). While it would seem that expression of a concern for people requires an emotional content to communications, there is only slight evidence that interpersonal relationships are affected negatively by this communications restriction. Harkness (1977) found that remote supervision was "less sensitive."

Another rationale that implies negative effects from OA on interpersonal relationships comes out of need theories of human motivation. Maslow (1943) and McClelland (1962) have established widely accepted concepts of social needs in individuals. Since many individuals have unsatisfied social needs, a need for affiliation (McClelland, 1962) becomes an important factor in work motivation. It has been assumed that OA will reduce the amount of social interaction (Olson and Lucas, 1982; Zientara, 1980), and it is obvious that time spent at a workstation is not time spent with people, i.e. social interaction. Thus, the rationale goes, OA will reduce motivation to work by inhibiting the satisfaction of social needs in the work environment. If true, this has negative implications for OA utilization.

On the other hand, it is also obvious that electronic communication can increase the number of people "known" and thereby increase interaction with others, albeit through a new medium (Morgan, 1981). Moreover, the successful uses of OA in superior-subordinate communications (Leduc, 1979) and the benefit of enhancing long distance communication (Panko, 1981) argue that OA may have offsetting, positive effects on the satisfaction of social needs at work.

A third construct that is obviously impacted by OA is the work group. OA has the potential for changing the make-up of work groups (Stout, 1981) as well as affecting the degree of intergroup conflict and degree of perceived interdependence (Olson and Lucas, 1982). Moreover, it appears that the "social inertia" found in work groups is itself a resistance factor to information system use (Keen, 1981).

While a number of reviews describe the potential impacts of OA on office sociology (Olson and White, 1979; Olson and Lucas, 1982; Olson, 1981; Kling, 1980), they are mainly speculative, since little empirical work has been reported.

Characteristics of the Organization

In one sense, all the characteristics that have been described to this point are organizational. For purposes of discerning factors in this section, however, the intent is to specify a level of analysis—the organization structure and process.

Organizational Structure

To say that available research evidence is mixed with regard to the impact of computer systems on organization shape is an understatement. Evidence and predictions are largely contradictory. Whisler (1970) found that centralization is increased (i.e. that the insurance companies became "taller" as a result of an IS system implementation). This is consistent with more contemporary arguments that OA will reduce the number of middle managers by increasing span of control (Sharp, 1981; Neumann, 1978). Other researchers have not found a decrease in middle managers as a result of computer systems (Steward, 1971; Delaharty, 1967; Stone, 1975). In a very rigorous study, an increase was noted in the number of middle managers (Blau, Falbe, McKinley and Tracy, 1976). A scholar focused recently on OA's effects and also predicted that the number of middle managers will increase relative to the number of subordinates below them (Zuboff, 1982). The reasoning behind this prediction is that managers will begin to take over office work formerly performed by subordinates, especially clericals and including other support personnel. However, it is also predicted by other knowledgeable writers that the primary effect of OA on organization structure will be decentralization or a "flattening" (Connell, 1981b).

No doubt these contradictory predictions are caused somewhat by lack of comparability in the studies. There has been no empirical work reported which focused on OA and specific structural dimensions. From a managerial perspective, it is difficult to anticipate how these effects translate into attitudes toward use of OA. But if the technology is seen as a replacement for middle management, resistance will surely be high.

Organization Boundaries

The notion of an organization boundary requires understanding how an organization distinguishes itself from its environment. Since organizations are made of people, the issue is: "Who is and is not an organization member." The connecting element that creates an organization out of the social aggregate has been defined as follows:

> ...a network of social relations transforms an aggregate of individuals into a group (or an aggregate of groups into a larger social structure (organization), and the group is more than the sum of the individuals comprising it since the structure of social relations is an emergent element that influences the conduct of individuals. (Blau and Scott, 1962).

Does OA somehow change who belongs to the organization? The possibilities for remote work that derive from OA provide a basis for believing that just such a fundamental change may occur. For certain kinds of office work (see Olson, 1981) there are a number of possibilities for "telecommuting" (Nilles in Olson, 1981) which remove individuals from physical relation to an organization. This is a sufficiently large change in social relations to call into question whether remote office workers are members. After all, is not the behavior of such individuals more like that of a subcontractor under such circumstances? It is even predicted that much office work may be subcontracted in precisely this way, and the subcontractors will be former members of the organization (Handy, 1980).

Consider the alternatives for remote work situations (Olson, 1981):

1. Satellite work centers that are set up by a firm for its workers in areas more convenient to their residence (from downtown to suburban locations, for example).

2. Neighborhood work centers that are facilities shared by a number of organizations and where only the tools, not the supervision, are present.

3. Flexible work arrangements under which employees come and go from the "physical" office based upon the demands of a particular task. Especially for managerial employees it may be useful to work at home (using a workstation) to produce a critical report away from everyday office distractions. In other cases, longer term arrangements may be made to accommodate pregnancies, child rearing and so on.

4. Regular work at home is the most physically remote circumstance. Many jobs might be performed quite adequately under this arrangement.

Are individuals who work under such conditions members of the organization? In some cases the answer is clearly "yes"; in others, the issue is not so straightforward.

<u>Organizational Loyalty</u>

Remote work is also expected to change the way people feel toward their organization—assuming they remain members in their mind and in the minds of individuals physically present. Harkness (1977) found that such reliance on telecommunications reduces the degree of identification and loyalty felt by office workers. To some degree this was the result of insensitive supervision. Even when individuals are physically present, Zuboff (1982) maintains that OA creates a focus on managerial control in the organization and changes the climate such that interpersonal behavior is reduced or even discouraged. Apart from the motivation problems created when social needs are not met, feelings of identity, loyalty and commitment likely depend on human contact. When interpersonal interaction is reduced, the informal organization created out of the feelings of individuals for one another may begin to evaporate. The importance of the "emergent" organization to goal achievement has been recognized in theory for many years. It is too soon to speculate about the consequences OA may have in this regard, but the importance of these ideas indicates a need for their investigation.

It is also important to note that some organizations have adapted to this technology with considerable success. Sharp (1981) reports that a software firm benefits extensively from the use of electronic mail and teleconferencing. He cites the following benefits experienced in this case:

1. 20 to 50 to 100 people can meet to discuss an issue in a way not possible in a face-to-face meeting.

2. The issue is discussed fully at a time when it is current, not when it is history.

3. It allows people to be in many places at the same time.

4. It obsoletes the concept of delegation in absentia.

5. Users can give their "mail" undivided attention and make replies as time and thought permit.

6. No time is wasted in pleasantries. (This may be a benefit that has a significant cost.)

Organization Performance

Whether these kind of results translate into hard financial benefits is a key issue in the field. In fact, the need to define and justify non-quantifiable benefits has become a major stumbling block to organizations considering adoption of the technology (Willmott, 1982). The focus on financial justification for OA has been heightened by claims that the improved productivity at an individual level that is created through word processing does not always produce overall, organization productivity gains (Driscoll, 1979). Since OA in most cases represents a major capital expenditure, measurable benefits should be planned and attained to justify expenditures for equipment, personnel and facilities (Maskovsky, 1982). Most believe that OA, like any project, must be planned and operated to produce tangible savings to offset costs and produce a return on investment. Yet, such "bottom line payoff" may be difficult to quantify for benefits like the following:

1. Improved decision making applications like modeling, simulation or other, more ad-hoc, analyses.

2. On-line access to organizational data.

3. Improved communications (Willmott, 1982).

Some have called for a broadening of the definition of productivity benefits to include: (1) better use of human resources, (2) better, faster decision making with more information used, (3) jobs with more involvement and creativity, (4) better products and services, (5) better competitive posture, and (6) improved quality of work life (Guiliano, 1979).

Even under the narrowest definition of productivity gain (i.e. time savings) large improvements are reported. Manufacturers Hanover Trust recently surveyed its users and found that on average each saved 36 minutes per day. This translates into an estimated savings of seven million dollars annually (Verity, 1983).

The significance of such cost-benefit reasoning to managerial utilization is obvious. Unlike clerical and professional employees, managers have a direct responsibility for financial results. To the extent OA is difficult to justify in these terms, its use may be restricted.

Characteristics of the IS Staff Organization

One organizational element that has special relevance to OA is the data processing (DP) or information services (IS) function. This staff department has traditionally assumed responsibility for providing line units with computing capabilities. Typically, there has been some interdepartmental conflict between user groups and DP departments. Conflict is a natural result of the resource allocation and priority-setting process required of the data processing department as it attempts to meet the ever growing demand for applications among users. Moreover, users are known to complain about the lack of understanding among data processing personnel for the kind of systems needed. In some respects, OA has fanned the flames of this conflict.

One concept of the problems between DP and users is in terms of a communications gap. There are credibility problems for DO departments because they are largely composed of "technocrats" (Bartimo, 1982). For lack of understanding of user needs, systems frequently fall short of these needs. There is hard empirical data to support the hypothesis that communications breakdowns between users and systems staff cause problems in systems design and implementation. Kaiser and Srinivasan (1982) found that users and DP staff who worked together felt differently about (1) user-analyst communication, (2) user needs focus, (3) systems staff competence, (4) development methodology, and (5) information systems potential. They attribute these differences to the differing orientations of personnel in end user and DP departments.

Because the hardware for OA may not include large, mainframe computers, implementation of such systems has sometimes been assigned to user departments that are independent of the DP function. Some have characterized this trend as representing the beginning of a "war" between DP departments and administrative functions over who will have control of a company's information resources (Scannell, 1981). The proliferation of micro computers in some organizations has occurred without the coordination of a central DP function (Schatz, 1983). Because this may be perceived by DP as a challenge to its authority, "most DP departments are fighting micros" (Schatz, 1983). While there may be some negative consequences from allowing this kind of uncontrolled spread of computers in the organization, many companies have a policy whereby departments or even individual managers make acquisition decisions on their own (Gillin, 1983). Managers seem to want control of their information resources.

Part of the explanation for this desire on the part of managers to "take matters into their own hands" may be found in the gap between the kind of systems DP departments have developed and the kind of systems managers perceive to be needed. A survey of 529 user-managers found "dissatisfaction and frustration" on the part of managers. These hostile feelings were created by the fact that forty percent of the systems that related to important managerial duties did so in an inappropriate fashion (i.e. were "inconvenient, inflexible, or incomplete") (Alloway and Quillard, 1983). Importantly, it was found that managers have "many important tasks which could be, but are not, supported by computer based information systems" (Alloway and Quillard, 1983). Managers want inquiry and analysis systems much more than is even represented in the applications development backlog of DP departments. Real demand (as measured in this survey) was found to be 739% and 784% of backlog for inquiry and analysis sytems, respectively. Alloway and Quillard attribute this finding to the fact that managers have concluded that DP departments cannot meet these needs because such demand is more "situational, dynamic and dependent upon the individual manager" than demand for traditional transaction oriented or monitoring systems. Thus, by the time a request overcomes the hurdles of written proposals and project approvals, the need may have vanished. Finally, user demand for new systems is so overwhelming (65% of the total installed base of applications), that the ability of IS to respond is clearly challenged (Alloway and Quillard, 1983).

The "war of independence" that some managerial users are fighting is understandable, but the negative consequences of incompatible or unsupported systems within an organization argue against this approach to meeting the managerial information need. It has been suggested that if DP departments could begin to understand the priorities of managers, the gap may be reduced. This means that the DP professional must acquire human interaction skills and the ability to see the "whole picture" rather than just technical factors (Batt, 1981). It may also be necessary that the DP function undergo a fundamental reorganization so that it is seen as a "business entity instead of a captive service department" (Gerstein and Reisman, 1982). Indeed, it has been found that user performance is greatly influenced by the "managerial sophistication" of the DP department (Cheney and Dickson, 1982).

Toward a Model of EW System Use

The model of EW system use identifies three factors as direct causes of system use: (1) the fit between tasks that can be accomplished using the system and the user's work (system/work fit), (2) the fit between the user's system competence (or literacy) and the system's ease of use (system/person fit factor), and (3) the user's background. Figure 2.1 depicts the model graphically. Arrows represent causal directionality. Use is the effect of the three causal factors.

The model identifies structural or causal relationships between each of the three factors and system use. System/work fit is conceived as a latent or theoretical variable representing the contribution of tasks performed on the system to job performance. System/person fit is conceived as a latent or theoretical variable representing an individual's ability to accomplish tasks using the system. The background factor is conceived as the set of individual background characteristics that create a propensity to use (or avoid use of) EW systems. Some research has shown an association between tenure in the organization, age, education, and managerial experience and the tendency to avoid using an EW. System use is conceived as the time a user spends interacting with the system. Operational definitions of the elements in the model are described in the Methodology section.

There is a substantial basis for inclusion of these three factors in a model of EW system use. Empirical support derives both from the work of others (reviewed earlier and recapitulated in the Research Hypothesis section) and from the results of an exploratory study to be described below. Deductive support is based on existing information systems theory and on the conceptual kinship between two of the factors in the model and expectancy theories of work behavior. In what follows, discussions of these issues are prefaced by a description of how the model fits into existing research and theory.

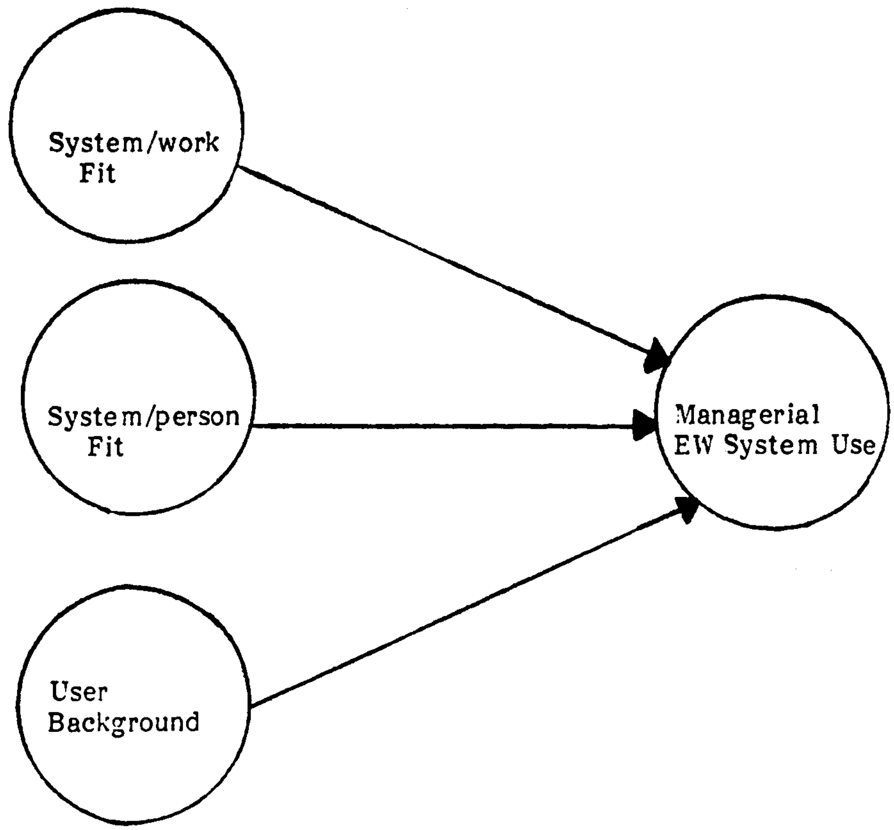


Figure 2.1: A Model of the Causes
of Managerial EW System Use

Context of the Model in the Literature

The sheer diversity of literature relevant to system use is a statement about the development of the field. Explanations of system success and use arise from very different perspectives: conceptual and operational definitions vary, variables included in the studies vary, units of analysis vary and theoretical orientations vary. There is no shared paradigm about the use of information systems.

The relationship of the present model to existing theory and research is described in two ways. First, the model is distinguished as (1) a theory with system use as the effect variable and (2) a theory with causal variables that operate within a single system environment. Second, the model is compared to a more comprehensive model recently developed by Shultz, Ginzberg and Lucas (1984).

There are two ways to categorize studies about information systems relevant to the development of causal models of EW system use. First, studies may be categorized according to whether use is treated as an effect (dependent) variable or as a causal (independent) variable. Second studies can be distinguished based on whether data was collected within a single system environment or collected across several systems.

System Use as a Cause or an Effect

Much of the interest in user-computer interaction focuses on computer use as a cause of something else. In this research, the effects of computer use on people, groups, organizations and society are examined.

Turner (1982) called this work "consequences research." In order to understand these ideas as pertinent to the causes of use, one must interpret how such impacts influence use. For example, it has been shown that EW system use increases the total volume of communications in an organization (The Yankee Group, 1979). What does this finding imply for use behavior or system success? Do users desire this outcome so that system use is increased, or does the increased volume of electronic messages only deter other uses and add to the general workload? In short, "consequences research" is not structured to address the causes of system use behavior. While it may contribute to our understanding of the effects of EW use, it is not designed to explain the causes of use.

Other studies <u>are</u> structured with system use as a dependent variable and focus on its causes. There is a general lack of integration and cumulative experience reported, however. Much of the published material is speculative or based on the experience of a single observer. Empirical research is limited mostly to studies of one or two variables and is typified by case study. Statistically valid generalizations are rare.

Other reviewers have come to similar conclusions about the literature of information systems research relevant to system use. Hamilton and Ives (1982) reviewed articles published in the management information systems (MIS) field. Thirty (30) percent of the material was categorized as empirical; forty (40) percent of these articles were case studies. Only eighteen (18) percent of the publications were field studies, lab studies or field tests. The sources represented in these statistics are well respected and include:

- Academy of Management Journal
- Academy of Management Review
- Harvard Business Review
- Sloan Management Review
- Decision Sciences
- Management Science
- Computing Surveys
- Data Base
- Information and Management
- MIS Quarterly
- Accounting Review
- Journal of Accountancy
- ACM Transactions on Data Base Systems
- Communications of the ACM
- IBM Systems Journal

In short, it is apparent that research in the information systems field provides a meager basis for theorizing about the causes of EW system use. More careful empirical study of use as an effect variable is needed.

Within and Between Systems Studies

Another useful distinction differentiates "within systems" from "between systems" research designs. Within systems studies are conducted by collecting data from a single system environment. Between systems studies are conducted by collecting data from a number of system environments. Examples of between systems studies include the Blau, et al., (1976) study of the structural effects of computer system implementation, Fuerst and Cheney's (1982) study of factors affecting perceived use of decision support systems in the oil industry (1982), and others reviewed earlier that are based on survey data across a number of system environments. Ginzberg's (1981) study of signs of system failure, Kaiser and Srinivasan's (1982) study of user and IS staff attitudes, and other studies that are based on data from a single system environment are examples of within systems designs.

Between systems approaches are suited most for studying the effects of factors that vary across systems: the organization, the technical system, the IS department, and the design and implementation process. Wtihin systems approaches, on the other hand, are suited best to research about factors that vary within systems: the individual and the work.

The suitability of these two designs for the study of relationships between different sets of factors and use results from the opportunity to control unmeasured variables. In within systems studies, one may reasonably control for organizational factors, technical system factors, IS department factors and implementation process factors. That is to say, data is gathered about individual use within a single organization, technical system, IS department and implementation environment. Consequently, the effects of individual and job differences can be isolated and studied in depth.

Between systems studies permit measurement of the variation in organizations, technical systems, IS departments and implementation approaches. Individual and job differences might also be measured and studied. More typically, however, these studies allow many relevant variables to go uncontrolled and unmeasured. Problems of this type are common for field studies (Cook and Campbell, 1979). If they can be avoided, however, confidence about results can be enhanced. In short, within systems studies provide a better opportunity to study the effects of individual and work differences on the use of EW systems.

The present study is designed to address (1) the causes of system use and (2) the effects of individual and work differences. Consequently, system use is the effect (dependent) variable, and data is collected within a single system environment.

Comparison with the Schultz, Ginzberg and Lucas Model

Schultz, Ginzberg and Lucas (1984) have developed a model designed to integrate many of the findings in the literature relevant to the use of information systems. Comparison of their model with the one being developed here shows conceptual overlap, but the purpose of the two models is not the same. Schultz, Ginzberg, and Lucas identified eighteen variables that may be related to use. (See Table 2.1.) Seven of these variables are related conceptually to the three factors. The following listing identifies the conceptual correspondence between variables in the Schultz, Ginzberg, and Lucas model and the three factors identified here:

Factor	Schultz, et al, variable
User Background	User demographics
System/person Fit	User knowledge
	User confidence in system and support
	System characteristics
System/work Fit	Problem urgency
	Goal congruence
	User job characteristics

The purpose of the Schultz, Ginzberg, and Lucas model is to represent comprehensively the "relationships established in replicated studies" (p. 14) between a variety of variables and implementation success (which includes acceptance, satisfaction, performance, and use). The model under investigation here is a more modest attempt to explain variation in use (one measure of implementation success) when "between systems" variables are controlled. The Schultz, Ginzberg, and Lucas model includes variables from six of the seven categories of characteristics identified in the literature review and is conceived as a means for integrating a complex set of relationships. The present model includes variables from only two of the seven categories of characteristics (i.e. characteristics of the individual and the work) and is conceived as a means for explaining system use when variation in organizational characteristics, implementation process characteristics, technical system characteristics, and IS department characteristics are controlled. Characteristics of interpersonal relationships are excluded by both models.

Empirical Support of the Model: Results from an Exploratory Study

An exploratory investigation (Durand and Floyd, 1984) provides an empirical basis for focusing on system/work fit, system/person fit and user background as the important factors related to system use within a single system environment. In this earlier study of managerial use of an EW system, measures were developed for: (1) organization support for users, (2) user involvement in the implementation process, (3) the degree of change involved in system use, (4) changes in interpersonal relationships brought on by system use, (5) user support from the Information Systems (IS) department, (6) the impact of the system on the user's efficiency and effectiveness and (7) the user's system skills. In addition, data about the user's level in the organization hierarchy and background characteristics (education, age, organization tenure, managerial experience) were collected. In short, a wide variety of relationships was explored.

The results of a path analysis (see Figure 2.2) of the relationships among these variables and system use revealed that the *efficiency and effectiveness impacts of the system on the user's work* and user support from the IS department were direct causes of use. Indirect causes of use were (1) managerial experience and level, (2) user system skills and (3) user involvement in system implementation. The model explained 64 percent of the variance in use.

An examination of the model from the exploratory study (Figure 2.2) reveals that the relationship between the system and the work (i.e., efficiency impacts plus effectiveness impacts) is the single most important factor related to system use. When user support from IS and user system skills are conceived as the basis for the user's judgment about his/her ability to use the system, this factor stands out as second in importance. Finally, managerial experience has an interesting, negative relationship with the work effectiveness variable. While user involvement in the implementation process appears to be related to the work effectiveness measure, the path coefficient between this variable and the effectiveness variable is relatively small.

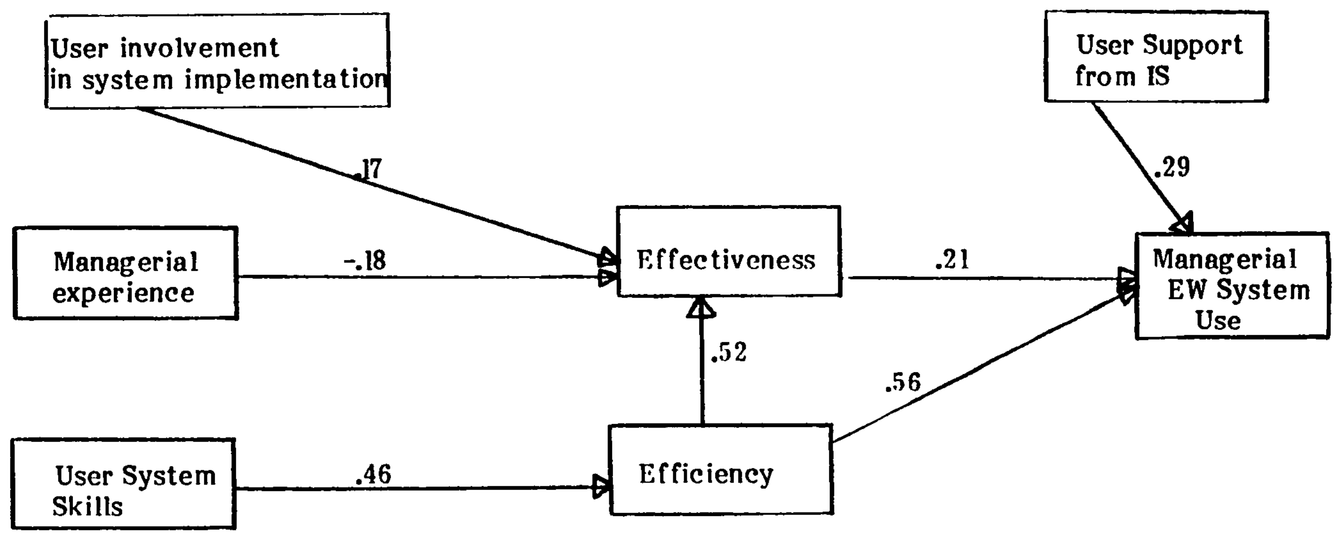


Figure 2.2: A Path Analysis of Variables Affecting Managerial EW System Use

In short, the tentative conclusions reached from the exploratory study were that within a single system environment: (1) the fit between tasks that can be accomplished on the system and the user's work (as represented by efficiency and effectiveness impacts) is the single most important determinant of use; (2) the fit between the user's ability to use the system and the demands of the system (as represented by measures of system skills and user support) are also important causes of use; and (3) the user's length of managerial experience bears an interesting, negative relationship to use. This suggests that within a given system, the causes of EW use are system/work fit, system/person fit and user background.

This conclusion is tentative for several reasons. First, the previous study was not designed specifically to test the relationships between the three factors and use. As a result, the measurement instrument was not designed to measure these three factors optimally. (The scales used in the path analytic model met reliability standards for exploratory work, i.e. Cronbach's alpha levels of at least 0.60.) Second, the sample size (n=55) was too small relative to the number of variables measured for making causal inferences. Third, path analysis relies on a series of multiple regression procedures for assessing relationships among variables. Causal modeling using maximum likelihood procedures permits simultaneous testing of causal and measurement relationships and is more suited than regression to "the development, modification, and extension of measurement and substantive theory"—particularly for theories constructed with latent variables (hypothetical constructs) like demographic propensity, system/work fit and system/person fit (Kenny, 1979, p. 5).

Deductive Support for the Model from Expectancy Theory

The role of system/work fit, system/person fit and user background in a model of system use is supported deductively from two distinct bodies of theory. First, the theory and research in the literature of information systems (reviewed above) points to the importance of these factors. Second, a well accepted and widely confirmed theory of work behavior, expectancy theory, identifies constructs that are very similar to the system/work and system/person fit factors in a general explanation of work behavior. This conceptual kinship provides additional support for the idea that the particular work behavior called use of an EW system can be explained by such factors. Specific studies from the literature of information systems will be cited in the Research Hypothesis section to support the model. In this section, the theoretical underpinnings from expectancy theory will be described.

Expectancy theory states that work behavior is a function of (1) an individual's preference for task goals (or task goal valence) and (2) his/her degree of belief that effort exerted will result in the accomplishment of the task (expectancy) (Campbell, 1970; Mitchel and Biglan, 1971). The theory is based on the principle of expected value: people make choices based on the expected payoff of alternatives (Mitchel, 1979). Thus, an individual engages in behaviors that he or she believes will contribute to the performance of preferred tasks (Mitchel, 1974; 1979).

Expectancy theory contributes to the logic of the system use model in two ways. First, it helps to define two of the constructs in the model (system/work fit and system/person fit). Second, it supports the assertion that these two factors are likely causes of system use.

Use of an EW is a specific type of work behavior. Inclusion of judgments about the fit between the system and work and between the system and the individual can be seen as an adaptation of expectancy theory to the case of system use. Like task goal valence, system/work fit represents an individual's evaluation of tasks in terms of their outcomes (i.e. contribution to job performance). The difference is that system/work fit is relevant only to those task goals that are attainable by using the EW system. Like expectancy, system/person fit represents an individual's degree of belief that effort exerted results in task goal accomplishment. The difference is that the effort relevant to system/person fit always involves use of the EW system. In short, system/work fit and system/person fit are conceptually similar to task goal valence and expectancy; the difference is that the former are attitudes about EW system related behaviors.

Expectancy theories describe work behavior as caused by the effort level determined by calculations in the mind of the actor. This calculus involves the multiplication of task goal valence and expectancy (Mitchel and Biglan, 1971). The validity of the multiplicative relationship has been questioned by Schmidt (1973) and received support from a study by Arnold (1981). Lawler and Suttle (1973) reviewed expectancy theory research and found that task goal valence and expectancy variables have direct statistical relationships to effort as great as the relationship between their multiplicative combination and effort. In the model of system use, system/work and system/person fit are not combined to produce a third causal variable; rather, they are seen as independent causes of system use.

Thus, the theoretical underpinning provided by expectancy theory for the hypothesis that system/work and system/person fit are causes of system use is summed up in the following logical proposition:

> If one accepts that work behavior is governed by (1) an individual's preference for tasks and (2) an individual's beliefs that his/her effort will lead to task accomplishment, then it follows that system use (a specific type of work behavior) is governed by (1) an individual's judgment about tasks that can be accomplished with the system and (2) an individual's judgment about his/her ability to use the system as a means for accomplishing work.

Research Hypotheses

The structural or causal relationships identified in the model are the subject of the research hypotheses. Each causal connection specified in the model has a corresponding structural hypothesis.

> H1: Use of an EW system increases as the fit between the system and the work increases.

In addition to the theoretical support H1 enjoys from expectancy theory, information systems theory and research supports the hypothesis. Many observers have recognized that successful information systems must aid in the performance of work (Fancher, 1982; Data Management, 1982, LeBoutillier, 1980; Hayman, 1980). Other evidence of this recognition is the research devoted to measuring the benefits to managers from information system use, including: (1) time savings (Poppel, 1983, Barcomb, 1981; Shindler, 1983), (2) improved decision making (Keen, 1982; Wagner, 1980), and (3) communications (Bair, 1978; Hiltz and Turoff, 1979; Moody, 1983). This literature proceeds by carving out some aspect of managerial work and demonstrating the improvements possible from information system use. System/work fit has not been identified as a cause of system use in previous studies, however.

> H2: Use of an EW system increases as the fit between the system's demands and the user's ability increases.

The fit between the system's demands and the user's competence is based partly on the ease or difficulty encountered in manipulating the system. Dickson, Senn and Chervany (1977) established that complex or hard to use systems may have little impact on managers. The underlying assumption in attempts to make systems more "user friendly" is that use can be facilitated by: (1) reducing the time it takes to learn the system, (2) reducing the rate of errors made by the user, (3) increasing the retention of system operating commands over time, and (4) increasing the speed of system performance (response time) (Shneiderman, 1983). A user's evaluation of the system's ease of use contributes to the expectation that he/she can successfully use the system.

System/person fit is based also on the user's own competence as a system user. Greater knowledge and skill at using the system produce such competence. Courgar (1983) argues, for example, that managerial users should be able to (1) learn the syntax, (2) know what problems the system can solve, (3) compose commands, (4) comprehend commands composed by others, (5) debug command sets, and (5) modify commands.

The system/person fit factor includes both the system's ease of use and the user's system competence. Work by Shneiderman (1983), Bailey (1982) and others has shown that improving ease of use and user "computer literacy" facilitates use. H2 is supported by such research, but these studies ignored system/work fit as an independent variable.

> H3: Increasing age, tenure in the organization, education, and managerial experience contribute to a background factor that causes a decrease in system use.

H3 asserts that a use is related inversely to a factor representing the user's background. Relationships between user background and use have been established in many research contexts. Zmud (1979) reviewed the management information systems literature and found that age, education, and tenure are consistently negatively related to use. His review produced mixed results with regard to organization tenure. Poppel (1982) concluded that tenure, not age, is "strongly" related to use of an EW system. Tisdall (1982), however, found that age was related to low usage. In these studies, system/work fit and system/person fit were not included as independent variables.

Contribution of the Model to Existing Theory

The primary contribution of the model is the identification of three factors as causes of EW use within a given system. The relationships between use and these factors have received attention separately, but no other study has taken a multivariate approach with them.

The present study extrapolates from findings about simple, bivariate relationships to produce a more complex, realistic picture of the causes of EW use. An empirical investigation of the model provides an assessment of the relationships between each factor and use, and equally important, of the relative importance of each factor as a cause of use. If the model proves tenable, then the body of knowledge surrounding EW use will be advanced significantly by an understanding of the combined effects of system/work fit, system/person fit and user background.

This basic contribution is enhanced by rigorous research methodology. Variables that are expected to vary across systems are controlled by a within system research design. Each of the independent variables is measured by multiple indicants. The analytical approach permits the separation of measurement error from the estimation of causal relationships. And the measurement of system use is accomplished with an innovative software monitor that captures the actual level of user-system interaction in a way other software monitors do not.

Finally, the model has important practical implications. Historically, those responsible for EW system implementation in a given environment have faced two relatively uncontrollable use inhibitors—user competence and user background. Training sessions can be offered, but users cannot be forced to learn. Selecting users based on favorable background characteristics is possible but impractical if the EW system is to be used widely. System/work fit is a factor that can be controlled, however. If the role of this factor is sustained empirically, those concerned about increasing EW use will have a new means toward that end. Increasing system/work fit can be accomplished by redesigning the system, but another important possibility is an analysis of the work to find matches between user tasks and system capabilities. On its face, this appears to be an effort that could prove beneficial to information systems implementation, individual productivity and organization effectiveness.

CHAPTER III

METHODOLOGY

Overview

The objective of this study is to explore the causal model of managerial EW system use described above. The focus of the study, the use of EW systems, suggests the need for a passive observational field study research design. A substantial sample of managers using an EW system at a single site was selected. Interview questionnaire items and output from electronic monitoring software provide measures of the variables in the model. The relationships defined by the theory can be described as a system of structural equations, and the analytical procedures available on the LISREL V statistical package provide a means for estimating the parameters in the equations.

Research Design

The model hypothesizes certain causes of managerial EW system use. Testing the model means establishing the validity of causal inferences based on it. Since the purpose of this study is also "model building," some exploration of possible inferences is also pursued. A causal inference is a statement affirming the relationship between two or more variables that are specified as causes and effects (Kenny, 1979). Such inferences are valid to the degree they are supported empirically.

There are three commonly accepted conditions for demonstrating empirical support for causal inferences. First, temporal precedence of cause over effect is considered an essential assymmetry in causal inference. This is an assumption made by philosophers of science since John Stuart Mill. The second condition for causation is the presence of a statistical relationship between cause and effect. This means that variation in the cause is associated with variation in the effect. Third, the relationship must be nonspurious. There must be no third variable that causes both cause and effect variables and that "explains away" the supposed relationship between them.

The alternative designs for research aimed at making causal inferences can be characterized at the broadest level as: experimentation, quasi-experimentation and passive observation. The fundamental distinction among these three types of designs is the degree of control the researcher exercises over independent variables and outside influences.

Whether to conduct research in the laboratory or in the field partly depends on the degree to which relevant theory has developed. When little is known about a phenomenon, the theory needed to provide the structure of a laboratory experiment is largely undeveloped. Consequently, there is little basis for the definition of the experimental setting. In short, one needs to know more about a phenomenon to conduct research in the laboratory than to conduct field research (McGrath, 1979). Managerial use of EW systems is a recent behavior in work organizations. There is relatively little empirical work and no well accepted theory on the subject. As a result, this project can be described as an exploratory study. Field studies provide the most appropriate source of information at this stage of a research program in this area (McGrath, 1979).

The consequences on the sample from the structure imposed by quasi-experimentation rule out this form of field study. Individuals would be assigned to nonequivalent groups for purposes of conducting difference tests. The groups would be differentially exposed to EW systems with varying task capabilities and ease of use. An experimental design would mean assignment of individuals to groups based on system competence, also. Organizations are unlikely to assent to these conditions for several reasons. First, EW systems are costly, and experimentation that presumably would reduce the productivity benefit from the investment is aversive. Second, the impact on the novice managerial user from exposure to intentionally inadequate EW system capability (i.e. manipulation of system/work fit) could be long-term disaffection for the new technology resulting in limitations on organizational productivity and the individual's career growth. Third, the high visibility of EW implementation efforts in organizations increases the probability of negative outcomes in the organization climate from the system deprivations of a subsample. Reductions in performance and attitude have been attributed to this kind of experimentation (Bishop and Hill, Hand and Slocum, in Cook and Campbell, 1979). The author's personal experience with managerial attitudes concerning the political overtones of EW systems implementation (e.g., deciding who gets which equipment) confirms the suspicion that significant dysfunctional consequences would accompany attempts to manipulate the process experimentally. In sum, while the scientifically optimal test of the model would be designed as a quasi-experimental field study, the unwillingness of organizations to submit managers to experimental conditions suggests a nonexperimental approach.

Nonexperimental designs can be employed for the purpose of causal inference (Blalock, 1961; Duncan, 1975). Studies of this kind are often termed "correlational," but Cook and Campbell (1979) note that this term is misleading as a label for research designs since it designates an analytical technique. "Passive-observational" is proposed as a more appropriate term for designs that describe natural variation in variables observed in field settings without experimental intervention (Cook and Campbell, 1979).

In order to control for influences thought to vary across organizations, the study was conducted within a single system environment. This means that certain sets of variables were held reasonably constant, including: organization characteristics, characteristics of the technical system, characteristics of the implementation process, and IS department characteristics.

The Sample

The sample consists of 110 executives, managers and professionals working at a headquarters location for a large, multinational company. All of the participants can be described as "principals" in the current jargon of office work, i.e. as nonexempt, nonclerical office personnel. While some of the participants had no current supervisory duties ("professionals"), nearly all (95 percent) had managerial experience during their career. According to organizational contacts, the participants could be classified as:

11	Executives
57	Managers
42	Professionals
110	Total

To find a sample with experience in a computing system of substantial functionality in 1985, it is necessary to study progressive organizations. There may be variables operating in such settings (e.g. unusually favorable attitudes about computers) that are not representative of "typical" organizations. Of course, generalizability of the findings is limited by the extent to which the organization is representative of the popualtion of organizations. In this case, the researcher's initial misgivings about the unrepresentative enthusiasm for computers in the sample were allayed by: (1) the relatively modest levels of EW usage observed, (2) the willingness of interviewees to express negative attitudes about the system, and (3) the wide diversity in the attitudes expressed in the interviews. Moreover, since inferences based on the model concern relationships among variables rather than mean values of variables, unusually high EW use levels in the sample are not a concern per se. (For more discussion on this issue see pp. 143 to 147 below.)

Operational Definitions

Two different types of variables are defined in the model. System/work fit, system/person fit, and user background are latent or theoretical variables measurable only with error. System use is defined as the time spent using the system; it was measured by the computing system with negligible systematic and random error. Operational definitions for each of the variables are developed below. Independent variables were measured by an interview methodology. Figure 3.1 formally represents the model.

The Independent Variables

System/work Fit (ξ_1)

System/work fit is a theoretical construct defined as the contribution of system supported tasks to job performance. There are three ways that the system may contribute to job performance: (1) facilitating the accomplishment of "core" tasks, (2) improving the productivity of the individual on the job, and (3) improving the quality of work outputs produced by the subject. Measures of the construct tap each of these potential indicators.

The concept of "core" work delineates those job activities that are essential to job performance. In general, managerial core work consists of job elements identified by theories of managerial work, including: (1) management functions (Miner, 1979), (2) managerial roles (Mintzberg, 1973), and (3) critical tasks (Kotter, 1982). In a particular case, the incumbent

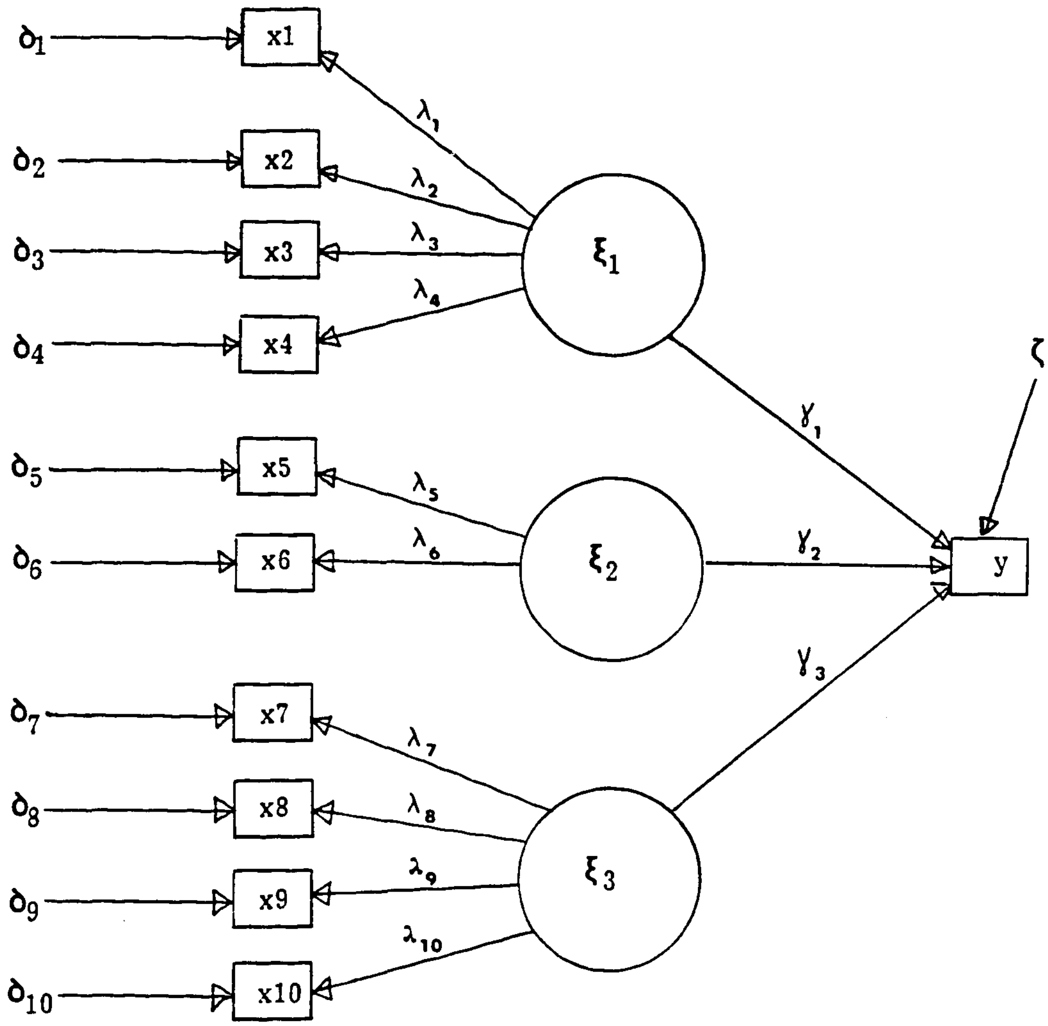


Figure 3.1: A Latent Variable Model of the Causes of EW System Use

defines the tasks that are relevant to core work because he/she presumably has the best knowledge about how the theoretical elements of managerial work relate to the specific job. For instance, communicating is an important managerial function (Miner, 1979), and the specific task of communicating policy to subordinates (in a meeting, on the telephone) is likely to be recognized as a core task by many managers.

Another study (Durand and Floyd, 1984) found that the core work concept was useful in describing the contribution of EW systems to job performance. For example, if a manager's job requires the creation of formal written reports to communicate project status to superiors, the use of a text editor on the EW may be seen to make an important contribution to core work. However, the manager's use of the text editor to type an important memo because the secretary is busy may not be seen as a core work task. The difference is the manager's perception about how closely related the task is to core job responsibilities. In the first case, the manager perceives use of the EW as facilitating the composition of a message that is part of an important communication act. In the second case, the manager perceives use of the EW as a substitute for delegating the almost trivial task to a secretary. Since the task can be delegated, it is not perceived to be closely related to core managerial work.

As another example, many managers perceive the task of maintaining a personal calendar to be a secretarial responsibility. Thus, using the EW to create an electronic schedule of activities may not be seen as a core task. On the other hand, an executive who peruses the calendars of subordinates in making delegation decisions may perceive use of the electronic calendar as contributing directly to core work. Thus, although one might reasonably speculate about the extent an EW facilitates the accomplishment of core work based on theories of managerial work and knowledge of system capability, the operational definition of the degree of core work relevance in the use of an EW by a particular manager is left to the user's judgment.

Measurement of each sample member's judgment about the contribution of the EW system to core work began by exposure to a one page written explanation of core work with an example. Interviewees were asked if they understood the concept. Then each participant rated each system function on a scale from zero to one hundred (100) percent to represent the proportion of use that contributes to their own core work responsibilities. The set of "system functions" to be rated was created by listing all system commands and grouping them into "functions." Synonymous commands were grouped together. For example, the commands, "MAIL," "INBASKET," and "MAILMAN" all produced a display of the user's electronic mail; they were rated as a single function. Computer support personnel provided a command list and synonym cross reference. The total degree of core relevance was calculated by summing core percentages across all functions for each participant.

The productivity and quality impacts of system use were measured with Likert-type scales. Respondents could describe the impacts on a scale as very negative, neutral or very positive. In addition, respondents were asked to describe several specific incidents of system use that improved their productivity or the quality of their work products.

Finally, a measure of the importance of each system function was collected on a Likert-type scale. This scale immediately followed the core work measure for each function in the interview and was intended to capture the importance of the core work being supported by each function (if any). (A copy of the data collection instrument appears in Appendix A.)

Thus, there were four measures (indicants) of system/work fit. These were named x1 (core), x2 (importance), x3 (productivity), and x4 (quality).

System/person Fit (ξ_2)

System/person fit is defined as an individual's ability to accomplish tasks using the EW system. The construct may be reflected in one of two ways: (1) system competence on the part of the user (or system "literacy") and (2) system ease of use. The measurement strategy for operationalizing this latent construct tapped both these aspects.

User literacy was measured as an integer representing the variety of commands used. This figure was obtained from reports of each individual's use over a monitoring period (produced by computer software). Each unique command was counted as an increment to literacy. Thus, a literacy score may range from one to whatever number of unique commands were available on the EW.

Measurement of respondents' beliefs about the system's ease of use was attained with a Likert-type scale ranging from "no undesirable/unnecessary effort required" to "excessive" effort required to use the system. A high response represents the belief that the system is relatively easy to use. In addition, respondents were asked to describe their beliefs about the system's usability.

Thus, system/person fit was measured by two methods. One is objective and produced by electronic monitoring (x5). The other was a subjective response to an interview item (x6).

User Background (ξ_3)

The background characteristics of the user measured were age, education, management experience, and tenure in the organization. Age and education were measured using ordinal categories. Management experience and tenure in the organization were measured in years. The background measures were collected in the interview.

The Dependent Variable (y)

Use of the EW system is defined as the time users spend using the system. The measure employed used electronic monitoring, a reliable procedure with considerable face validity.

Because EW systems are interactive by definition, there is always the potential for monitoring usage through the system itself. Many centralized computer systems include software that measures central processing unit time (CPU time) for purposes of allocating cost back to user departments. Such a measure represents use of computer capacity rather than actual time spent by the user in interactive sessions but is still a valid indicant of overall EW use. Software has been developed recently that monitors the time spent by a user within each subsystem of an EW system. The clock starts when a particular command is initiated and stops when another command is invoked. In this study, EW use was measured by such a clock over a representative period of time (three to four weeks).

EW use is the only variable in the structural model with a single indicant. This amounts to the assumption that the electronic monitor provides a measure sufficiently reliable and valid to support treatment of the dependent variable as measured without random error. While this appears to be a reasonable assumption, electronic monitoring is not a perfectly valid measure. For example, if a manager were interrupted by a telephone call while composing an electronic message, the electronic clock for the use of that command would measure time spent dealing with the interruption. A strategy of eliminating a few "outlier" subjects may help to overcome extreme cases of this sort but, practically speaking, the error cannot be eradicated.

Analysis

Relationships among variables in the model can be represented by a system of structural equations. LISREL V is a computer program for estimating the unknown coefficients in a system of structural equations. A brief review of structural equation models along with the strengths and weaknesses of LISREL precedes the formal specification of the present model. Finally, analytical procedures to test the model will be described.

Structural Equation Models

Structural equation models (or causal models) have been used in formulating and testing many theories in the social and behavioral sciences. These models specify theory in terms of cause and effect variables as well as their indicators. Coefficients in the equations are parameters describing the causal and measurement relationships in the model.

Structural equation models differ from regression models. In a structural equation model, each equation represents a causal link rather than a mere empirical association (thus the term "causal model"). In regression, the parameters being estimated from sample observations are coefficients that show the influence of explanatory variables on the conditional mean of the dependent variable. While regression models estimate the mean value of y as values for the independent variable vary, they do not characterize the mechanisms that generate observations in terms of more fundamental, causal parameters (Goldberger and Duncan, 1973). Goldberger (1973) shows how estimating the parameters in structural equations by least square regression procedures is particularly inappropriate in three cases: (1) models involving latent variables in which measurement errors are an issue, (2) models involving simultaneous (or reciprocal) causation, and (3) models involving omitted variables (i.e. without adequate controls).

Causal models have been applied to research situations characterized by three common features: (1) where there is a need to analyze nonexperimental data, (2) where the model includes hypothetical constructs (latent variables), and (3) where the model consists of several equations that interact together.

Models with latent constructs point to an explanation of the statistical relationships among measured variables in terms of the latent constructs. Estimates of the parameters in the model are obtained with maximum likelihood (ML) or generalized least squares (GLS) procedures. The degree of similarity between the observed covariance structure and the covariance structure hypothesized by the model is also assessed by ML or GLS methods. A good fit is represented by a low chi-square statistic relative to the degrees of freedom. In the case of a "perfect fit," the chi-square value would be zero and the p-value would be 1.0. Thus, the null hypothesis that there is no difference between the hypothesized covariance structure and the observed structure is the research hypothesis in causal modeling. When the null hypothesis cannot be rejected at a particular alpha level, the model can be regarded as a plausible representation of the causal structure among the variables (Bentler, 1980, p. 420). There must be more information in the observed covariance matrix than is needed to estimate the parameters of the model if the observed covariance matrix is to be compared to the covariance structure of the model and be potentially rejected by the data (Bentler, 1980). When the observed covariance matrix meets this criterion, the model is said to be overidentified. Only overidentified models are statistically testable (Kenny, 1979). Further discussion about the identification status of the present model can be found in Chapter 4.

LISREL V

LISREL V is a general computer program for estimating the unknown coefficients in a set of linear structural equations. It is particularly designed to handle models with latent variables, measurement errors, and reciprocal causation (i.e. interdependence) (Jöreskog and Sörbom, 1983, p. I.2).

The general LISREL model consists of two submodels: the measurement model and the structural model. the measurement model specifies how the latent constructs are measured in terms of the observed variables and describes the measurement properties (validities and reliabilities) of the observed variables. The structural model specifies the causal relationships among the latent variables and describes the causal effects and the amount of unexplained variance (Jöreskog and Sörbom, 1983).

The general LISREL model is defined by three matrix equations.

(1) Structural equation model: $\eta = \beta\eta + \Gamma\xi + \zeta$

(2) Measurement model for y: $y = \Lambda_y \eta + \varepsilon$

(3) Measurement model for x: $x = \Lambda_x \xi + \delta$

where $\eta = (\eta_1, \eta_2, \eta_3 \dots \eta_m)$ and $\xi = (\xi_1, \xi_2, \xi_3 \dots \xi_n)$ are random vectors of latent dependent and independent variables, respectively, and where β (m x m) and Γ(m x n) are coefficient matrices with $\zeta = (\zeta_1, \zeta_2, \zeta_3 \dots \zeta_m)$ representing the error in the equations. η and ξ

are not observed but instead vectors $\underset{\sim}{y} = (y_1, y_2, y_3 \ldots y_p)$ and $\underset{\sim}{x} = (x_1, x_2, x_3 \ldots x_q)$ are observed, and $\underset{\sim}{\varepsilon}$ and $\underset{\sim}{\delta}$ are vectors of errors of measurement in $\underset{\sim}{Y}$ and $\underset{\sim}{x}$, respectively. The assumptions in the model are:

(1) $\underset{\sim}{\zeta}$ is uncorrelated with $\underset{\sim}{\xi}$.

(2) $\underset{\sim}{\varepsilon}$ is uncorrelated with $\underset{\sim}{\eta}$.

(3) $\underset{\sim}{\delta}$ is uncorrelated with $\underset{\sim}{\xi}$.

(4) $\underset{\sim}{\zeta}$, $\underset{\sim}{\varepsilon}$, and $\underset{\sim}{\delta}$ are mutually uncorrelated, and

(5) $\underset{\sim}{\beta}$ has ones in the diagonal and $\underset{\sim}{I} - \underset{\sim}{B}$ is nonsingular.

If $\underset{\sim}{\Phi}$ (n x n) and $\underset{\sim}{\Psi}$ (m x m) are the covariance matrices of $\underset{\sim}{\xi}$ and $\underset{\sim}{\zeta}$, respectively, and $\underset{\sim}{\theta}_{\varepsilon}$ and $\underset{\sim}{\theta}_{\delta}$ are the covariance matrices of $\underset{\sim}{\varepsilon}$ and $\underset{\sim}{\delta}$, respectively, then the covariance matrix $\underset{\sim}{\Sigma}$ is

$$\begin{bmatrix} \underset{\sim}{\Lambda}_y(\underset{\sim}{I}-\underset{\sim}{\beta})^{-1}(\underset{\sim}{\Gamma}\underset{\sim}{\Phi}\underset{\sim}{\Gamma}'+\underset{\sim}{\Psi})(\underset{\sim}{I}-\underset{\sim}{\beta}')^{-1}\underset{\sim}{\Lambda}_y'+\underset{\sim}{\theta}_{\varepsilon} & \underset{\sim}{\Lambda}_y(\underset{\sim}{I}-\underset{\sim}{\beta})^{-1}\underset{\sim}{\Gamma}\underset{\sim}{\Phi}\underset{\sim}{\Lambda}_x' \\ \underset{\sim}{\Lambda}_x\underset{\sim}{\Phi}\underset{\sim}{\Gamma}'(\underset{\sim}{I}-\underset{\sim}{\beta}')^{-1}\underset{\sim}{\Lambda}_y' & \underset{\sim}{\Lambda}_x\underset{\sim}{\Phi}\underset{\sim}{\Lambda}_x'+\underset{\sim}{\theta}_{\delta} \end{bmatrix}$$

The elements of Σ are functions of the elements of $\underset{\sim}{\Lambda}_y$, $\underset{\sim}{\Lambda}_x$, $\underset{\sim}{\beta}$, $\underset{\sim}{\Gamma}$, $\underset{\sim}{\Phi}$, $\underset{\sim}{\Psi}$, $\underset{\sim}{\theta}_{\varepsilon}$, and $\underset{\sim}{\theta}_{\delta}$. In applications, the elements of these matrices are of three kinds:

(1) fixed parameters that are assigned values (often 0 or 1).

(2) constrained parameters that are unknown but equal to one or more other parameters, and

(3) free parameters that are unknown and not constrained to be equal to any other.

In summary, the structures of eight parameter matrices are specified for the general LISREL model:

1. $\underset{\sim}{\Lambda}_y$: the regression matrix of the y indicator variables on η.

2. $\underset{\sim}{\Lambda}_x$: the regression matrix of the x indicator variables on ξ.

3. $\underset{\sim}{B}$: the paths from the latent endogenous variables to latent endogenous variables.

4. $\underset{\sim}{\Gamma}$: the paths from the latent exogenous variables to latent endogenous variables.

5. $\underset{\sim}{\Phi}$: the covariance matrix for the latent exogenous variables.

6. $\underset{\sim}{\Psi}$: the covariance matrix for the disturbance terms of the latent endogenous variables.

7. $\underset{\sim}{\theta}_\varepsilon$: the covariance matrix for the disturbance terms of the indicators of the latent endogenous variable.

8. $\underset{\sim}{\theta}_\delta$: the covariance matrix for the disturbance terms of the indicators of the latent exogenous variables.

Strengths and Weaknesses of LISREL

LISREL is a full information maximum likelihood (ML) method for estimating the parameters in structural equation models. With a full information method, estimates of all the parameters are obtained simultaneously from an observed correlation matrix. Alternative approaches for estimating the parameters in a latent variable causal model (e.g. a combination of factor analysis and multiple regression) estimate parameters one structural equation at a time using only the information from the correlation matrix relevant to the equation at hand (Anderson and Gerbing, 1982).

Thus, a major strength of the LISREL procedure is that parameter estimates for both measurement and structural relationships are derived simultaneously from a set of correlational data. In addition, LISREL output includes a goodness-of-fit (chi-square) statistic that represents the overall fit of the model to the data. In short, LISREL provides a wholistic approach to analyzing correlational data for the purpose of testing the validity and adequacy of causal models (Jöreskog and Sörbom, 1982).

This strength, however, may lead one to overlook the logical distinction between measurement and structural models (Anderson and Gerbing, 1982). The proper specification of the measurement model is necessary before meaning can be assigned to the analysis of the structural model. Unless one is confident that the constructs in the structural model are adequately measured, it is impossible to determine whether sample data supports hypothesized structural relationships among constructs. In other words, specification errors in the measurement model preclude any judgment about the analysis of the structural fit of the model to the data (Kenny, 1979, p. 62).

This logic leads toward an atomistic approach to testing causal models, i.e. analyze measurement submodels to overcome any measurement misspecification before testing any structural relationships among constructs. Anderson and Gerbing (1982) argue that lack of construct unidimensionality is a frequent problem with initial models and suggest some methods for improving specification of measurement models. These respecified models may then be subjected to full information estimation.

Bagozzi (1983) identifies four situations when one might want to take this stepwise approach to estimation. First, one may want to look at measurement models of constructs to diagnose the reasons for why a model failed to perform as predicted, i.e. to answer the question: Was it misspecification in the measurement of the constructs that caused a poor fit? Second, in exploratory studies, in pretests, or in the early stages of confirmatory research, separate examination of measurement models may aid in item selection. Third, if the purpose of the investigation is validation of constructs, then measurement issues should receive separate analysis. Finally, there may be pragmatic reasons for examining measurement models separately, e.g. the researcher may lack any guidelines on where to begin or what measurements might be poor ones.

The danger in examining submodels of an overall model is the potential for selection bias. If one selects out certain measures from the model on the basis that data do not support their inclusion, then the fit of the remaining measures to the data will no doubt improve substantially. "But this would be a capitalization on chance" (Bagozzi, 1983).

Thus, Bagozzi (1983) argues that measurements may be dropped in an auxiliary analysis (with cautious interpretation of the results) but that results should be presented using all measurements hypothesized in the original model. Otherwise, LISREL's strength as a wholistic test of causal models becomes a flaw by increasing the temptation to fish for well fitted models.

Consequently, the wholistic nature of LISREL may be at one in the same time a strength and a weakness. If one uses the procedure to test a model that includes bad measures of constructs and concludes that the poor fit of the model to the data reject structural hypotheses, then one's use of the procedure has been a disservice to the theory. On the other hand, using a full information analysis has the unique advantage of testing the model as a whole, and atomistic approaches to the use of LISREL undermine this strength.

Clearly, how one uses LISREL determines whether an analysis plays on its strength or to its weakness. Choosing whether to use an atomistic or wholistic approach to the analysis can be guided by the cases Bagozzi (1983) provides. However, when a model is respecified based on submodel analysis, interpretation of results that suggest a good fit must always be cautious.

Specification of the Causal Model of System Use

Figure 3.1 formally represents the model. The latent independent variables are user background (ξ_3), system/work fit (ξ_1) and system/person fit (ξ_2). The dependent variable, use, is a measured variable (y). Error in the structural equation representing the relationship between causes and effect is shown as ζ. Error in the measurement of latent constructs is shown as δ.

The path coefficients in the model are a function of the correlations among (standardized) variables. It is more convenient to define correlations in terms of path coefficients for this hierarchical (no reciprocal causation) model using the "tracing rule" heuristic:

> The correlation between two variables is the sum of the product of all paths obtained from each of the possible tracings between them provided that (1) the tracing does not enter the same variable twice and (2) the tracing does not enter and leave through the end point of an arrow for a single variable. (Kenny, 1979)

The model of EW system use can be specified in two parts. The measurement model and the structural equation model. The measurement model specifies how the latent or theoretical constructs (ξ_1, ξ_2, and ξ_3) are measured in terms of the observed variables and describes the measurement properties (validities and reliabilities) of the observed variables (x1, x2, x3, x4, x5, x6, x7, x8, x9, and x10). The structural equation model specifies the causal relationships between the independent (causal) variables (ξ_1, ξ_2, and ξ_3) and the dependent (effect) variable (y).

The structural equation model is expressed in the following equation:

$$Y = \gamma_1 \xi_1 + \gamma \xi_2 + \gamma \xi_3 + \zeta$$

Equations for the measurement model are:

$$
\begin{pmatrix} x1 \\ x2 \\ x3 \\ x4 \\ x5 \\ x6 \\ x7 \\ x8 \\ x9 \\ x10 \end{pmatrix} = \begin{pmatrix} \lambda_1 & 0 & 0 \\ \lambda_2 & 0 & 0 \\ \lambda_3 & 0 & 0 \\ \lambda_4 & 0 & 0 \\ 0 & \lambda_5 & 0 \\ 0 & \lambda_6 & 0 \\ 0 & 0 & \lambda_7 \\ 0 & 0 & \lambda_8 \\ 0 & 0 & \lambda_9 \\ 0 & 0 & \lambda_{10} \end{pmatrix} \begin{pmatrix} \xi_1 \\ \xi_2 \\ \xi_3 \end{pmatrix} + \begin{pmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \\ \delta_4 \\ \delta_5 \\ \delta_6 \\ \delta_7 \\ \delta_8 \\ \delta_9 \\ \delta_{10} \end{pmatrix}
$$

The measurement model can be summarized in the following table. The rows of the matrix are the ten measures and the columns are the three latent variables in the model. 1's in the body of the table represent the loadings of the measures on latent variables; 0's show that measures do not load on the latent construct.

	ξ_1	ξ_2	ξ_3
x1	1	0	0
x2	1	0	0
x3	1	0	0
x4	1	0	0
x5	0	1	0
x6	0	1	0
x7	0	0	1
x8	0	0	1
x9	0	0	1
x10	0	0	1

The structural model can also be summarized in a table. Columns are causes and rows are effects. 0's in the table indicate that no relationship exists between variables while 1's represent parameters (path coefficients) to be estimated.

	ξ_1	ξ_2	ξ_3	y
ξ_1	1.0	0	0	γ_1
ξ_2	0	1.0	0	γ_2
ξ_3	0	0	1.0	γ_3
y	γ_1	γ_2	γ_3	1.0

Analytical Procedures

The causal model of managerial EW system use presents a relatively complex analysis task. LISREL (Jöreskog and Sörbom, 1976) can be used to estimate the parameters of the use model by full information, maximum likelihood procedures. The fit of the model can be evaluated by a chi-square goodness-of-fit test by this procedure. The LISREL procedure provides the most complete solution to the estimation problem (Kenny, 1979; Jöreskog, 1982).

Since the initial model is exploratory, it was not expected to be free of specification error. That is, the research situation met several of the conditions mentioned by Bagozzi (1983) where it is "meaningful and useful" (p. 449) to examine the measurement model independent of the model as a whole: it was exploratory, constructs needed validation, and the theoretical support for the structural hypotheses suggested that they should not be rejected without examining the reasons for a poor fit.

The process for analyzing the use model can be described as a series of steps in the analysis.

1. Test of the measurement model. A confirmatory factor analysis was performed using LISREL to investigate the degree to which the measured variables were valid and reliable measures of the latent constructs.

2. Respecification of the measurement model. LISREL itself provided a "modification" index for each variable that indicated changes in the model that will enhance the model's fit. In addition, there were other indications of how the measurement model could be better specified (e.g. examination of standardized residuals, size (and sign) of path coefficients, parameter correlations, etc.) provided by LISREL V (Jöreskog and Sörbom, 1983).

3. Initial Tests of the Structural Model. Tests of both the initial and the respecified model as a whole were performed. It should be emphasized that results from the tests of all but the initial model cannot be interpreted definitively; rather, they are aimed at exploring foundations for future research.

4. Reciprocal Causation Model. Finally, there was some basis for probing the possibility that use and system/person fit may be reciprocally related, i.e. that both are causes of each other. Common sense suggests that the more one uses a system the more positive system

expectations become. The initial model and respecified model were tested permitting two-way causality between these two variables.

It was realistic to assume that the initial model would be somehow misspecified. In this event, the steps described above help to assure a meaningful contribution from the study by identifying models for future research.

CHAPTER IV

RESULTS

Introduction

The primary aim of the analysis was to explore the relevance of a theoretical structure to a set of observations. While the hypotheses in Chapter Three were grounded in existing theory and research, the model developed imposed a rather definite structure on the relationships among eleven (11) measured variables. There was no previous work to support this precise structure. Consequently, chances were small that the data gathered to test the model would closely fit both measurement and structural specifications ideally.

To fulfill the explorator purpose, "reanalysis" of models modified, in light of misspecification revealed by prior analyses, was a necessary supplement to the investigation of the initial model. By fitting a modified model to the same data, one can examine the reasons for a less-than-perfect fit. It would be unwise, for example, to reject hypothesized structural relationships if some aspect of the measurement model was causing a poor fit. A better procedure is to improve the measurement model where possible and "refit" the data to the revised model. As pointed out above, however, refitting modified models to the data from whence they are derived, risks an obvious capitalization on chance. Such post hoc data analysis must always be construed as exploratory; yet, these procedures are essential to tapping the information potential contained in the data set.

The results from this study are reported under four major headings: (1) findings regarding the initial measurement model; (2) findings regarding the initial structural model and research hypotheses; (3) modifications of the model suggested by the results, and (4) results from the analysis of modified models. This description of the analysis and results is preceded by a discussion of identification issues relevant to the model.

Identification of Parameters in the Model

Use of LISREL demands that the researcher first examine carefully whether all parameters in the model are identified. If a parameter cannot be estimated from observed covariance, then that parameter is said to be nonidentified. It is recommended that nonidentified models be dealt with by adding restrictions to make all parameters identified. By constraining the value of certain parameters to be equal (1) to some constant (including zero), (2) to each other or (3) to some mathematical combination of other parameters, it is usually possible to reduce the number of parameters to be estimated and thereby successfully estimate some or all parameters. These overidentifying restrictions reduce the demand (number of parameter estimates) placed on available data.

There is no list of necessary and sufficient conditions for identification (Jőreskog and Sorbom, 1983). Kenny (1979) has stipulated that there must be at least as many observed correlations as parameters to be estimated. Jőreskog and Sorbom (1983) define a similar requirement for models with measurement errors as:

$t \leq (p + q)(p + q + 1)/2$

where t is the number of parameters, p the number of x variables and q the number of y variables. Here, the number of parameters to be estimated is compared to the number of equations in the model.

Under Kenny's criterion, single factor measurement models must include at least five indicators (i.e. so that the number of correlations (10) just equals the number of parameter estimates (10) in order to be just identified. Jöreskog and Sörbom's (1983) criteria requires that single factor measurement models include three indicators in order to be just identified (i.e. $(p + q)(p + q + 1)/2 = 6$; number of parameters = 6). In both cases, no overidentifying restrictions are assumed.

Jöreskog and Sörbom (1983) go on to suggest examination of the equations defining the covariance between measured variables as a function of a unique parameter, i.e.

$$sigma_{ij} = F(\theta_{ij}),\ i \leq j$$

where θ is the parameter matrix. This makes explicit the need to determine whether each parameter can be estimated from available data. If a parameter can be determined from observed covariance, it is identified, otherwise it is not. "However, it is not necessary to actually solve the equations, but one should convince oneself about which of the parameters can be solved and which cannot" (Jöreskog and Sörbom, 1983).

Geraci (1976) addressed the complications to the identification problem found in models with measurement error. His arguments lead to a condition for identification that can be stated simply: the overidentifying restrictions that would exist in the same model without measurement errors must be "adequate in number and variety to compensate for the additional unknown parameters (in the form of error variances) introduced by the measurement errors" (Geraci, 1976, p. 282). Usually, the set of restrictions specifying the mutual independence of the error terms for measured variables satisfies this condition.

Finally, Jöreskog and Sörbom (1983) assert "...for many users of LISREL V the identification problem may be too difficult to resolve" (p. I. 23). Fortunately, the LISREL computer program checks the positive definiteness of the information matrix. If the information matrix is positive definite, the model is almost certainly identified.

In the model of system use, the question of identification is most pertinent within the three measurement models for the constructs, ξ_1, ξ_2, and ξ_3. The number of parameters to be estimated from observed correlations is relatively large because measurement errors (δ) for each x variable are included as parameters in addition to the causal paths between observed and latent variables.

Consider the initial measurement model (see Figure 4.1). There are three types of parameters to be estimated: paths between x's and ξ's (λ), paths between ξ's (Φ), and the error terms for x's (δ). λ_1, λ_6, and λ_7 may be equal to one in order to fix the scales for the latent variables—reducing by three the number of parameters to be estimated. Alternatively, the latent variables could be standardized to fix the metric—with the same reduction in the number of parameter estimates. In

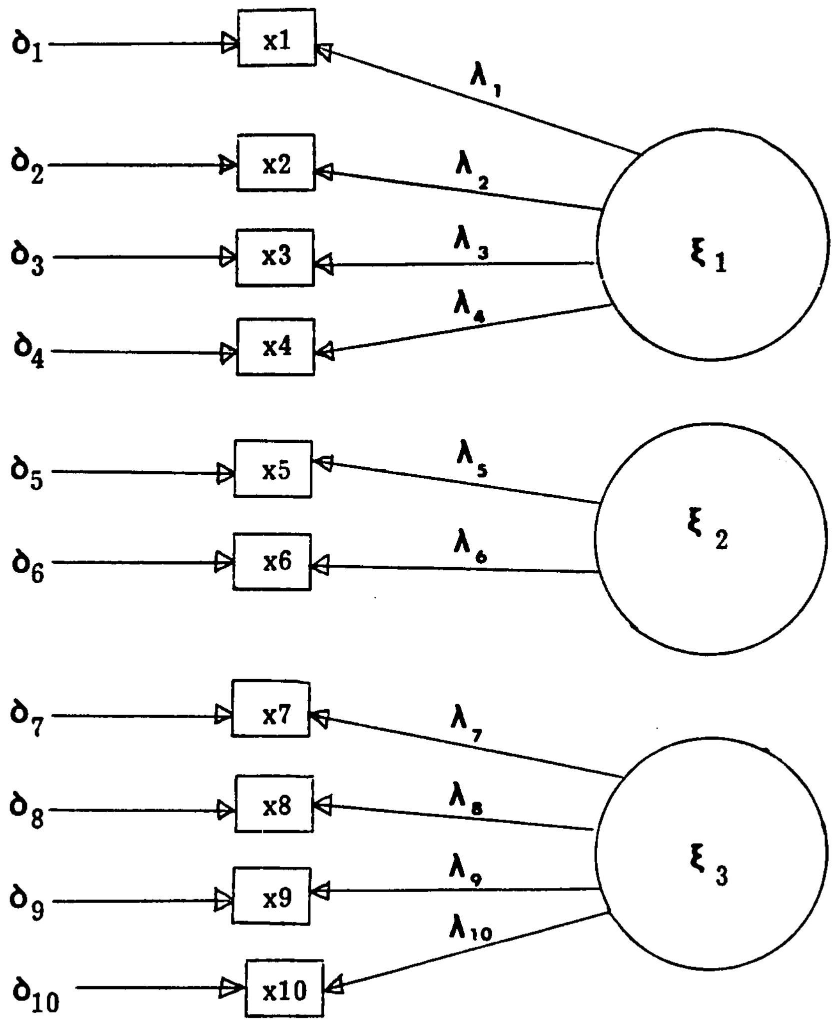


Figure 4.1: A Latent Variable Measurement Model of System/work Fit, System/person Fit and User Background (Initial Measurement Model)

addition, substantive theory calls for the paths between factors to be set equal to zero, again reducing by three the number of parameters to be estimated. Another set of restrictions derives from the assumption of independence of the measures, ie. correlations between measures x1 through x10 are set to zero. As a whole, the model seems clearly identified since the number of parameters to be estimated is twenty and the number of equations in the model is fifty-five (55). Indeed, the information matrix is positive definite when checked by LISREL.

However, identification issues should be examined also at the level of measurement submodels. The measurement model of system/person fit specifies two measures, x5 and x6, of ξ_2. The number of parameters to be estimated is only three since λ_6 has been set to 1.0. But these three parameters must be estimated from only one observed correlation. The submodel is clearly not identified. What this means is that our confidence about the construct validity of ξ_2 is unlikely to be bolstered by the assessment of internal consistency reliability provided by the estimates of the parameters, λ_5 and λ_6. However, in the context of the measurement model as a whole, the construct validity of ξ_2 can be estimated from the fit of the three-factor model to the data. Since the larger model is identified, all is not lost when a submodel is nonidentified. Nonidentified submodels do provide a source of limitations to the conclusions, however.

The submodels for ξ_1 and ξ_3 seem to be identified. Both meet Jőreskog and Sőrbom's (1983) necessary condition for identification, i.e. the number of equations in the submodels exceeds the number of parameters to be estimated. In addition, each includes a restriction to set the scale of the latent variable and each includes the restriction (assumption) that correlations between indicants are zero.

The addition of a dependent variable (y) to the measurement model increases by four the number of parameters to be estimated, i.e. γ_1, γ_2, γ_3, and ζ and increases by sixteen (16) the number of equations in the model. In addition, λ_y is set to 1.0 since there is only one measure for the latent dependent variable, and y is assumed to be measured without error. The causal model as a whole seems identified.

In sum, there appears to be enough information from the covariance matrix among observed variables in the whole model to identify the parameters of the causal model as initially specified. Thus, LISREL should be able to provide consistent estimates of these parameters as well as guide an assessment of the adequacy of the model as an explanation for observed covariance among measured variables.

Results from the Analysis of the Initial Measurement Model

Causal modeling with latent variables permits simultaneous analysis of both structural relationships (i.e. cause-effect associations supported by substantive theory) and measurement relationships (i.e. cause-effect associations between theoretical constructs and their indicants). The ability to sort out measurement error from the structural relationships among latent variables is a major benefit that results from the application of the procedure.

However, when the theoretical constructs in the model are themselves exploratory, it is logical to consider the validity and reliability of their measures before the substantive relationships among them are explored. Anderson and Gerbing (1982) make the point firmly: "proper specification of the measurement model is necessary before meaning can be assigned to the analysis of the structural model."

Accordingly, the first step in this analysis was to estimate parameters for the measurement model as conceived in Chapter Three. Table 4.1 shows the correlations among the measured variables and includes means and standard deviation. Table 4.2 shows the maximum likelihood parameter estimates provided by LISREL V for a three-factor, ten-indicator model wherein the constructs are conceived to be orthogonal. For this factor analytic model, LISREL estimates three sets of parameters: (1) λ_i to indicate the strength of measurement relationships between x and ξ variables, (2) δ_i to indicate measurement errors in the observed variables, and (3) Φ_i to indicate correlation among latent variables. In the initial model, correlations between latent variables are constrained to be zero and the latent variables have been standardized for purposes of setting their metric (Long, 1983, p. 77). Thus, Table 4.2 shows estimates for λ's and δ's, the standard errors of the estimates and t-values.

Evaluating the Results from the Analysis of the Initial Measurement Model

As is evident from the table, not all the measures are equally good indicators of the latent variables. In particular, the small coefficients

Table 4.1: Correlation Matrix, Means and Standard Deviations for Measured Variables
N = 73

	y	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10
y	1.0										
x1	.46	1.0									
x2	.53	.94	1.0								
x3	.41	.48	.47	1.0							
x4	.20	.14	.24	.37	1.0						
x5	.85	.53	.59	.54	.33	1.0					
x6	.09	.22	.28	.15	.34	.17	1.0				
x7	-.20	-.11	-.16	-.12	-.03	-.23	.27	1.0			
x8	-.12	-.10	-.13	-.04	.01	-.17	-.15	-.26	1.0		
x9	-.16	-.14	-.23	-.06	-.07	-.21	.18	.81	-.36	1.0	
x10	-.29	-.24	-.29	-.19	-.13	-.42	.03	.48	-.13	.59	1.0

	Mean	S.D.
y	20.88	19.77
x1	645.16	455.94
x2	6042.15	3865.71
x3	7.14	1.18
x4	6.80	1.16
x5	14.59	9.14
x6	4.39	2.27
x7	43.87	7.37
x8	14.79	1.59
x9	18.49	7.50
x10	8.23	7.90

Table 4.2: ML Estimates for the Initial Measurement Model (Standardized)

Parameter	Estimate	Standard Error	T-value*
λ_1	.93	.09	10.40
λ_2	1.00	.08	11.89
λ_3	.46	.11	4.09
λ_4	.24	.12	2.07
λ_5	.61	.11	5.51
λ_6	.28	.12	2.33
λ_7	.80	.10	7.69
λ_8	-.35	.12	-3.09
λ_9	1.00	.10	10.43
λ_{10}	.58	.11	5.24
δ_1	.13	.04	3.01
δ_2	.00	.04	n/a
δ_3	.79	.13	6.00
δ_4	.94	.16	6.01
δ_5	.63	.11	5.72
δ_6	.92	.16	5.97
δ_7	.36	.09	4.12
δ_8	.87	.15	5.99
δ_9	.00	.10	n/a
δ_{10}	.66	.12	5.76

*Critical two-tailed t-values: $t \leq .10 = 1.282$, $t \leq .05 = 1.645$, $t \leq .005 = 2.576$.

for λ_4, λ_6 and λ_8 are noteworthy. An examination of the error terms makes clear that the reliability of x4, x6 and x8 limits the validity of the variables as measures of their respective constructs (Ghiselli, Campbell and Zedeck, 1981). Squared multiple correlations for each of the x-variables within constructs are the complement of the error terms and may be interpreted as the reliability coefficient of each x with respect to the construct it is supposed to measure, i.e. it is the correlation among scores on what are presumed to be "parallel tests" (Ghiselli, Campbell and Zedeck, 1981).

The estimates for λ_2 and λ_9 and the squared multiple correlations for x2 and x9 are all approximately 1.0. These values require careful scrutiny because of their magnitude. It is important to determine whether they are reasonable estimates that can be meaningfully interpreted or whether they result from some problem in the analysis.

Long (1983, pp. 62-63) pointed out six problem areas that could cause unreasonable values for parameter estimates: (1) missing data may have been handled pairwise (so that each parameter estimate is based on a different sample), (2) the computer program may have been misapplied, (3) the model may be misspecified, (4) there may be violations of the normality assumption, (5) the sample may be too small, and (6) the model may be "empirically" unidentified.

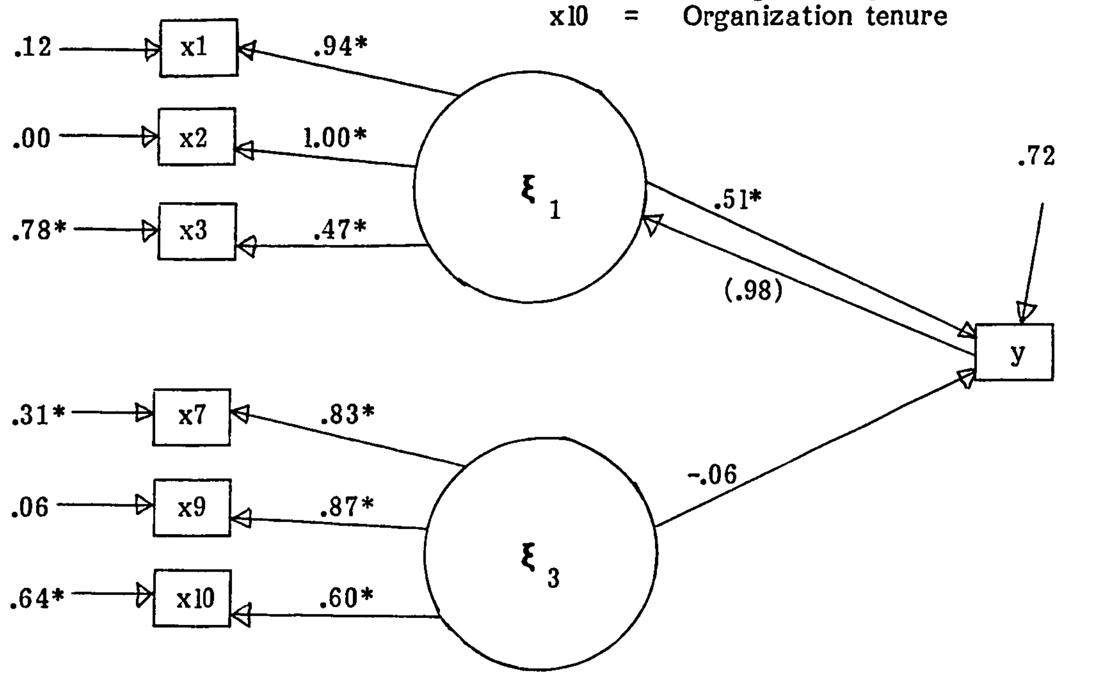
First, it should be noted that the estimates were generated with casewise deletion of missing data and, second, careful use was made of the LISREL program. Thus, two of the six problems identified by Long (1983, pp. 62-63) can be eliminated as causes of unreasonable parameter values.

An evaluation of the present situation indicates that the most likely problems (if there are any) affecting parameter estimates in the model are misspecification and empirical underidentification (Kenny, 1979, p. 40). The stability of the estimates across various versions of the model and between ML and unweighted least squares (ULS) estimates argues against sample size or violations of the normality assumption as problems (Boomsma, 1982; Long, 1983, p. 62).

The basis for suspecting empirical underidentification is the relatively high correlation between two of the parameter estimates in each of the measurement submodels, ξ_1 and ξ_3. These effects are comparable to the effects of multicollinearity in multiple regression (Long, 1983, p. 63). Essentially, what this means is that there is some redundancy in the data so that the method of estimation has a difficult time distinguishing between two parameters. The most direct means for overcoming multicollinearity is to eliminate one of the variables; in the context of causal modeling, this amounts to respecifying the model. When x4 and x8 are eliminated in a respecified model (see below for the rationale of this respecification), all parameter estimates fall within reasonable ranges (see Figure 4.2). Further, in the modified model the values for λ_2 and λ_9 are still quite high and close to the initial estimates given in Table 4.2. This suggests that the degree of multicollinearity or empirical underidentification is not too great.

The negative path coefficient between x8 (education) and ξ_3 (user background) is contrary to the a priori definition of the latent

Y	=	Use
ξ_1	=	System/work fit
ξ_3	=	User background
x1	=	Core work relevance
x2	=	Importance of system to work
x3	=	Productivity impact of system use
x7	=	Age
x9	=	Managerial experience
x10	=	Organization tenure



Chi-square	18.13
D.F.	13
Chi-square/D.F.	1.40
GFI	.76
Incremental Fit Index	.96
Coefficient of Determination	.28

* $p \leq .005$, two-tailed

Figure 4.2: Modified Structural Model—Parameter Estimates (Standard Error)

variable. Moreover, δ_8 is very high, meaning that the reliability of measurement of x8 as a part of the construct ξ_3 is very low. If x8 is included as a measure of ξ_3, the construct cannot be construed to be unidimensional.

The magnitude of the squared multiple correlations for x5 and x6 together with the relatively small value for λ_6 suggest that these indicants are not measuring a common underlying construct. An examination of the correlation table (Table 4.1) shows that the correlation between x5 and several other measures exceeds the correlation with x6. This violates the "differentiation in constructs" criteria spelled out by Bagozzi (1981) for evaluating construct measurement models with multiple indicators. Because there are only two measures, the "convergence in measurement" criteria cannot be applied, and respecifying the measurement model by eliminating one of the indicants means treating the construct as measured by a single indicant.

Bearden, Sharma and Teel (1982) summarize the procedure recommended by Werts, Linn and Jöreskog (1974), Fornell and Larcker (1981a), and Bagozzi (1981) for estimating construct reliability. The measure is analogous to coefficient alpha and is an estimator of internal consistency. Though this statistic is often used to evaluate the measurement properties of models, little is known about its distribution (Bearden, Sharma and Teel, 1982, p. 427). The construct reliabilities for ξ_1, ξ_2, and ξ_3 are .79, .33, and .69 respectively. (The interpretation of an internal consistency measure of reliability for constructs with two indicants is problematic (Spearman and Holzinger, 1924 in Anderson and Gerbing, 1982) so that the estimation of construct reliability for ξ_2 is impossible, strictly speaking.) These statistics reflect a reasonable degree of reliability of measurement for ξ_1 and ξ_3.

In sum, the measurement model does include some reliable and valid measures for at least two of the constructs, ξ_1 and ξ_3. x1, x2, x3, x7, x9 and x10 seem to capture the constructs intended. x5 and x6, however, do not appear to be reliable or valid measures of the same construct; thus, measurement of the system/person fit construct in the model is problemmatic.

The overall goodness-of-fit of the model is shown in Table 4.3. The chi-squared value is 72.84 with 35 DF which yields a ratio of 2.08. This is well below the value of 10.0 identified by Schmitt and Bedeian (1982) as indicating an acceptable fit based on this ratio as defined by Boruch and Wolins (1970). Nevertheless, the chi-square statistic is sizeable and sufficient to reject the null hypothesis that there is no difference between the observed and predicted covariance structure. (In causal modeling the null hypothesis is equivalent to the research hypothesis.)

However, interpretation of the chi-square statistic as the definitive measure of the model's appropriateness is unwarranted. Bearden, Sharma and Teel (1982) show that the statistic provided by LISREL V is not chi-square distributed for small samples and more complex models (four constructs, twelve indicators, in their study) (p. 428) and may imply rejection of a model when it is unwarranted. Boomsma (1982) warns that

Table 4.3: Measures of Overall Fit for the Initial and Modified Measurement Models

	Initial Measurement Model, Ml	M2	M3
Chi-square (p-value)	72.84 .000	64.29 .000	43.68 .002
Degrees of Freedom	35	27	20
Chi-square/ D.F. ratio	2.08	2.38	2.18
GFI Index	.67	.67	.69
Incremental Fit Index	.86	.87	.91

erroneous conclusions may be drawn on the basis of the chi-square statistic in samples of less than 200. In addition, Jöreskog and Sörbom (1983) point out that use of the chi-square as a test statistic is not valid in most cases (p. I.39); rather, they advocate use of chi-square as a means for evaluating the fit of alternative models to a given set of data.

Since the probability distribution of the chi-square statistic is not well behaved for small samples, alternative indications of the goodness-of-fit should be examined. LISREL V provides a "goodness-of-fit index" (GFI) that represents "the relative amount of variances and covariances jointly accounted for by the model." It varies between 0 and 1.0 so that .67 for the present model seems reasonably adequate. Unfortunately, the probability distribution of the GFI is unknown. The slope of a line drawn through a Q-plot of the normalized residuals is approximately one or slightly less than one—indicating a moderate fit (Jöreskog and Sörbom, 1983). Inspection of the residuals shows values greater than two (thought to indicate misspecification) for relationships involving the variables noted above to be unrealiable indicators (x4, x5, x6 and x8), but in a table of 55 normalized residuals only six exceed the 2.0 criterion (most are less than one).

As another complement to the chi-square statistic, Bentler and Bonnett (1980) have suggested an incremental fit index. This measure is calculated by comparing the chi-square statistic of the hypothesized model with the measure for a "null model" in which no structure is imposed on the relationships among variables. Bearden, Sharma and Teel (1982) found that this statistic should exceed .95 in well fitted models. The value is .86 for the initial measurement model.

Bearden, Sharma and Teel (1982) also demonstrate that estimates of construct reliability based on LISREL parameter estimates (λ and δ) can come very close to the "true" value even in very small samples. Therefore, there is no reason to reject parameter estimates for the present model even though an N of seventy-three is probably lower than would be desirable for a three-construct model. (There were 110 members of the original sample; the sample "shrinkage" was caused by missing data.)

In sum, the results of the analysis of the initial measurement model are mixed. Two of the latent variables (ξ_1 and ξ_3) have some reasonably reliable and valid measures, but each also has a measurement relationship that appears misspecified. The measurement of one construct (ξ_2) was not accomplished with reasonable reliability and validity. Ways to improve the model are suggested by these findings, and a modified model will be discussed in a subsequent section.

Results from the Analysis of the Initial Structural Model

The parameters of the initial causal model could not be estimated with LISREL. Attempts to produce such estimates resulted in unreasonable values that are outside the bounds of meaningful interpretation. Since the measurement model appeared to suffer to some degree from misspecification, it seemed likely that the cause of unreasonable parameter estimates lay with the measurement aspects of the structural model.

Before beginning investigation of modified models, it was important to confirm that the unrealistic parameter values were indeed caused by measurement model problems rather than by the introduction of the dependent variable. The first step in the strategy for making this determination was to attempt an analysis of a structural model with ten measured variables, i.e. where x1 through x10 are independent variables and use is the dependent variable. The program was able to provide reasonable estimates for this "multiple regression" model, and the multiple R-squared value was .74. Thus, it can be concluded that the cause of unreasonable parameter estimates in the initial model lies with one or more of the latent independent variables.

To isolate which of the latent independent variables was the source of the problem, an analysis was conducted involving the introduction of independent variables one at a time. The analysis of the measurement model pointed to system/person fit (ξ_2) as the most problemmatic construct. An analysis of a structural model without ξ_2 but otherwise the same as the initial structural model confirmed the suspicion that it was the cause of unrealistic parameter estimates. In the model with only two independent variables (system/work fit and user background), the measurement parameters were consistent with those estimated in the measurement model and the structural parameters took on reasonable values. (A thorough description of the model can be found in the following section.) When ξ_2 was introduced with x5 and x6 as measures or when either x5 or x6 was introduced as the single measure of ξ_2, the unreasonable structural parameter estimates appeared (i.e. values for structural coefficients and the multiple R-squared exceeded 1.0.)

The analysis of structural relationships cannot proceed on the basis of the causal variables as defined in the initial measurement model. Consequently, efforts to improve the model should begin with modifications to the measurement model. If an adequate measurement model can be defined, a reexamination of structural relationships is in order. Of course, findings about such modified models are tentative.

Modifications to the Initial Measurement Model

Because the causal model of EW use is exploratory, it is not surprising that initial attempts to confirm relationships among variables were found lacking. One of the strengths of LISREL is the potential for comparing the fit of alternative models. Alternative models may be suggested by the analysis of the initial model and by substantive theory. Of course, fitting modified models to data from the same sample in which initial models were analyzed risks capitalizing on chance, and cross validation of the results in future research is required.

To sort out which changes in the model make the most impact, it is necessary to make modifications one at a time. The order of these changes should be determined by logic and relevant theory. In models with latent variables, measurement model modifications should precede structural modifications because it is illogical to respecify structural relationships before settling on respecification of the causal variables. Choosing which specific changes to make within the measurement model should be based on indications from the initial analysis about where misspecification is the most serious.

The analysis of the initial measurement model pointed to two modifications. Both involve the elimination of a measure. The expected impact is an improvement in the goodness-of-fit statistics resulting from the increased unidimensionality of the constructs (Anderson and Gerbing, 1982). Table 4.3 shows the goodness-of-fit measures for the initial and modified measurement models. There is a third modification to the model that must be made before causal parameters between latent variables can be estimated. It is discussed after the impact of the first two changes has been assessed. Finally, a means for estimating a parameter representing a reciprocal relationship between system/work fit and use is defined.

A negative value for λ_8 suggests that x8 is not part of a unidimensional construct ξ_3. There is no indication from the modification indices that removing x8 will improve the overall fit of the model, but retaining it is as a measure of ξ_3 is untenable on substantive grounds. After the fact, it is not surprising to find that education fails to covary with age, management experience and organization tenure. Older, more senior managers may not have had the benefit of the boom in business education of the last twenty years. Table 4.4 shows the parameter estimates, standard errors, and t-values for this modified model (M2).

The second modification to the measurement model suggested by the initial analysis is the elimination of x4 as an indicant of system/work fit. The basis for choosing to respecify the measurement of ξ_1 in this way

Table 4.4: Parameter Estimates, Standard Errors and T-Values for First Modified Measurement Model (M2)

Parameter	Estimate	Standard Error	T-value*
λ_1	.93	.09	10.45
λ_2	1.00	.08	11.91
λ_3	.46	.11	4.11
λ_4	.24	.12	2.07
λ_5	.61	.11	5.58
λ_6	.27	.12	2.24
λ_7	.83	.10	7.95
λ_9	.97	.10	9.77
λ_{10}	.60	.11	5.43
δ_1	.13	.04	3.01
δ_2	.00	.04	n/a
δ_3	.79	.13	6.00
δ_4	.94	.16	6.00
δ_5	.63	.11	5.78
δ_6	.93	.16	5.98
δ_7	.32	.09	3.50
δ_9	.05	.10	.54
δ_{10}	.64	.11	5.62

*Critical two-tailed t-values: $t \leq .10 = 1.282$, $t \leq .05 = 1.645$, $t \leq .005 = 2.576$.

is empirical. The magnitude of λ_4 was much smaller than the size of the loadings for other measures of system/work fit, and the size of the error term for x4 (δ_4) was significantly greater than that of other indicants of ξ_1. Thus, it seemed clear that the unidimensionality of the construct ξ_1 could be improved by eliminating x4. Consequently, the model M2 was respecified to exclude x4 as a measure of ξ_1. Relevant statistics for this second alternative measurement model (M3) are shown in Table 4.5.

An a posteriori review of the original correlation matrix (Table 4.1) reveals that improvements in the measurement models for ξ_1 and ξ_3 come as no surprise. x8 is correlated negatively with all other measures for ξ_3. x4 has intercorrelations with measures of ξ_1 consistently lower than x1, x2 and x3.

A comparison of the goodness-of-fit measures for the three measurement models (initial, M2 and M3) from Table 4.3 shows significant improvement for the modified models, especially M3. Further, the consistency of parameter estimates in the three models (see Tables 4.2, 4.4 and 4.5) encourages confidence in the identification status of the models. It should be recognized that the chi-square value is too great even in M3 to prevent rejection of the null hypothesis that there is no difference between observed and hypothesized measurement relationships. Given the size of the sample, the incremental fit index may be more representative of the model's status, however. The magnitude of this measure (.91) comes close to a value (.95) that indicates a well-fitted model according to the simulation carried out by Bearden, Sharma and Teel (1983). In short, it

Table 4.5: Parameter Estimates, Standard Errors and T-Values for Second Modified Measurement Model (M3)

Parameter	Estimate	Standard Error	T-value*
λ_1	.94	.09	10.52
λ_2	.99	.09	11.79
λ_3	.46	.11	4.17
λ_5	.67	.12	5.65
λ_6	.27	.13	2.14
λ_7	.83	.10	8.01
λ_9	.97	.10	9.74
λ_{10}	.61	.11	5.46
δ_1	.12	.04	2.76
δ_2	.01	.04	.12
δ_3	.78	.13	5.99
δ_5	.54	.11	4.79
δ_6	.93	.16	5.89
δ_7	.31	.09	3.46
δ_9	.06	.10	.62
δ_{10}	.64	.11	5.62

*Critical two-tailed t-values: $t \leq .10 = 1.282$, $t \leq .05 = 1.645$, $t \leq .005 = 2.576$.

appears that the measurement of ξ_1 and ξ_3 is adequate enough in M3 to justify investigation of the structural relationships between them and the dependent variable.

The third modification to the measurement model to be made before analyzing a modified structural model involves ξ_2. The initial analysis showed that the system/person fit construct was not adequately measured (the construct reliability was .33) and that introducing the variable into the structural model as measured by either one or both of its hypothesized indicants resulted in unrealistic parameter values. Accordingly, if an analysis of any structural relationships between latent variables is to proceed, ξ_2 must be omitted. Thus, the revised structural model includes two independent variables (ξ_1 and ξ_3) with three measures each (see Figure 4.2).

Another substantive modification is suggested by the notion that use increases system/work fit: the more one uses the system, the more ways of using the system to accomplish important work are discovered. This idea suggests reciprocal causation between y and ξ_1. Another way to view this two-way causation is that system use causes system use indirectly by increasing system/work fit. Estimation of the path in the nonrecursive model (from use to system/work fit) does not impact other parameter estimates because the calculations are simple and made apart from the LISREL procedures. Consequently, the value of this parameter need not be investigated prior to the analysis of the modified structural model, and the discussion concerning it can be found in the following section.

Results from the Analysis of the Modified Model

Figure 4.2 shows the modified model with ML estimates of parameters provided by LISREL. The path from use (y) to system/work fit (γ'_1) was not estimated by the computer program. A discussion of its derivation precedes an evaluation of the results for the model as a whole.

Jőreskog and Sőrbom (1982, 1983) describe the study of reciprocal causation (or causal feedback loops) as a cycle. A cycle is a causal chain between the two variables that are reciprocally related. In the present model, one cycle consists of the path from ξ_1 to y (γ_1) and the return from y to ξ_1 (γ'_1). The effect of one cycle on y is $\gamma_1\gamma'_1$. After two cycles the effect will be $\gamma_1^2\gamma_1'^2$, after three cycles $\gamma_1^3\gamma_1'^3$, etc. Thus, the total effect on y will be the sum of the infinite series:

$$\gamma_1\gamma'_1 + \gamma^2\gamma_1'^2 + \gamma_1^3\gamma_1'^3 + \ldots.$$

which is equivalent to

$$\frac{\gamma_1\gamma'_1}{(1 - \gamma_1\gamma'_1)}$$

In order to estimate the parameter γ'_1, i.e. the return path from y to ξ_1, Jőreskog and Sőrbom (1982, 1983) provide formulas for decomposing the effects. For effects on η/y by ξ, the formulas are:

Direct effect	Γ
Indirect effect	$(I - B)^{-1}\Gamma - \Gamma$
Total effect	$(I - B)^{-1}\Gamma$

Since the matrix of paths between latent dependent variables B, is the zero matrix (there is only one dependent variable), these formulas are not useful in estimating the path from y to ξ_1. From the formula for computing the total effect of y on itself, however, it is possible to estimate the path. Since B is zero, the total effect of y on itself is 1.0 (i.e. identity). Thus,

$$\frac{\gamma_1 \gamma_1'}{(i - \gamma_1 \gamma_1')} = 1.0$$

Since γ_1 is estimated to be .51 (in the modified structural model), one can substitute in the above equation and solve for γ_1', the path to be estimated. This results in a value of .98 for the modified structural model. This value is shown in parenthesis in Figure 4.2. One can see from the derivation of this estimate that it simply means that the size of the coefficient from system/work fit to use is not large enough to rule out a reciprocal path. Comparison of the magnitude of the reciprocal path estimate with other parameter estimates is probably unwarranted because the reciprocal path was not estimated from the same information or by the same procedure as other estimates.

Significance levels, measures of goodness-of-fit and the coefficient of determination for the modified structural model are also given in Figure 4.1. (Standard errors and t-values for measurement model parameters are not repeated.) The parameters relevant to the measurement aspects of the model are nearly identical to those of M3 (see Table 4.5). The signs of structural parameters (γ_1 and γ_3) are consistent with research hypotheses H1 and H3 but the magnitude of γ_3 is not statistically significant. Thus, analysis of the data in a modified model provides a basis for confirming H1: Use of an EW system increases as the fit between the system and the work increases. H3 is not supported by the data: User background (i.e. increasing age, managerial experience and organization tenure) does not cause decreased levels of EW system use. H2 cannot be investigated because of problems in the measurement of system/person fit.

The modified structural model fits the data well. The chi-square value is small enough to prevent rejection of the (post hoc) null (and research) "hypothesis" that the observed covariance structure is different from the structure contemplated in the modified model. The incremental fit index is above the value usually associated with well fitted models.

The multiple R-squared value for the structural equation was "multiple regression" model of measured variables that included all ten indicators as independent variables. An examination of the original correlation matrix (Table 4.1) reveals that x5 bears a higher correlation to the dependent variable than any other x. It is likely that a substantial proportion of the decrease in the coefficient of determination results from the elimination of ξ_2 as a predictor. The magnitude of the bivariate correlations between use and x4 or x8 suggests that the elimination of these measures was not material in the reduction of the multiple R-squared value. In any case, a multiple R-squared of .28 is respectable considering the multiple determinants of any human behavior (Kenny, 1979).

In sum, the modified structural model is a representation of the structure of covariance among seven of the measured variables in the study that fits sample data far better than the initial model. Since one independent variable was deleted, however, the predictive validity of the model (as measured by the multiple coefficient of determination) was decreased.

The consistency in path estimates between the models and the successful fit of the modified model provides the basis for interpretation of the results. First, the hypothesized direct causal relationship between use and system/work fit is supported. Second, the third research hypothesis (that user background is causally related to use) is not supported by the nonsignificant magnitude of the parameter estimate, γ_3. Third, support for the second research hypothesis about the causal relationship between system/person fit and use cannot be affirmed or denied. The measures of system/person fit were correlated highly with many other measures in the model and resulted in an empirically underidentified model for which parameters could not be estimated. This last outcome was the most damaging to the present research effort but points to a new conceptualization of the dependent variable that could be a basis for future research. This possibility along with the implications and limitations of the findings as a whole will be articulated in Chapter Five.

Limitations to the Findings

The intent of the present study was to model relationships among selected variables in order to examine them as causes of EW system use among managers. In pursuit of this goal, observations were made in a field setting to measure the relevant variables (system/work fit, system/person fit, user background, and use). A non-experimental analysis of covariation was made to test whether the structure of relationships expressed in the causal model was reasonably consistent with observed correlations. Some aspects of the initial model seemed consistent with the data while other parts of the model were inconsistent with sample observations.

The relevant question at this stage of inquiry is: What is the validity of causal inferences, based on the results?

The conclusions elaborated in the next chapter spell out the causal inferences that seem reasonable. In this section, the results are summarized and threats to their validity are examined. Validity investigation is the social scientist's means for assessing the approximate truth or falsity of propositions. The conclusions are propositions derived from the findings (summarized below). Thus, threats to the validity of the study's findings define the limits to the "truth" of its conclusions. Cook and Campbell (1979) define four types of validity that provide the structure for this discussion: statistical conclusion validity, internal validity, construct validity and external validity.

The findings whose validity is to be examined can be summarized as follows: (1) system/work fit is a significant cause of use; (2) user background is not a significant cause of use; and (3) the modified causal model provides a reasonable, albeit tentative, explanation of managerial EW use levels. Because the modified model excludes system/person fit as a cause of use, the initial causal model cannot be evaluated. Thus, the fact that the second research hypothesis (about the effect of ξ_2 on use) went untested is a significant limitation to the findings in itself.

Statistical Conclusion Validity

Threats to statistical conclusion validity are factors that cause one to believe there is covariation based on statistical evidence when, in fact, there is none (or that cause us to believe there is no covariation when, in fact, there is). In the present passive observational, field study, potential threats to the validity of the statistical analysis arise from the reliability of measures, the statistical power of the analysis, random irrelevancies in the research setting and random heterogeneity of respondents. Concerns about the threats from the first two factors can be allayed; threats from the second two factors are a source of limitations.

Results from the analysis of the initial measurement model were used to develop acceptably reliable measures of system/work fit and user background. This procedure reduced the threat of unreliability of measurement to statistical conclusion validity about the results. The construct reliabilities (Bearden, Sharma and Teal, 1982) for the latent variables in the modified measurement model are .87 (for ξ_1) and .84 (for ξ_3). These values are high enough to allay most concerns about the effect of measurement reliability on the validity of the statistical results concerning the structural relationships between the independent variables and use. Use itself was measured electronically; it was assumed that this approach produced a highly valid and reliable measure.

The finding that user background is not a significant cause of use is threatened by the possibility that the statistical analysis was not powerful enough to detect an effect that was actually present in the data. In the absence of prior research to suggest the expected magnitude of this effect in a structural equation including system/work fit, it is not possible to conduct a formal power analysis, but two considerations mitigate this threat. First, a significant effect <u>was</u> detected by LISREL V for system/work fit (in the form of a parameter estimate with a significant t-value for an alpha of .05 or less). It seems reasonable to assume that since the statistical power of the analysis was sufficient to detect this effect, any effect of user background would also have been detected if it were present. Secondly, if the threat arises because the effect of user background is smaller than the effect of system/work fit (but still significant), then it must be assumed that a larger sample would provide greater variation in the measures of user background. The size of variation in the measures of user background for the present sample belies this possibility, however. (See the standard deviations in Table 4.1.)

The third and fourth threats to the validity of the statistical evidence in this study are not as easy to assess as the first two. The existence of either random irrelevancies in the setting or random heterogeneity in the sample could have the effect of inflating the error term in the structural equation. Thus, the size of the estimate for the effect of user background on use may have been depressed by random variations in workload such that the use levels measured for sample members was somehow skewed to mitigate the real effect of user background on use (random irrelevance in the setting). In addition, there almost certainly were characteristics distributed randomly across participants (e.g. race, sex) that affect use levels but that went unmeasured and uncontrolled so as to increase the error in the structural equation.

The researcher sampled a substantial period of use (at least three weeks) across a broad range of participants in the field setting so as to minimize the influence of random irrelevancies in the setting. Moreover, the characteristics of sample members that were measured were those suggested from theory in the hope that other characteristics would be unrelated to the dependent variable. These precautions provide a reasonable defense against the threats to the validity of the statistical evidence arising from irrelevancies in the setting or heterogeneity in the sample. However, the influence from such factors cannot be ruled out. Thus, the findings are limited by the assumption that random irrelevancies in the setting and random heterogeneity of respondents played no significant role in: (1) the covariation detected between system/work fit and use, (2) the lack of detected covariation between user background and use, and (3) the model's overall fit.

Internal Validity

Given that the statistical procedures have detected covariation where it exists and failed to detect it where it does not exist, the extent to which covariation represents causality should be investigated. Threats to the internal validity of causal inferences based on statistical covariation arise when there are alternative explanations for a relationship other than causation and when the direction of causality is difficult to establish. In cross-sectional, passive observational studies, temporal order is not manipulated so that causal directionality is impossible to assess empirically. The causal direction in the present model was based on an interpretation of prior theory and research. In the case of user background, it is nonsensical to think of reversing the directionality presumed in the model. However, it is not nonsensical to consider that use of an EW could cause system/work fit. For this reason and in the absence of definitive theory, the reciprocal path coefficient was estimated, although the overall fit of the reciprocal causation model could not be established.

Since the research was conducted in the field, the possibility that some unmeasured and uncontrolled variable or variables accounts for observed covariation between the independent and dependent variables looms rather large and provides the most significant threat to the internal validity of the findings. The research design achieved some degree of control over certain potential but unmeasured causes of use by holding their values constant, i.e. characteristics of the technical system, characteristics of the implementation process, characteristics of the organization, and characteristics of the IS Staff organization. It should be acknowledged that the design did not achieve perfect control over all the variables in these five sets of characteristics. For example, within a single system environment, variation in the characteristics of the implementation process should be held reasonably constant, but this does not rule out the possibility that some sample members felt more involved in the implementation process than others. Moreover, characteristics of interpersonal relationships were neither controlled nor measured; this set of characteristics could be a source of "third variables" that accounts for the covariation between system/work fit and use or the lack of covariation between user background and use. The fact that others have not found predictors of use in interpersonal relationships is as likely to be a result of the dearth of research rather than the reality of the role of these variables. Finally, since the role of system/person fit was acknowledged in the initial model but not evaluated in the structural analysis, it could be a third variable related to either system/work fit or user background that accounts for the covariation or lack of it.

The significant possibility that unmeasured variables account for the structural parameter estimates is a natural consequence of conducting research in a field setting. The use of existing theory to guide variable selection and the degree of control provided by the research design help to reduce threats to internal validity that were anticipated. However, the problem of empirical underidentification was not anticipated. The resulting exclusion of system/person fit from the analysis of the structural model is an unfortunate consequence of exploratory theory building that seriously limits our confidence about the causal relationships in the model.

Construct Validity

The "truth" of causal inferences depends also on the extent to which constructs are validly measured by their indicators (the measured variables). Construct validity concerns the degree to which the measured variables are indicators of the constructs in the model and not indicators of some other construct(s) (Cook and Campbell, 1976). An assessment of the measurement model provides a good empirical basis for examining construct validity in the present study. Construct validity should also be assessed deductively based on the theoretical content or meaning ascribed to the constructs. (See Section IIID.)

The initial measurement model was revised before structural parameters were estimated. One measure each was dropped from system/work fit and user background, and system/person fit was dropped altogether. The correlation matrix is revised to include only the measures from the modified model in Table 4.6. Using this matrix, the two independent variable-constructs can be examined in light of both the convergence in measurement and differentiation in constructs criteria recommended by Bagozzi (1981) for establishing the validity of indicators as measures of latent constructs.

Table 4.6: Correlation Matrix for Measured Variables in the Modified Model

	y	x1	x2	x3	x7	x9	x10
y	1.0						
x1	.46	1.0					
x2	.53	.94	1.0				
x3	.41	.48	.47	1.0			
x7	-.20	-.11	-.16	-.12	1.0		
x9	-.16	-.14	-.23	-.06	.81	1.0	
x10	-.29	-.24	-.29	-.19	.48	.59	1.0

The convergence in measurement criterion is similar to Campbell and Fiske's (1959) concept of convergent validity, except that the former does not presume different measurement methods. As formulated by Bagozzi (1981, p. 375) the criteria is: "Measures of the same construct should be highly intercorrelated among themselves and uniform in the pattern of intercorrelations." In other words, the intercorrelations of measures for a given construct should all be high and of about the same value. The intercorrelations for the measures of system/work fit (x1, x2, and x3) satisfy the first part of the criteria (they are all high), but the correlation between x1 and x2 (.94) is significantly greater than that between x1 and x3 (.48) and x2 and x3 (.47). The pattern of intercorrelations for the measures of user background is similar but not as marked: the correlation between x7 and x9 (.81) is greater than that between x7 and x10 (.48) and x9 and x10 (.59). The structure of this covariation shows up on the LISREL parameter estimates, also. λ_3 and λ_{10} are smaller than the path coefficients between other measures of the respective constructs (see Figure 4.2.)

Bagozzi suggests that if the convergence in measurement criteria is not met, it is for one of three reasons (1981, p. 376): (1) one or more measures is invalid, (2) one or more measures is inacurately obtained (excessive random error), or (3) at least one contaminating external factor is present (e.g. demand characteristics, method factors, or some other exogenous contaminator).

In the case of system/work fit, it seems likely that an external contaminating factor is present. x3 is a measure of productivity impact from use. (See pages 80-84 for the operational definition of this construct.) x1 is an assessment of the degree that system use supports "core" work. x2 is an assessment of the importance of the work accomplished using the system. On a deductive basis, it may be argued that work relevance (x1 and x2) is different from work impact (x3) and that combining these ideas in one system/work fit construct ignores this difference.

In the case of user background, the measures are relatively objective so that inaccuracy and construct contamination can be ruled out as explanations for the lack of convergence. x7 and x9 are the sample member's age and tenure in the organization; x10 is years of managerial experience. The difference in the magnitude of intercorrelation among the measures can be accounted for in terms of the degree of validity of each as a measure of the construct, i.e. the degree of theoretical correspondence between construct and measures. Since user background is a construct conceived as a combination of background variables that predispose one to use (or avoid use) of an EW, the differences in the validity of the measures can be interpreted as the degree that each individual background measure reflects this predisposition. In other words, age and tenure in the organization play a larger role in this predisposition than years of managerial experience. Because the range of intercorrelation magnitudes (.81 to .48) is not too wide and the three measures fall more or less evenly along this range (.81, .59 and .48), this interpretation for the lack of convergence seems appropriate and mitigates the effect on the construct validity of user background.

The criterion of differentiation in constructs can be stated as: "The cross-construct correlations among measures of empirically associated variables should correlate at a lower level than the within-construct correlations and should be uniform in pattern" (Bagozzi, 1981, p. 376). As Table 4.6 shows, the correlations for the construct measures meet both parts of this criterion.

Based on the degree of convergence and differentiation of the measures against their respective constructs, it appears that the independent variable constructs in the modified model were measured with a reasonable degree of validity by the operations in the study. x3 is the most suspect of the measures in the modified model. Whether the relevance/impact difference in the measures of system/work fit threaten the unidimensionality of the construct should be examined in future research.

EW system use was treated as a measured variable in the model. Thus, the construct validity of the dependent variable is not in issue. As is noted below, future studies might benefit from multiple measures of use.

External Validity

The interpretation of operational measures as being generalizable representations of abstract concepts (e.g., x1, x2, and x3 as constituting system/work fit) is the part of external validity that Cook and Campbell (1976, 1979) label construct validity. The issue of the generalizability of propositions (i.e. causal inferences) as a whole across different times, settings and persons is the second aspect of external validity.

The external validity of a causal inference depends on the generalizability of the relationship articulated in the statement. In correlational or passive observational designs, the presence of relationship is investigated by establishing the degree of covariation occuring between variables in a natural setting. The amount of covariance or the magnitude of a correlation coefficient does not depend on the mean values of the variables being analyzed (Kenny, 1979). (For example, an x and y that take on particularly low values in the sample when compared to the population may exhibit as much or as little covariation as the same x and y when measured at especially high values in another sample. In fact, the correlation coefficients for the two samples could be identical and equally representative of the magnitude of the relationship in the population.) Thus, the generalizability of mean values of variables from the sample to population is not important to establishing the external validity of relationships identified in causal models when such models are investigated with correlational field data.

This situation is in contrast to experimental or quasi-experimental designs, where the mean values of variables are compared between experimental and control groups to establish the presence of relationship. When the mean value of the dependent variable in either group is not representative of the population value, the researcher may reach wrong conclusions about the presence of relationship. (For example, if y happened to be unusually high in the experimental group and unusually low in the control group, then the researcher may conclude incorrectly that x, the treatment variable, caused higher levels of y in the experimental group.)

In sum, the external validity of relationships identified in the results of this study depends on the generalizability of association between variables rather than the generalizability of mean values of variables. Of course, there are threats to the external validity of associations. These can be formulated in the traditional terms of experimental or quasi-experimental research as: (1) interaction of selection and treatment, (2) interaction of setting and treatment, and (3) interaction of history and treatment. Interaction of selection and treatment refers to the generalizability of cause-effect relationships across different categories of persons. Interaction of setting and treatment refers to the generalizability of cause-effect relationships across different situations (e.g. from the organization studied to other organizations). Interaction of history and treatment refers to the generalizability of cause-effect relationships across different times (e.g. from the present into the future, from one business cycle to the next).

Participants in the present study were selected from the population of computer-user/managers in the organization on a non-random basis. Letters were sent to each potential participant requesting their cooperation, and most of those who were asked agreed to be interviewed and monitored. Some, however, refused to participate. There may be systemmatic characteristics of those who refused that bias the results of the study. For example, non-participants may have been persons who use the EW considerably but rated the system low in terms of system/work fit. In order to reduce the bias introduced into the study from selection based on "volunteer subjects", several steps were taken. (See Rosenthal and Rosnow, 1975, for an excellent discussion of volunteer subject bias and means to avoid it.) The appeal for volunteers was made by a letter from a top management official. In this communication, the study was described as important to the organization's overall objectives. It was emphasized that interview and use-monitoring data would be kept confidential and that no evaluation of an individual's use patterns would be made by anyone except the participant. The study was framed as an evaluation of the system, not the users. The interview and monitoring process was designed to be easy from the participant's viewpoint. Interviews were scheduled at the participant's convenience and usually in his or her own office to make them as comfortable as possible. Although the request/response rate was not measured, only twelve participants failed to participate in the follow-up interview, and reasons for this non-participation included schedule difficulties as well as reluctance to continue participation. Thus, the success of the efforts to recruit participants seemed to be high, and there is little reason to suspect substantial volunteer bias.

Since system/work fit was an important construct in the model, there was concern that sample members be drawn from a variety of functional areas within the organization. Specifically, the researcher wanted to avoid over-participation by members of the Information Systems function. Table 4.7 shows the distribution of participants across eight functional departments. Participation does not appear skewed toward any particular type of functional department.

Another work related bias that was more difficult to overcome concerned the organization level of participants. (There were 11 executives, 57 managers and 42 business professionals.) Since there were fewer executives in the organization and because executives may have less time for participation, this group may be under-represented in the sample. On the other hand, the mix of managers (even business professionals had some managerial experience) seems fairly representative of the mix in most business organizations. If any group is under-represented in this sense, it may be business professionals.

A more serious concern than the selection of participants within the organization is the selection of the setting itself. To what degree are the measures used and relationships detected in this one system environment (organization) generalizable to other organizations? While this question can only be answered empirically, two points should be made about the representativeness of the setting.

First, in order to find an organization with a group of managers experienced in EW system use, a relatively progressive organization had to

Table 4.7: Distribution of Sample Members Across Functional Departments

Organization	Number of Participants
Finance	14
Planning	18
Product Development	19
Information Systems	18
Service	19
Operations/ Logistics	22
Total	110

be studied. While the progressiveness of the organization may have influenced the EW system use of sample members, it may be argued that the sample is a "modal" or "target" instance (Cook and Campbell, 1976) of the population to which generalizing is desired. In other words, the findings are generalizable only to organizations where managers are experienced users of EW systems. Given the increasing diffusion of EWs on the desktops of mangers, this characterization of the population may not limit the external validity of the findings too severely.

Second, the organization came from the computing industry, so that the corporate culture may influence the variables in the model. However, a deliberate effort was made to increase the heterogeneity of participants. Managers who were not great proponents of computers were solicited to participate. Often, the researcher interviewed participants who expressed less than enthusiastic (if not outright hostile) attitudes about the EW system. Thus, although there is no arguing the point that the organization's culture supported EW system use, the sample was deliberately constituted to offset this influence as much as possible. Moreover, generalizations about the relationships in the model detected by an analysis of covariation are not necessarily threatened by unsually high use levels among participants.

The final threat to external validity is the interaction between history and treatment. In this case, the relevant question seems to be whether the period during which the use monitoring was accomplished was representative of sample members' typical use. Use data was collected over a minimum of fifteen working days for each sample member. A working day included all weekdays in which the user logged on the system. Questioning of sample members revealed that only rarely did they fail to log on to the system when present at their work site. Some participants indicated that the monitoring period was not representative of their typical use. The period was described as unusually "light" or unusually "heavy." It was assumed that the monitoring period was lengthy enough to be representative. By sampling use from a broad cross section of functional departments, unusually "heavy" periods in one department should be offset by unusually "light" periods in another department. In short, it appears that the period of use monitoring provided a reasonably accurate representation of EW system use by managers at this site.

Summary of the Limitations to the Study

The findings are limited by threats to all four types of validity. Some of these threats are more serious than others. The limitations are summarized according to the severity of the threat from which they arise.

Serious Limitations: The fact that system/person fit was inadequately measured and could not be introduced into the structural equation is a serious limitation. This variable is the most likely "unmeasured third variable" that could account for what otherwise appears to be a causal association between system/work fit and use. In addition, however, there may be other "third variable" explanations for the association including: variables that the research design attempted to control, variables relevant to characteristics of interpersonal relationships that were unmeasured and uncontrolled, and variables that are unknown influences on variables in the model and that were unmeasured and uncontrolled.

Moderate Limitation: Random irrelevancies in the setting and random heterogeneity of the sample must be presumed not to influence the results, and this assumption provides some limitation to the findings. There is no specific evidence that these are serious considerations, however. The validity of the system/work construct may pose a moderate limitation on the study since the construct is arguably two dimensional (system-work relevance and system-work impact). The conceptual similarity between these two dimensions reduces the degree to which this issue limits the findings. A third moderate limitation is the failure to establish evidence of causal directionality between independent and dependent variables. This is an issue only between system/work fit and use, and the reciprocal path was estimated between these variables. Nevertheless, the presumption that the most important path is from system/work fit to use relies on logic rather than empirical evidence.

Minor Limitations: Limitations arising from the representativeness of the sample members, setting and time period seem minor. There is no specific reason to believe that the people, setting and time period are not representative of those in the target population (managers in organizations where EW sytems are used) in terms of the relationships in the model even though the sample probably exhibited unusually high levels of use and system/work fit. The limits to the definition of the population should be recognized as a limitation. The findings are intended to be generalized to experienced users in organizations with sophisticated computer systems. (For the present, such organizations are probably progressive).

CHAPTER V

CONCLUSIONS, IMPLICATIONS AND DIRECTIONS FOR FUTURE RESEARCH

Overview

The final chapter in this study is an interpretation of the findings. The study's conclusions are essentially a set of causal inferences that seem appropriate based on the findings. There are implications to these conclusions that have relevance to theory, research and practice. Finally, the modified causal model suggests some interesting directions for future research.

Conclusions

The major conclusions of the study are derived from the three essential findings of the analysis: system/work fit is a cause of use, user background is not a cause of use, and the modified structural model provides a reasonable explanation of the level of EW use by managers.

The role of system/work fit in explaining use of EW systems by managers was explored for the first time in this study. Results indicate that this construct is an important cause of use and that the relationship between it and use may be reciprocal. Based on these findings, two important conclusions follow:

1. Managers will use EW systems to the extent that these systems fit their work.

2. The more managers use EW systems the more work-related uses they discover.

The first of these propositions may seem almost self-evident to the reader uninitiated in the literature of computer system use. In fact, there are many competing ideas about why managers use or fail to use EW systems. A focus on the system's contribution to the user's normal workload is relatively novel. Many researchers and practitioners seem to assume that the system supports important aspects of managerial work; low usage is then attributed to age, resistance to change, lack of education, etc.

The reciprocity of the relationship between system/work fit and use provides further support to the idea that EW's are used when they support the work of their users. It means that managers have increased system/work fit by using the EW, and this has motivated them to use the system more.

An EW is a general purpose, multi-function computer system. The determination of appropriate uses in support of important or core managerial work has received very little attention. The focus on decision support systems (DSSs) and management information systems (MISs) is a logical result of the important role that decision making plays in managerial work. Managerial work involves more than decision making, however, and an EW system can do more than provide access to a DSS or MIS. Moreover, using a DSS or MIS often does not involve interaction with an EW (Keen, 1976). The key to increasing managerial use of EWs may be to expand the search for core aspects of managerial work that match system capabilities: in other words, to find ways to increase system/work fit.

The second major conclusion from the study is that user background is not causally related to use of an EW. The fact that other researchers have concluded the opposite can be explained in a number of ways. First, other researchers have examined background variables one at a time in bivariate relation with use rather than examining an underlying construct in a multivariate model. The lack of effect in the present study was determined relative to the system/work fit construct, i.e. the nonsignificant path estimate shows the effect of user background on use when system/work fit is held constant. Indeed, bivariate correlations in the present sample between age, tenure in the organization and managerial experience with use were -.20, -.16 and -.29; when system/work fit is introduced into the structural equation, these associations become nonsignificant. Second, the relationships found in prior studies between background variables and use may be spurious. That is, some moderating variable may create association detected in a statistical analysis that does not represent a causal relationship. The moderator could be system/work fit, system/person fit or some other variable. Third, no prior study has focused on experienced managerial users of a multi-functional EW. It may be that the effects of user background on use are present only with inexperienced users. As managers find work-related uses for the EW and the level of use increases, user background may cease to be an inhibitor of use.

The capacity of the modified model to explain EW use level among managers is the subject of the third major conclusion from the study. The multiple coefficient of determination was equal to .28. This value can be interpreted as the percentage of variance in use "explained" by the model (most of which is "accounted for" by system/work fit); it represents the model's predictive validity. It means that the chances of accurately estimating use level in a given case based on the structural equation are improved by 28 percent over the chances of an accurate prediction using the average as the estimate. The incremental fit index is .96. This means that alternative structures for the variables in the model have only a four percent chance of improving the fit. The incremental fit index is one indication of the degree to which the structure of covariation among measured variables is accurately portrayed by the model. These two measures of adequacy suggest somewhat different conclusions about the overall adequacy of the model.

The multiple R-squared suggests that there are other significant predictors or causes of system use that were not included in the structural equation. From the outset, the present research effort has acknowledged the role of other variables. While the research design was meant to control many of the "between systems" variables, the level of control achieved is not known. Moreover, system/person fit could not be included in the equation because of difficulties encountered in measuring the construct. Third, variables related to the characteristics of interpersonal relationships went unmeasured and uncontrolled, and there may be other unknown, unmeasured variables that would improve the predictive validity of the structural equation. Nevertheless, a multiple R-squared of .28 represents a respectable degree of predictive validity for a structural equation with only two predictors.

In addition, the model is quite adequate for the variables that were measured. Room for improving the structure is slight (.04). The model is a good explanation of the relationships among system/work fit, user background and use.

Conclusions about the Research Hypotheses

The hypotheses for this study were formulated to guide the development of the causal model. Since the model was exploratory, the hypotheses were not subjected to testing in any strict sense. Nevertheless, a statement of the study's conclusions in terms of the research hypotheses may help clarify the findings. The hypotheses are restated in this section for the reader's convenience.

> H1: Use of an EW system increases as the fit between the system and the work increases.

H1 is supported by the findings. The parameter estimate of the structural path between system/work fit and use in the modified structural model (Figure 4.1) was substantial and statistically significant.

> H2: Use of an EW system increases as the fit between the system's demands and the user's ability increases.

The results from analysis of the initial measurement model showed that the system/skill fit construct was not measured with sufficient reliability or validity. The construct was dropped from further structural analysis. Consequently, no conclusion can be stated regarding H2.

> H3: Increasing age, tenure in the organization, education, and managerial experience contribute to a background factor that causes a decrease in system use.

The user background construct was modified as a result of the analysis of the initial structural model. In the modified structural model, education was not included as a measure of the construct related to use. Further, the parameter estimate for the path coefficient between the revised construct and use, was small and not statistically significant. H3 is not supported.

In short, H1 was supported by the findings; H3 was not supported by the findings; and no conclusion can be stated about H2.

Implications

Findings are the raw inductions made on the basis of empirical research. Conclusions are more general causal inferences that seem appropriate given the findings and their limitations. Implications represent an attempt to link the conclusions to previous research and existing theory, and in an applied discipline, the conclusions of a research effort usually have implications for practice. The conclusions from this study have implications for both theory and practice.

Implications for Theory

The most obvious implication for theory is the importance of system/work fit in explaining managerial use of EW systems. Others have examined particular aspects of managerial work (e.g. decisions, communications) with regard to specific computer uses (e.g. DSS, electronic mail). In relation to a multi-function EW system, however, it seems sensible to broaden the concept about the fit between system and work.

Broadening this concept involves an appreciation for the diversity of managerial work. Mintzberg (1973) and Kotter (1982) have described the multiple roles and activities of managers. These and other theories of managerial work provide the basis for developing uses of an EW that increase system/work fit. For example, consider the correspondence suggested between Mintzberg's descriptions of managerial roles and specific uses of the EW mentioned by participants in the interview.

Mintzberg's Roles	EW Use
Interpersonal role	- to delegate assignments
- figurehead	- to follow up
- leader	- to provide directions
- liaison	- to make announcements
Informational role	- to request information from staff
- disseminator	
- monitor	- to provide information to staff
- spokesman	

The uses identified above were discovered by experienced managerial users in the normal course of their work so that the correspondence between work content and EW use provides indirect support for Mintzberg's theory. Theories about managerial use of EWs could benefit from theories of managerial work by explicating system functions that are important to managers. The links between the two kinds of theories could provide a valuable guide to the design and implementation of managerial EW systems.

To date, however, the efforts of EW systems designers have been focused on peripheral activities, such as scheduling a meeting, leaving a telephone message, typing a memorandum and filing documents. These secondary activities may be a necessary part of the workday, but many managers find means for delegating or otherwise avoiding them. Managerial EW systems designed and implemented with a focus on secondary activities are less likely to be used by managers than systems designed to support important core work.

In sum, this study implies that the role of EWs in the work of managers is an important determinant of system use. This role can go well beyond the performance of peripheral tasks. To the degree an EW is a tool that fits managerial work, use of the system will increase.

This study also provides a new perspective on the role of background variables as causes of computer use. Previous research has been contradictory about the role of age, organization tenure and managerial experience in influencing use. In relation to system/work fit, this study shows that user background is unimportant in determining use. There appears to be little basis for the stereotypical description of reluctant users as older, senior managers when the system supports core managerial work.

Often theorists have argued that older, senior managers resist EW systems because they have a vested interest in the status quo based on their knowledge and skill base (Galitz and Cirillo, 1983; Scannel, 1982; Zuboff, 1983). If user background is not associated with low EW use when system/work fit is held constant, the basis for resisting the change brought on by EW implementation may need reexamination. The resistance may be for lack of system/work fit rather than fear of change.

Implications for Practice

Those responsible for the design and implementation of EW systems for managers seem convinced that there is great potential for productivity gain from managerial use. This enthusiasm is not always shared by the users themselves. Part of the reason for the gap in EW attitudes between IS professionals and managers may be that the two do not share the same perspective about how EWs should be used.

Historically, EWs have been presented to managers as a means to make them more productive by saving time spent on "less productive activities" (Poppel, 1982). Managers may agree that such time savings are desirable, but the activities involved are not core aspects of their work. Thus, finding better ways to do peripheral tasks (that could be delegated if secretarial support was sufficient) is unexciting to managers.

In the future, EWs should be presented to managers as a tool to support important, core managerial work. Most managers are eager to find ways to do their jobs better, but the burden usually falls on the IS professional to demonstrate how the system helps get the job done. Current practice usually fails to show how the EW helps support core work; instead, the secondary, secretarial functions are emphasized in orientation and training sessions. This study suggests that the IS professional should approach the design and implementation of managerial Ew systems as a task of discovering the fit between system capabilities and managerial core work.

Directions for Future Research

Most research projects raise as many questions as they answer. For this study there are several responses to the question: "Where does one go from here?" The suggestions that seem to have the most potential for furthering an understanding of the causes of managerial EW use include: (1) a replication of the study with new measures for system/person fit; (2) a replication of the study with multiple measures of system use; and (3) a replication of the study with measures of interpersonal effects. In addition to these specific pursuits, the study points toward certain guideposts that may enhance the contribution of future efforts.

New Measures of System/Person Fit

The concept that the fit between system demands and user skills effects the level of EW system use has a certain face validity. The elimination of the construct from the structural model in this study should not preclude study of its role in future research. A new measurement strategy seems to be needed, however, since the measures used here proved untenable.

The "user skill" or "literacy" side of the construct could be measured a number of ways besides variety of commands used. (As noted below, variety of commands used may be a measure of use itself rather than literacy.) A paper and pencil test of the user's knowledge of the EW system would tap the traditional sense in which the word "literacy" is used. Alternatively, self-rating scales could be constructed that would be behavioral descriptions of degrees of user literacy, e.g. "In using the electronic inbasket, to what extent do you rely on help screens to manipulate the system?" (rated on a scale from none, once each session, twice each session, three or more times each session).

The ease of use component of system/person fit is difficult to measure on a subjective basis. The problem with the scale in the present study may reflect the tendency for users at all levels of ability to rate systems as requiring too much effort. For example, even an experienced user who has mastered the system may rate it as requiring an excessive amount of effort based on his/her own conclusions about how the system could be improved. One interviewee in the present study commented, "Now that I know the system, moving between all these menu screens is a real burden."

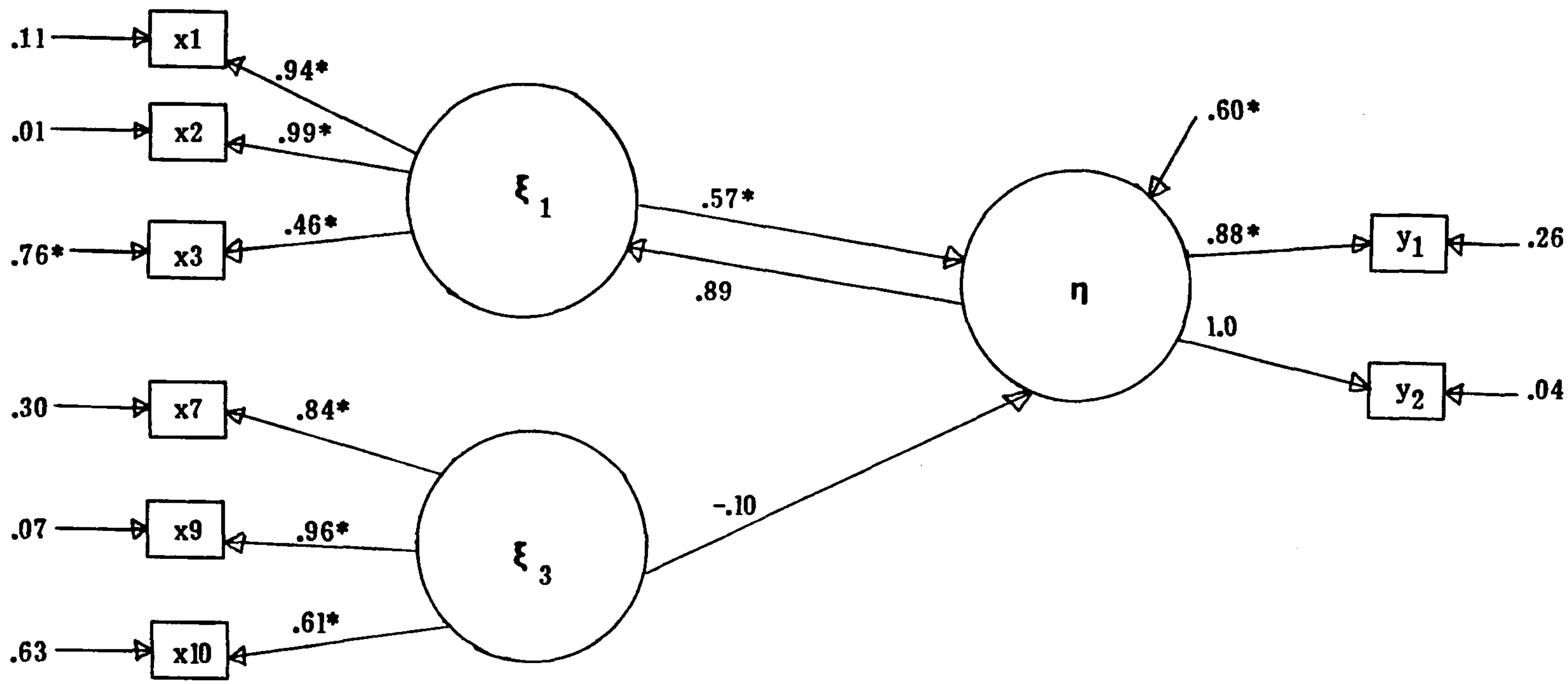
One strategy for overcoming this tendency would be to anchor the scale with behavioral descriptions that would represent the amount of effort required of the user. Anchors could be developed with the help of an expert panel. For example, the user could be asked how long it took him/her to learn the system; longer learning times would be associated (presumably) with lower ease of use. This approach would require multiple measures of ease of use based on alternative behavioral manifestations of "user friendly" systems.

Multiple Measures of System Use

X5 (variety of commands used) was conceived to measure an aspect of system/person fit. It was so highly correlated with use and other measures that it had to be excluded from structural parameter estimation analysis. The highest correlation with x5 was with the dependent variable, use.

Reasoning after the fact, the researcher surmised that x5 was behaving just like a dependent variable measure. Indeed, it can be argued (post hoc) that the construct, use, might be conceived as both level and variety of use. In a search for an explanation of the possible role of x5, a model was estimated with x5 as another measure of use. Otherwise the model was the same as the modified structural model in Figure 4.1. Figure 5.1 shows the parameter estimates and statistics for the model.

The parameter estimates for the effects of the independent variables on their measures and on the dependent variable are fairly consistent with those in the modified structural model from Chapter 4.



Chi-square	33.77
D.F.	18
Chi-square/D.F.	1.88
GFI	.70
Coefficient of Determination	.38

* $p \leq .005$, two-tailed

Figure 5.1: A Modified Model with Multiple Measures of Use

The reliability of measurement for the use construct is .92. It is interesting to note that while this model does not fit the data quite as well as the model in Figure 4.1, the multiple coefficient of determination is .38 versus .28 in the model from Chapter 4. In the role as a measure of use, x5 behaves rather well.

What this analysis demonstrates is that future research might benefit from a broader conception of use. In addition to electronic measures, subjective use could be measured with Likert-type scales that ask users to rate the degree to which use of the EW is integrated into their normal work pattern. This could be achieved at the level of system components (e.g. electronic mail, text editing, etc.) and then a composite created for overall use level.

A priori, the single measure of use produced by the electronic monitor seemed so valid as to preclude the need for other measures. At this point, a broader conception of use seems not only justified but necessary to adequately tap the meaning of the construct.

Effects of Interpersonal Relationships

The influence of interpersonal relationships and the immediate work group on EW use would make an interesting topic for a research effort. The exclusion of variables measuring these influences from the present study reflected prior research thrusts and the willingness of the sample to submit to longer interviews. However, given the importance of interpersonal relationships and work groups in organization behavior, the role of such variables in use behavior seems self-evident.

A research program in this area should probably begin with clarifying the impact of EW use on group process. Communications, coordination, and power are impacted by an EW system. The nature and extent of this impact may determine the influence these variables have on EW use. For example, it has been asserted (Argyris, 1971) that computer systems undermine authority based on formal power (presumably because access to information is broadened beyond that provided in traditional hierarchical organizations). If this hypothesis were valid and perceived to be true, then aspiring managerial users high in the need for power (McClelland, 1967) should be greater users of the EW.

Guideposts for Future Research

The effect of interpersonal relationships on computer use is just one of many potential influences suggested by the literature of organization behavior. EW use is, after all, an organization behavior. As such, it needs to be put into the context of organization behavior theory.

The work that has been done in this area focuses on the impacts of computer use on organizations as a whole, and it is difficult to understand how these consequences impact EW use. Organization behavior theories at the individual and group level of analysis are probably more likely sources for causes of EW system use. Consider, for example, the help that theories of organization behavior could be in answering the question: "What motivates EW system use?"

Thus, future research about the causes of EW system use by managers could benefit from existing organization behavior theories at the individual and group level. Before substantial benefits can accrue, the theories most relevant to managerial EW use must be elucidated. For example, tests of expectancy theory, McClelland's motives and path-goal theory should be made with EW system use as the dependent variable to determine which theory provides likely causal variables. A research program aimed in this direction will be lengthy, but the use of lab studies in tests of these well developed theories could expedite progress.

The importance of system/work fit in the modified structural model suggests that the most important body of theory for understanding managerial EW use is the theory of managerial work. These theories may provide the basis for decomposing the elements of managerial work so that the fit can be examined at a lower level of detail. Improving the fit by designing EW systems to support components of core work may be one key to increasing use.

The state of theory regarding managerial work may limit the contribution to explicating the causes of system/work fit. Generally, theories of managerial work have not focused at the task level (referring instead to roles, activities or functions). Viewing the EW as a tool for supporting managerial work, requires that roles, activities and functions be understood at a lower level of abstraction. Ultimately, it is important to understand what specific tasks are accomplished on the EW and how these tasks relate to core work roles, activities and functions. One means for ascertaining relationships of this kind would be to observe managerial users and obtain descriptions of each task accomplished using the EW. A factor analysis guided by theories of work could then be performed to determine correspondence between tasks, roles, activities and functions.

Of course, the goal of increasing the fit between the system and managerial work is not use itself but managerial performance. An important limiting assumption regarding the relevance of any future work about managerial EW use is the determination that use improves performance. In addition, there may be other outcome variables that use affects, e.g. job satisfaction, turnover, absenteeism. The potential productivity benefit from using an EW is taken for granted by most researchers. If system/work fit is important, however, the benefit is not universal and equal across all managerial users.

Moreover, effective management is not an end in itself. Ultimately, organizational scientists are concerned with organization effectiveness. Thus, another way to approach the link between managerial EW use and performance may be to identify managerial work that is central to organization performance and that can be supported by an EW system. There are many views of the dimensions of organization effectiveness. (See Cameron and Whetton, 1984, for a review). Recently, there have been attempts to provide explicit links betwee information technology and competitive strategy (Porter and Millar, 1985) that could guide the search for crucial EW uses that contribute to the performance of businesses. Since the performance of top executives is often tied directly to organizational performance, the specification of EW systems that support the core work of chief executives and their immediate staff would enhance substantially the managerial EW use-performance link.

Thus, the final guidepost offered is the exhortation to link EW system use to the dimensions of managerial job performance. Fitting the system to the work of managers at all levels should be aimed at increased efficiency (time savings), improved performance and organization effectiveness. One can imagine studies wherein EW system use is the independent variable and performance is the dependent variable.

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